Pricing Disputes, Technical Efficiency and Oligopsonistic Market Power: An Analysis of Seed Cotton Pricing Disputes under Contract Farming arrangements in Zimbabwe

by

John Mutukumira

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Department of Economics
Faculty of Social Studies
University of Zimbabwe

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Declaration

I declare that this piece of work is my own effort and it has never been submitted anywhere as part of a degree study or any other research.

Dedication

To my Mother, Tsitsi Chiwara.

Acknowledgements

I wish to express herein my sincere gratitude to my supervisor Dr Clever Mumbengegwi. His supervision, support, and guidance made this dissertation a worth script of literature. I further give credit to Mr Admire Mutizwa for his warmth support and encouragement throughout this dissertation; his critics helped much in shaping this dissertation. Further credit goes to the MSc Economics Class of 2013, and the Department of Economics for their support.

Glory to God who gave me resilience and strength to finish this dissertation.

Abstract

Stochastic Frontier Analysis framework is used in this study to examine technical efficiency among small holder cotton farmers in Gokwe North district, Midlands Province in Zimbabwe. The study further analysed market power through calculation of concentration ratios (CR4) and HHI as well as correlating market share of each contractor for the 2012/13 and 2013/14 marketing seasons with farm seed cotton prices of each contractor. Farmers on average are found to be 30 percent technically inefficient. The inefficient component of variation was found to be statistically significant at 1 percent and to contribute about more than 90 percent of variation in cotton output across farmers. Market power was found to be at-least moderate as indicated by CR4 ratios of above 60 percent and HHI above 1000. It was also found that seed cotton price was positive but weakly associated with market share. This implied that cotton is not bought by price but in the contract (input supply) which is open to price. The study therefore validates the contentions that farmers are technically inefficient and that contractors wield market power; hence disputes in cotton pricing between farmers and contractors.

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Acronyms

AMA   AGRICULTURAL MARKETING AUTHORITY
CMB   COTTON MARKETING BOARD
COTTCO   COTTON MARKETING COMPANY
CR4   FOUR FIRM CONCENTRATION RATIO
CRI   COTTON RESEARCH INSTITUTE
DEA   DATA ENVELOPMENT ANALYSIS
GC   GINNING COSTS
GOZ   GOVERNMENT OF ZIMBABWE
HHI   HERFINDAHL-HISCHMAN INDEX
LSR   LEAST SQUARES REGRESSIONS
M&DC   MARKETING AND DISTRIBUTION COSTS
MOAMID   MINISTRY OF AGRICULTURE, MECHANIZATION AND IRRIGATION
           DEVELOPMENT
MPC   MARGINAL PRODUCT COST
MRC   MARGINAL RESOURCE COST
MRP   MARGINAL REVENUE PRODUCT
PFC   PRODUCTION FINANCING COSTS
PPF   PRODUCTION POSSIBILITY FRONTIER
SCP   STRUCTURE CONDUCT PERFORMANCE
SFA   STOCHASTIC FRONTIER ANALYSIS
SI   STATUTORY INSTRUMENT
TE   TECHNICAL EFFICIENCY
ZIMSTAT   ZIMBABWE STATISTICAL AGENCY

Chapter One: Introduction and Background

1.0 Introduction

This dissertation uses the Stochastic Frontier Analysis (SFA) to examine technical efficiency among smallholder cotton farmers in Gokwe North district, Midlands Province of Zimbabwe. Farm level data together with interviews on cotton contractors' pricing structure of seed cotton form the basis of an analytical framework for market power exploitation in contract farming. Gokwe North district is in Gokwe area, one of the leading cotton producing areas in Zimbabwe with a population of 576 362 (ZimStat, 2012) or 35.52 % of the total Midlands Province population. About 90 % of smallholder farmers in the district depend on cotton production as the major source of incomes, livelihoods, food, healthcare and command over other goods and services. Most of these smallholder farmers operate under contract farming arrangements with cotton merchants or buyers. Under the contract farming system, the contractor provides inputs and other support services to the contracted farmer such that the latter becomes contractually bound to sell his/her output to the former. Within this arrangement questions and disputes have arose over prices offered and received by contractors.

Previous empirical studies (Islam and Backam, 2011; Henderson and Kingwell, 2002) seem to suggest that of the many factors that threaten farmers' incomes and livelihoods, technical inefficiency in the use of production inputs ranks among the most critical. Additionally, Porter and Phillips-Howard (1997), Glover (1990) and Kusterer (1990) noted that peasant/smallholder farmers are likely to be exploited when they lack alternative incomes or production possibilities and where an unequal power relationship exists between two contracting parties. It is important to examine these issues further in an attempt to understand the underlying causes of pricing disputes in cotton farming. Validation of the contention that, either farmers are technically inefficient or contractors wield market power in cotton pricing or both would be a major contribution to the understanding of the most contentious policy debates between contractors and contractees as to why the latter feel that prices they are receiving are below their production costs to sustain their farming activities.

SFA has been found to be an appropriate parametric method to measure technical efficiency especially in circumstances where data is subject to measurement error. Thus deviations of output from the production frontier are attributed to both inefficiency and statistical noise (Bravo-Urretta and Pinheiro, 1997) due to the fact that smallholder farmers do not keep accurate farm records; thus the study relied on recall method. The data is therefore likely to

contain statistical noise and recall bias. Similarly, the computation of concentration ratios and an analytical approach to market power exploitation in contract farming has been found to be the most suitable approach than the measurement of market power in empirical studies (White, 2011; Sivramkrishna and Jyotishi, 2008) due to data limitations. Even in developed markets such as United States of America (U.S.A), data limitations resulted in seriously biased empirical results on market power (Rogers and Sexton, 1994). Perhaps, the SFA approach to technical efficiency and an analytical approach to market power exploitation in cotton pricing are best suited for this study.

1.1 Background of the Study

Cotton is an important cash crop grown in Zimbabwe by more than 200 000 smallholder farmers annually. The crop is of strategic importance in the sense that it generates cash income and creates direct or indirect jobs for the rural people while it promotes equitable distribution of income. In addition it is one of the major drivers of the economy as it contributes at-least 23 % to the agriculture sector of the economy which subsequently contributes about 15.5 % to the Zimbabwean economy (GoZ, 2012). The production of cotton provides key inputs into the clothing, garment, textile and food industries in Zimbabwe. It also provides demand for manufacturing industries' products such as chemicals and fertilizers. Thus it has strong backward and forward linkages with manufacturing industries. Cotton production provides incomes and livelihood to smallholder farmers in the communal areas of Zimbabwe. Based on the above, Agricultural Marketing Authority (AMA) (2012) noted that growth and sustained production of seed cotton is necessary to supply the existing ginning and textile capacity, to tap into export market opportunities and to alleviate poverty.

1.1.0 Cotton Farming: Growers and Buyers

In Zimbabwe, cotton is mainly grown through contract farming as 99% of the crop is contracted each year (AMA, 2013). Contract farming is a pre-production agreed supply arrangement between farmers and contractors. Contractors are cotton merchants who provide key inputs and technical support to the farmer such as advance loans, seeds, fertilizers, pesticides and technical advice, all which will be charged against the final purchase price (Vermuelen & Cotula, 2010). The farmer has to combine these inputs together with land, labour and draught power in order to produce and supply seed cotton for the contractor to recover costs. The contractor buys the crop at prices they determine each season and the prices vary with the quality of cotton delivered. The arrangement has often led to disputes with farmers demanding a fair price for their produce while contractors challenge farmers for failure to maximise production from supplied inputs for better profit margins. These disputes

which begun in 2009 cotton marketing season need to be resolved in order to promote sustained growth for the cotton sector.

Cotton prices in Zimbabwe have been depressed since 2009 and had been the centre of contention between farmers and contractors. In 2009, cotton prices ranged between US$0.15 and US$0.25 per kilogram. The prices improved between 2012 and 2013 to US$ 0.35 and US$32 respectively. The prices are far below the US$0.65 demanded by farmers and as a result, AMA noted in its end of year 2012 report that its intervention and declaration of minimum producer prices was a result of wide differences between price demands of contractors and farmers in the price negotiations. It is imperative to note that, contractors are more likely to exploit market power given their number in the market, access to information and their knowledge on the characteristics of buyers as detailed below. Thus price negotiations are likely to be skewed in favour of the contractors at the expense of farmers, however this remains to be established in this research whether or not contractors exploit market power in cotton price determination.

Cotton is grown in the arid and semi arid areas of Zimbabwe falling within agro-ecological regions 3, 4 and 5. Low rainfall and high temperatures characterise these agro-ecological regions. Rainfall amount between 400mm and 1000mm provides optimum production of cotton in these regions (AMA, 2011). Success of farmers in growing cotton in these arid or semi-arid regions is anchored on the fact that cotton is drought resilient. This means that, even during years characterised by erratic rains, the farmer has a chance to grow the crop and yield close to optimal output. Rain fed cotton has the advantage that it directly reduces irrigation input thereby reducing management stress. However, variability in rainfall, dry spells and droughts affects the efficient use of other inputs. If cotton is the main crop grown by farmers in these arid and semi-arid regions, farmers are possibly dependent on a single crop with no alternative production possibilities. Additionally, cotton may have a significant role in farmers' income. Farmers will therefore be constrained in decision making and may be forced to enter into exploitative contract farming arrangements.

The structure of cotton growers has changed from large scale commercial production with about 350 farmers to smallholder production with over 200 000 farmers growing the crop on land measuring less than 10hactares, annually. During the period 1960 to 1980, commercial farming dominated cotton production while the advent of independence in 1980 saw the government giving much attention to smallholder production hence increased number of smallholder cotton farmers and production levels. Consequently, smallholder production accounted 75 % of the total seed cotton production in the 1994/5 agricultural season. In 2008,

208 000 farmers produced seed cotton, the number of farmers increased to 282 347 in 2011/12 before falling to 230 000 in 2012/13 season. Most of the production occurs on small pieces of land measuring less than 10 hectares (Musara et al., 2006). In Zimbabwe, cotton farming is therefore dominated by smallholder farmers: playing an important role in their social and economic construct. The fragility and numerous of farmers: distribution and their number in arid rural areas of Zimbabwe likely means that farmers are less organized and more dependent on cotton. Their rural and subsistence characteristic means that they are of less income while their landholdings of less that 10ha are too small for effective production capable of affecting the market supply curve. If these are combined with access to market and other technical information, farmers are likely exploitable.

The increase in smallholder cotton farmers was a result of deliberate government policy to increase smallholder cotton production after independence. The government, through the Cotton Marketing Board (CMB) supplied inputs and production support to smallholder cotton producers in a contract farming arrangement commonly referred as cotton out-grower schemes. In turn CMB was the sole buyer of cotton. The role of CMB in production and marketing support was crucial in the sense that given the nature and characteristics of smallholder farmers (low income, located in remote areas, less education, poor access to information) support with finance, technical services and market access was and remains paramount for successful cotton production. Through the CMB's input and production support programme, farmers were provided with technical support and ensured market, thus smallholder cotton production increased.

The monopoly power of CMB was reduced following the liberalization of cotton production in 1994 and the privatisation of CMB into Cotton Company of Zimbabwe (Cottco) in 1995. Cargill joined the cotton sector in 1995/6 season transforming cotton buyers' structure into a duopsony. The production and marketing season that followed the entry of Cargil was characterised by tense competition; more farmers were sponsored for cotton production while farmers received good prices for their produce. Cargill introduced a spot cash payment system for cotton forcing Cottco to abandon its Stop Order Payment system where farmers were paid two weeks after the delivery of their cotton. Prices paid to farmers at delivery were base prices with premium prices paid when farmers prepare for a new production season. Thus farmers benefited from higher prices, cash payment and more marketing and credit options (Rusare et al. 2006). Entry of Cargill therefore maintained orderliness in cotton production, increased competition while maintaining the quality standards of cotton. Liberalization of the cotton buying sector and privatisation of CMB was therefore regarded as

a success due to the competition brought by new players and continued orderliness in cotton production.

The structure of seed cotton buyers remained dynamic and further transformed from the duopsony outlined above to the current oligopsony structure characterised by depressed prices, compromised quality standards and protracted disputes in the marketing of cotton. At the end of the year 2011 there were 13 contractors in the cotton sector namely Alliance, Cargill, Cottco, Cotzim, Fahad, Grafax, Insing, Olam, Parrogate, Romsdal, Sinozim, Southern Cotton and Viridis. Instead of more players bringing more competition in pricing and production support, pricing disputes have aroused. Farmers had been claiming prices higher than those offered by their contractors. The level of contracting differs across the players, thus also the transacting costs of contracting. Players who do not invest much in contracting offer better prices (Musara et al., 2011). As a result, farmers are tempted by better prices hence side marketing. The resultant effects are reduced credit offered to farmers and untimely delivery of inputs as the contractors study each other in efforts aimed at enforcing each player to contract. Musara et al. (2011) found that inadequate and late input supply was cited by 97% and 96% of farmers as the major problems affecting their production respectively.   The current cotton buyers' structure raises questions on the relationship between farmers and contractors due to cotton pricing disputes. In addition, cotton contractors seem to force non-contractors into cotton contracting; this destroys the spot market for cotton leaving farmers dependent on contractor prices. It has been established that, there should be an alternative and competent market for cotton farmers rather than to rely on contractors. Thus there seems to be strategic efforts aimed at manipulating the market in favour of buyers.

Cotton contract farming in Zimbabwe operates in a weak and inadequate legal framework for combating moral hazard problems and ensuring risk sharing between producers and contractors while removing price uncertainties for smallholder growers. The Government, through the Ministry of Agriculture, Mechanisation and Irrigation Development is responsible for spearheading agricultural production and facilitates contract farming through its policies. At the height of cotton pricing disputes in August 2009, the Government of Zimbabwe (GoZ) introduced a legislation to address the problems affecting the cotton industry, as well as providing a framework to guide cotton production and marketing. The Agricultural Marketing Authority (Seed Cotton and Seed Cotton Products) Regulations Statutory Instrument 142 of 2009 as amended by Statutory Instrument 63 of 2011 and Statutory Instrument 147 of 2012 seeks to ensure long term stability of the cotton industry

through regulating the cotton value chain. The regulations do not provide for reliable supply and quality in contracts. Let alone, the regulations provide for negotiation of cotton prices between the government, farmers and contractors yet these parties do not participate in the negotiation and signing of contracts between farmers and contractors. Continued reneging of contracted growers on contractual obligations and selling of cotton to non contracting buyers as well as erratic prices paid to farmers each season exposes the inadequacy of the regulations in protecting contract farming in Zimbabwe.

The narrative discussion above points out that cotton contract farming in Zimbabwe is operating in a weak legal framework where numerous farmers may be exploited by few contractors in the production and marketing of seed cotton. Farmers are generally numerous in their numbers making their coordination difficult hence difficult to speak with one voice. They are frigidly distributed across the arid and semi-arid areas of Zimbabwe probably making them dependent on cotton production for the greater part of their incomes. Given their smallholder nature, individual farmers cannot influence the total supply of cotton hence smallholder farmers may maximise output at any price level.

1.1.1 Cotton Production Levels and Yield

Cotton production increased after independence due to increased number of smallholder farmers and area under cotton production, and fluctuated on a declining trend since 2007. The period beginning 2009 shows pronounced spikes in cotton output despite that more land is being put under cotton production as shown in Figure 1.1. In the 2012/13 production season, cotton production declined from 350 703 tonnes in 2011/12 to 140 702 tonnes as at 31 September 2013 (AMA, 2013). While various factors such as erratic rainfall, inadequate supply of inputs and poor agronomic practices have been blamed for the declining output levels, pricing disputes have a more important role as prices offered are a disincentive to farmers while contract farming had been disturbed due to side marketing problems.

Figure 1.1: Cotton Production in Tonnes
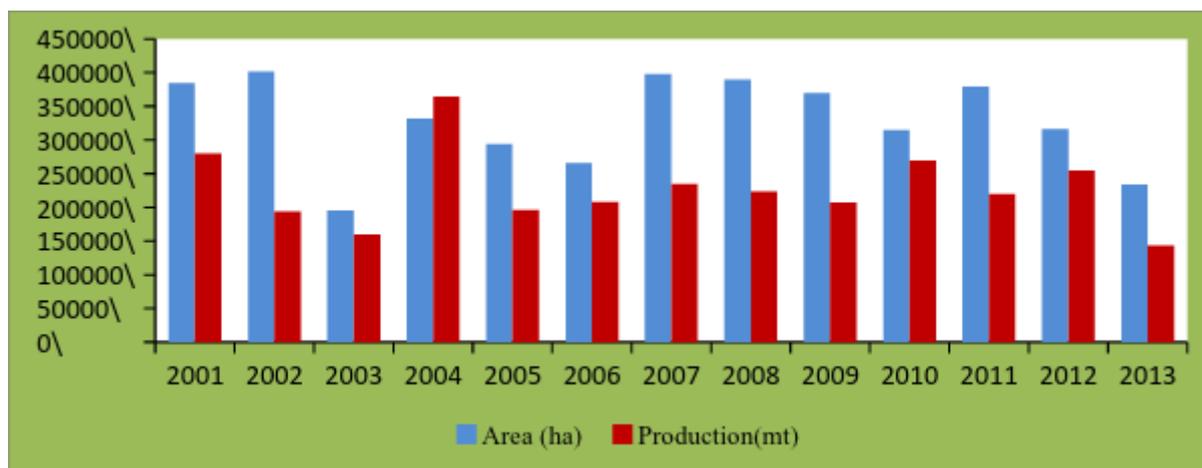
Cotton yield as measured by output (kg) per hectare has remained predominantly depressed below the 700kg/ha between the years 2000 and 2013.The annual yield given by Figure 3.1 are far too less than the 2240 kg/ha expected from Albar SZ9314 variety commonly grown by smallholder farmers. This is so despite considerable government and private sector effort to increase output through research, training and extension. Government owned Cotton Research institute (CRI) and a private company, Quton Seed Company have developed high yielding varieties as shown in Table 1.1. The varieties are resistant to pests, jassids and bacteria, tolerant to drought and produce large bolls with high lint outturn (Jarvis, 2008). It is unknown whether these depressed yields are a result of opportunistic behaviour by farmers to benefit from higher cotton prices at low output.

Table 1.1: CRI Seed Cotton Varieties and Yields (kg/ha) Under Specific Conditions

Year Released	Variety	**HIGH INPUT PDN** –Irrigation, fully funded inputs + good management**.**	**LOW INPUT PDN-** Dry land, no irrigation, fully funded inputs +not so good management.
1982	Albar G501	2700	1800
1989	Albar K502	2900	2000
1995	BC853	2800	1500
1997	FQ902	3500	2000
1998	Albar SZ9314	4000	2240
2006	CRI MS1	4200	2300

| 2006 | CRI MS2 | 4300 | 2400 |
| 2013 | X (upcoming) | | 2500 |

Source: Cotton Research Institute, 2013

The pricing disputes in cotton marketing witnessed since 2009 raise a lot of questions. These include; how is cotton priced? What regulatory measures are in place to avoid potential moral hazard problems in cotton production? Are cotton contractors making strategic commitments in contract farming aimed at manipulating competition and pricing in a manner profitable for them? Major questions asked relate to potential exploitation of farmers in cotton contract farming arrangements. However, in the pricing disputes contractors have questioned the technical efficiency of farmers. Farmers are alleged to be failing to maximize production from the supplied inputs (AMA, 2012). Depressed production levels of cotton as well as low yields support the assertion that farmers are not technically efficient however there is need for a profound analysis into the efficiency levels of smallholder farmers in order to resolve the disputes.

1.2 Statement of the Problem

Cotton production under contract farming initiative has potential moral hazard between the farmers and contractors. Contract farming is the lending of inputs by a firm (cotton merchants) to a farmer in exchange of exclusive purchasing rights of the crop (cotton) (Prowse, 2012). Moral hazard in cotton contract farming is a principal-agent problem where the farmer (agent) does not act in the full interest of the contractor (principal). Farmers may divert inputs, produce poor quality crop and/or less output than contracted (Eaton and Shepherd, 2001) and these increase contractors' risky. Unequal power between the contractors and farmers likely leads to exploitative gains and losses. Clapp (1988) outlined that contract farming is an unequal power relationship that leads to exploitation, disguised proletarization, loss of autonomy and subordination of farmers. In similar terms, White (1997) understands contract farming as the ability of contractors to capture value added by producers through price and contract manipulations. Only efficient contracts are able to ensure a smooth relationship between the farmer and the contractor: a contract that avoids hold-ups and moral hazard while neither the contractor nor the farmer enjoys excessive rents.

The moral hazard problems often lead to price and marketing disputes between producers and contractors. Saes (2005) relates major disputes in contract arrangements to moral hazard problems while Eaton and Shepherd (2001) attributes major contract farming disputes to price setting models. In the current cotton cropping seasons (2009-2013), AMA (2013) acknowledges the existence of pricing and marketing disputes in cotton as the potential threat to the existence of the cotton sector. In some instances, farmers hold on to their cotton demanding prices higher than those offered by their contractors. Farmers allege unfair pricing practices/models by the contractors. However, contractors allege that farmers fail to maximise output from the supplied inputs, hence they demand higher prices as a cushion. The weak regulation of contracts and the structures of contractors and farmers possibly facilitates the moral hazard problems. A weak legal enforcement of contracts means that farmers can sell output to other buyers or they do not have the legal force to produce maximum output as set in the contract. The large numbers of buyers scattered in the rural side of the country reduce their market power in negotiation of contracts and cotton prices. On the other hand, contractors may possess market power given their oligopsonistic structure leading to uncompetitive output and input prices of cotton.

Disputes in the cotton sector have detrimental effects on cotton production and growth that may also translate to increased rural indebtedness and poverty. The price disputes have increased side marketing of the crop, hence reduced financing of cotton under the contract

farming initiatives and loss of domestic assets by farmer to contractors (AMA, 2013). This threatens the potential growth of the cotton sector while exacerbating poverty in the small holder rural cotton growing areas. Unresolved cotton pricing disputes will translate to less jobs in the cotton industry, reduced command of other goods and services, and possibly, the loss of the social pride in cotton farming. It is imperative to know the sources or underlying causes for these disputes for a resolution to be passed. Although the sources and underlying causes of the disputes are unknown, conjecture and surmise seems to suggest that either the farmers are technically inefficient or contractors wield market power to determine selling prices of cotton, or both.

No studies have been done to establish the validity of contracting parties' arguments. Mushunje et al. (2003) attempted to determine the level of technical efficiency of cotton farmers using farm level data from the Mutanda resettlement area of Manicaland province. The study sought to establish the possibilities of output gains following the Fast Track Resettlement Programme that started in 1998 and was officially launched in 2002. The study was further anchored on the need to maximise output as a mechanism of improving farmer incomes. The study sheds little understanding of the rural communal farmers who are in scattered settlements, hence poorly connected to main roads, communication and distributional networks. The study established worrying levels of efficiency ranging between 22% and 99% with an average of 71%. The inefficiencies were found to be statistically significant at 25% yet statistical tests are taken at 5% or less. The conclusion that education has a significant negative relationship with technical efficiency is counterintuitive. The study results' reliability is generally questionable, hence insufficient for concrete decision making.

The contention of market power exploitation in price determination had not been studied at all in Zimbabwe. Given this paucity of theoretical and empirical evidence, a study on technical efficiency of small holder farmers, and market power in cotton pricing and marketing will shed much light in the controversies between cotton farmers and contractors. This will be a welcome development into the body of knowledge and policy formulation in Zimbabwe.

Studies from elsewhere have used the DEA and SFA approaches in estimating technical efficiency in agriculture. SFA has been widely used than DEA, and Coelli (1995) argued that the choice of estimation approach is based on the nature and underlying assumptions in the data. Bravo-Uretta and Pinheiro (1997) used the SFA specified in the Cobb-Douglas production function to estimate technical efficiency of peasant farmers in Dominican Republic. The SFA was used based on its ability to separate random elements in data from

the technical efficiency component. Battesse *et al.* (1989) and Huang *et al*. (1986) used the SFA while Ray (1985) used the DEA approach to estimate technical efficiency in Indian farms. Comparing the results, it was noted that the DEA approach overstate inefficiencies. This had been largely attributed to its failure to account for measurement errors and statistical noise in data. The DEA however has the advantage of removing the arbitrary assumptions on the functional form of the frontier and the distributional assumptions for inefficiencies.

Empirical studies on the estimation of market power (monopsonistic and oligopsonistic) are concentrated in the U.S agricultural markets with little applications in developing countries. Schroeter (1988), and Raper and Love (1999) used the demand and supply functions approach to estimate market power in the U.S tobacco and Beef markets. Rogers and Sexton (1994) noted that data limitations have widely hampered these U.S based studies. Sivramkrishna and Jyotishi (2008) further noted that data limitations are greater in developing countries hence the absence of market power estimation studies. As a result, Sivramkrishna and Jyotishi (2008) argued for an analytical policy oriented approach in establishing monopsonistic exploitation in Indian contract farming arrangements. White (2012) further discussed market power (its arousal and measurement) and noted serious inaccuracies of these developed market studies on measuring market power: the inadequacies mainly emanate from data limitations. Due to data limitations to measure market power, this study uses questionnaires and interviews that will serve as the base for a logical and analytical conceptualization of cotton pricing in Zimbabwe.

1.3 Objectives of the Study

The broad objective of this study is to determine the underlying causes of the pricing and marketing disputes between smallholder farmers and cotton contractors

The specific objectives are:

1. To empirically estimate the level of technical efficiency of smallholder farmers

2. To establish whether contractors wield and exploit market power on determining the cotton price and terms of the contract.

3. To assess the importance of these factors in the genesis and resolution of the contracting parties' disputes

1.4 Research Questions

1. Are smallholder cotton farmers technically efficient in production?

2. Do contractors wield and exploit market power in price determination?

3. What policy interventions may be appropriate to resolve the disputes between the contracting parties?

1.5 Hypothesis

The study tests two hypotheses:

1. Smallholder farmers in Zimbabwe are technically inefficient.

2. Seed cotton contractors wield and exploit market power in the pricing of seed cotton.

1.6 Justification of the Study

It is important to guide policy in resolving disputes in the cotton sector to ensure cotton production viability, sustained production and growth levels, smooth provision of inputs to value chain industries and improved income and livelihood of cotton farmers. The current adverse consequences of cotton pricing disputes include declining and highly volatile levels of cotton production (for example, cotton production fell between 2011 and 2012 by about 40%). It is likely that, if the disputes are not resolved, production will continue to fall with adverse effects as the sector is the backbone of most rural and drier economic areas of Zimbabwe, underpinning their growth, food security and poverty alleviation, with systematic challenges in the entire cotton value chain ranging from lack of agricultural inputs to poor industrial competitiveness. Side-marketing has been a phenomenon characterising cotton disputes; however it is accompanied by limited use of inputs as contractors supply inadequate and incomprehensive credit facilities coupled with high input costs in succeeding seasons with the overall effect of reduced yield and cotton production. Establishment of market power exploitation will help to direct policy that towards fair sharing of risks and loses between farmers and contractors and overall market transparency. This will have important impact on enhancing income and livelihood for smallholder farmers, hence less poverty. In addition, resolving the disputes will help to ensure that migration of cotton farmers to tobacco production is lessened thus preserving agro-ecological farming where land is used for the production of the crop it is best suited. The study also adds into paucity literature on technical efficiency for academic use as it provides a check on previous empirical studies such as those of Mushunje *et al.* (2003). Farmers, contractors, government, NGOs and academics are all likely to benefit from this study as it is major attempt towards resolving cotton pricing disputes while it adds on the links between market structure and pricing performance which has not been examined in the Zimbabwean cotton sector.

1.7 Methodology

This study is based on Farell's measures of efficiency (1957) and Joan Robinson's classic on the economics of imperfect competition. Primary data is used whilst reviews and reports provide complementary information for analysis and evaluation. An adequate number of seed cotton farmers will be interviewed from Gokwe North District, Midlands Province of Zimbabwe through face to face administration of questionnaires in order to collect farm level data. SFA will be used to estimate technical efficiency levels of the smallholder farmers using the farm level data. The study will further purposively interview a few contractors on their cotton pricing structure and contract farming experiences; as far as competition and cooperation is concerned; in an effort to establish market power exploitation in contract

farming. The interviews on pricing structure, experiences and practices of contractors will serve as the basis for an analytical conceptualization of market power exploitation in contract farming and will be complemented by an analytical evaluation of farmer operating environment relating to income sources, possible production possibilities and membership to farmer organizations.

1.8 Organization of the Study

This study is organised as follows; chapter two focus on reviewing literature on economic theories of imperfect competition and efficiency. Both theoretical and empirical literature will be critically examined in order to situate our study. Chapter three will focus on outlining the methodology, empirical estimation procedure, and sampling and data collection issues. In chapter four we present an analysis of seed cotton pricing structure in Zimbabwe as well as competition and cooperation among buyers. The chapter further provides a descriptive analysis of contract farming experiences in Gokwe North district in the Midlands Province of Zimbabwe. Additionally, in this chapter we will empirically measure the level of technical efficiency of cotton farmers in Zimbabwe and its variants, carry out econometric tests; and present, analyse and discuss the results. Chapter five concludes the study, gives policy implications, and outlines limitations of the study as well as areas of further research.

Chapter Two: Literature Review

2.0 Introduction

This chapter examined theoretical and empirical literature in attempt to situate the present study. This Chapter discussed market power foundations in the economics of imperfect competition and its measurement. The theoretical review further examined the economic theory of production as it relates to technical efficiency of cotton production and efficiency measurement. The study present a critique of market power and technical efficiency empirical studies in terms of their adequacy in explaining the alleged technical inefficiency in the use of production inputs by small holder farmers and market power exploitation by contractors.

2.1 The Economics of Imperfect Competition

Market power has always been a central issue for economists in the Economics of Imperfect Markets (Robinson, 1933; 1972) and Monopolistic Competition (Camberlin, 1933) and pervades the theories of New Industrial Organisations. In non-competitive markets, the case of monopsonistic (oligopsonistic) market structures characterised by one (few) buyer (s) and many producers, the buyer has the power to restrict prices or other non-price variables in pursuit of self interests at the expense of the producer. In seed cotton contract farming it means that seed cotton contractors are sufficiently few to obtain from farmers, favourable prices and other terms of the contract that could have been available or are expected under perfectly competitive market conditions. Under perfect competition, market power is not of concern as competition forces buyers to charge same price equated to their marginal costs which is not the case for monopsonistic and oligopsonistic markets where there are barriers to entry into markets and firms can collude and coordinate, manipulating market conditions to their advantage. The concept of market power itself is not new but its dynamism in creation, existence and exercise has negative effects to the society hence a fundamental concern for government policy and its regulation through antitrust or competition policy.

In a pure monopsonistic model, a buyer has monopsony power to buy less quantity at a lower price than the optimal price and quantity for a competitive market. Under imperfect competition, buyers of resources (seed cotton in this case) have to pay a higher price to attract an additional unit of the resource. However, payment of a higher price to an additional unit of the resource means that all suppliers have to receive a higher price as the firm cannot differentiate among the seed cotton farmers to alter farmer price. The Marginal Product Cost (MPC) is therefore the sum of the additional price for an additional unit and the amount necessary to bring the price to the new level for all units. MPC for the monopsonist lies above

the average cost curve or the supply curve. Maximum profits exists when the firm charges a price where the MPC equal the marginal revenue product (MRP) and the price charged will be less that the ideal price under perfect competition.

Accordingly, each firm in oligopsonistic market can have monopsony power or the firms may tacitly or openly act in concert buying, hence greatly enhancing their monopsony power. Profits for the firm depends on the actions and behaviour of other firms, hence firms interact in a setting of strategic interdependence. A buyer's best action is a profit function partly determined by actions of other buyers. The buyers can decide to jointly operate and accrue joint monopoly profits that will be shared some sought among them. An individual buyer can however do better than its share of monopsony profits by increasing its price and capitalising on the farmers of other firms thereby increasing its market share. The firm could however lose out in the event other firms are quick to respond to its action and this means the incentives for an initial price increase are weak. If all buyers fear falling victims of increase in price by others, they will all reason towards increasing their prices and as a result a Bertrand competitive outcome will prevail.

The analysis above presents questions which will need to be answered through empirical analysis. The major question is are the structural conditions in the Zimbabwean cotton market conducive for coordination by the contractors that result in a collusive outcome attained by holding significant market power? If there is easy coordination, market power is exercised in the oligopsonistic market with farmers deprived prices that would have prevailed in a largely competitive outcome, hence deprived income.

2.1.0 Measuring Market Power

The standard measure of market power is the deviation of price (P) of a factor of production from its marginal revenue product (MRP). The Lerner Index (L) for the monopolistic and oligopolistic markets can be used in monopsonistic and oligopsonistic markets, L= (P-MRP)/P; can be used to show the existence of market power. The MRP is used in this case since the original Lerner index uses marginal cost (MC) of producing the good to be sold while in our case the firm buys the good as a raw material for production. The decision rule in non-competitive markets is to charge a price where MRP equal MRC. L= 0 for competitive markets (implying P=MRP) while L<0 (if P<MRP) for the monopsonistic and oligopsonistic markets. This index measure real market power and indicates the above normal profits for contractors that deprive farmers.

Measuring market power through the application of Lerner index has been seriously weighed down by the difficulty in ascertaining data on marginal costs hence reliance for proxies. Profitability index is the closest proxy for the Lerner index since the profit margin is the difference of price from marginal costs. However, reliance on the profitability index to measure market power in our case suffers the major drawback that seed cotton contractors do not report their profits publicly, thus there are no consistent reports on profitability that can be used to establish market power for the seed cotton contractors. White (2012) further stated that the use of profitability index suffer from the weaknesses of accounting data. Accordingly, the two indexes are not disposable for purposes of this study hence reliance on buyer concentration indexes.

Concentration ratio has been widely used as an indicator of market power as it is positively related to the Lerner index. White (2012) noted that higher industry concentration as measured by concentration ratio (CR4) (the fraction of industry sales accounted by the largest four firms) means that firms have monopolistic power. A Study by Bain (1951) and Least Square Regressions (LSR) of industry cross-sectional data (industry profit rates and CR4 ratio) summarised by White (2012) indicate a positive relationship between the two variables implying that more concentrated industries were more likely to be exercising market power. Use of CR4 is embedded in the systematic thinking that structure (S) influences conduct (C) which in turn influences performance (P); the SCP paradigm. The CR4 therefore measures structure while the Lerner index is a measure of both conduct (prices charged) and performance (profitability). A famous critic for the use of CR4 is its failure to consider relative and dynamic distribution of the first four firms and ignorance of the other firms in the industry. As data is available for computation of the CR4, we follow suit and compute the concentration ratios for the seed cotton contracting sector. The Herfindahl-Hischman index (HHI) has also been computed as an alternative that overcomes the use of CR4 since it is computed by summing up squared market shares of all the sellers in the market. It has been a practice to report the CR4 together with the HHI in empirical studies (Dobson, 2005), an approach we follow as we suggest it will help strengthen the results of our study.

Studies related to our study falls short in explaining market power as they concentrated on assessing the cotton sector following the liberalization of the cotton sector. A number of studies assessed key issues in the cotton sector following the liberalization; these include Imani Development (2003), Tschirley et al. (2006), Poulton and Hanyani-Mlambo (2008) and Rusare at al. (2006). Key recognition of these studies was that the liberalization of the seed cotton sector had not transformed into a competitive sector as planned hence the need to

establish the effects of the new structure on sector performance. We note with concern that no study has tried to specifically measure the level of market power in the new structure and its relationship with prices. This is so despite the recognition that liberalization was seen as a process towards establishing competitive cotton sector yet the resultant structure is an imperfect oligopsonistic market. Thus, the performance of this new structure should have been under constant check as non-desired outcomes are likely to emerge.

2.1.1 Market Power and Policy Based Research

The literature on contract farming is spread with discussions on real market power as researchers caution the possibility of monopsony or oligsony exploitation of many contracted farmers under the contract farming initiative. In the policy studies (Dobson, 2005) focus had been on issues in relation to sources of income, forms and how exploitation occurs. The buyers given their number have the power to alter prices through altered quantity purchased while contracted farmers (many) have weak bargaining power to negotiate prices and other contract terms. Sivrankrishna and Jyotishi (2007) noted that vast literature on contract farming has simply reduced monopoly power to a simple bargaining problem where a single buyer has a relatively stronger bargaining power compared to farmers hence market power is easily created and exercised. However, a stronger bargaining power is not a sufficient though necessary condition for farmer exploitation in imperfect markets. Market power is exploited where farmers lack alternative production and income possibilities making their livelihood dependent on the buyer (s).

Due to lack of production or income alternatives farmers can accept "unfair" contract terms as set by buyers with power in the market. Farmers are thus cheated, manipulated and exploited through pricing and other non-price terms within or outside the contract. Glover (1987, p.446) stated that, "availability of alternatives is one of the most important preconditions for a contract farming system that benefits farmers." Rehber (2000, 13) also stated that, "the availability of monopsony power is abused when alternative marketing opportunities are closed out and an overly integrated firm or sector may beat down the terms of the contract."

In theoretical terms, Sivramkrishna and Jyotishi (2007) disqualified the argument that monopsonists sets price because of a stronger bargaining power; this depends on the growers' supply curve. The provision of production alternatives do not eliminate the monopsonistic power but improve growers' price by shifting the supply curve. It is therefore this powerful shift in the supply curve that will result in improved farmer prices even in the existence of market power that of interest from a policy perspective seeking to improve farmer incomes.

Are individual seed cotton farmers able to affect the supply curve? Is the seed cotton supply curve perfectly elastic? While Sivramkrishna and Jyotishi argued from a monopsonistic exploitation point of view, it also implies the same for oligopsonistic markets that the removal of imperfection in the supply curve to make it perfectly elastic will solve market power exploitation instead of addressing the simple bargain power problem. The interest is however on improving farm prices, altering the supply curve would be achieved through the formation of association of farmers which coincidentally relates to strengthening the negotiation power of farmers. Thus, farmers" negotiation power needs to be improved to reduced exploitation by buyers.

Spot market also ensures that farmers get a fair price from the contracted crops as buyers are likely to factor it in their pricing structure. Are Zimbabwean seed cotton farmers exploited due to lack of alternative spot markets for their seed cotton? Clapp (1988) argued that agribusinesses are often frustrated by opportunistic behaviour of farmers where alternative markets exist therefore they prefer to locate in remote areas where there are no alternative markets such that any price offered is enough to induce farmers to sign the contract. Product asymmetry (where the product is not the same to the buyer and the seller) crucially align the contract price to the spot market price (Sivramkrishna and Jyotishi, 2007) because the buyer can only purchase the crop from the contracted farmer while the contracted farmer can sell the product to the domestic spot market. Is seed cotton different from the perspectives of buyers and farmers in Zimbabwe?

2.2 The Economic Theory of Production

The concept of technical efficiency of cotton farmers is embodied within the microeconomic theory of production. In microeconomics, cotton production takes place when inputs are converted into outputs. In simple theoretical framework, inputs are usually identified as capital and labour, however, cotton production is a multilevel input exercise where numerous inputs including land, labour, equipment (cultivators, ploughs), ox, chemicals (fertilizers, insecticides, pesticides, herbicides) and entrepreneurship are employed . The theory asserts that seed cotton produced depends on the mixing of these inputs, that is the level of technology and the scale of production; quantity of inputs used. Thus, from this theory one can model out scale and technical efficiency effects of production.

2.2.0 Technical Efficiency

Efficiency, in production economics is synonymous with frontier production. Frontier production is the maximum possible output that can be produced by a given set of inputs. According to Coelli (1995), efficient firms operate on the production frontier while

inefficient firms operate beneath the production frontier. From a theoretical point of view, it is possible for inefficient firms to increase output by simply avoiding wasteful production, without adding more resources. If this is possible, planning needs to know by how much are these inefficient farmers able to increase their output without increasing their set of inputs. In order to further guide policy, there is need to establish the variants of efficiency. Belbase and Grabowski (1985) argued that if it can be shown that farmers in developing nations are less efficient in their practices, it follows that output can be increased at little cost to the economy through extension and education. This kind of argument is practically applicable in this thesis as we simply argue that, if cotton farmers are technically inefficient (TE) in their practices, then, farm level output can be increased by improving the variants of TE resulting in cotton revenue improvements hence less pricing disputes.

2.2.1 Efficiency Measures and Methods

There exist simple-partial measures of efficiency which are expressed as output per unit of input. In cotton production the commonly used indicator is cotton yield; that is cotton production produced in kilograms (kg) per hectare (ha). Cotton yield has been described as low and non-impressive, consequently, AMA (2013) reported that there is need to derive yield to 2000kg/ha in the next five years. Policy based on this measure are however likely to be misleading given that only a single factor of production is considered, thus land is the sole input considered with all other important inputs in the production of cotton ignored. The resultant policy is likely to push for intensified use of land with over application of other inputs such as fertilizers and insecticides. Under contract farming, output will increase however overuse of inputs will continue to burden the farmer persisting the disputes as farmers' likelihood fail to repay credits increase.

It is also inappropriate to compare farmer yield against expected yield from the CRI. This is because farmer conditions distinctly vary from those of the CRI in the sense that; farmers are socially constrained through extended families than CRI, CRI is equipped with skilled and qualified personnel compared to labour endowments of farmers, CRI has a better financial muscle compared to farmers who are subjected to weaknesses of contract credits and farmers are generally located in poor areas with poor road and communication networks than where CRI is situated. It is critical to compare farmers among themselves; comparing yield of all farmers against best performing farmers. However, in this comparison, the inadequacy of yield as a measure of efficiency described in the preceding paragraph suffices. We therefore turn to measures of efficiency that consider multiple inputs of cotton production.

In 1957, Farrell developed measures of efficiency that take into account multiple inputs of the production process and avoid index number problems. Farrell stated that with the knowledge of the unit iso-quant/production possibility frontier (PPF), technical efficiency can be calculated as the deviations of observed output from the frontier. Despite the superiority of Farell's measures of efficiency compared to simple partial measures, the assumption of the knowledge a unit iso-quant complicates practical application of these measures. In reality, the PPF had to be estimated basing on sample data (Coelli, 1995). It is the estimation of the PPF that has created debate in literature (see Coelli, 1995; Forsund and Hjalmarsson, 1977, 1979; Aigner et al., 1977; Timmer, 1971; Aigner and Chu, 1968; Koopmans, 1951). There exist three methods of modelling the PPF and the subsequent calculation of efficiency. These are the deterministic approach, the stochastic frontier analysis (SFA) and the data envelop analysis (DEA).

A deterministic approach refers to a group of methods that assume a parametric form of the PPF along with a strict one sided error (Schimdt, 1976; Afriat, 1972, Aigner and Chu, 1968). The major drawback of the deterministic approach to modelling efficiency is that, all deviations from the frontier are attributed to inefficiency. This means that deviations due to measurement errors and other statistical noise in data are all regarded as inefficiency on the aspect of the farmer. The inefficiency scores from the deterministic approach are likely to be overstated and inaccurate.

Shortcomings of the deterministic approach above led to the development of the SFA by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977). The SFA addresses the noise problem through the inclusion of a symmetric error term to the non-negative error term in the deterministic approach. The non-negative error term was further assumed to be either half normally distributed or exponentially distributed. Coelli (1995) argued that in addition to removal of statistical noise in the deterministic model, the SFA allows for estimation of standard errors and test for hypotheses which were not possible with deterministic approach due to violation of certain maximum likelihood (ML) regularity conditions. The SFA is however criticised on the fact that efficiency measures are susceptible to distributional assumptions of the non-negative error term.

DEA is a non parametric mathematical programming approach to frontier estimation. Coelli (1995) stated that the DEA approach has two distinct advantages; (1) it does not require the arbitrary assumption on the functional form of the frontier and (2) no distributional form of the non-negative error is required. However, the fact that all deviations from frontier are

attributed to inefficiency means that DEA also suffers from measurement errors and statistical noise, similar to the deterministic approach.

It can be noted from the discussion above that none of the approaches described is perfect. However they do provide better estimates of efficiency compared to commonly used, simple partial measures such as cotton yield. Empirical examination has largely used SFA than DEA depending on the nature and some assumptions on the underlying data (Coelli, 1995). This study uses the SFA since we are using farm level data, and we expect it to be influenced by measurement errors, missing variables, and other factors outside the control of the farmer such as weather and luck. The approach also allows us to perform some statistical tests about the degree of inefficiency and yield results comparable to the study by Mushunje (2003) which also utilised the SFA.

2.2.2 Technical Efficiency Literature

Studies on technical efficiency are primarily interested in deriving growth from the existing technology. Bravo-Ureta and Pinheiro (1997) stated that, "an effective economic development strategy depends critically on promoting productivity and output growth, particularly among small scale producers." In the event of exhausted productivity gains from the green revolution in developing countries, Ureta and Pinheiro (1997) argued for a shift towards the efficient use of existing technology. Exploiting efficiency gains would ensure agricultural competitiveness in the face of declining world commodity prices; increased competition from both subsidized and non-subsidized oversees industries, and declining expenditure on agricultural research (Coelli, 1995). Estimation of technical efficiency in this study is therefore in no isolation. It is grounded upon low levels of cotton output despite huge investment in research and technology over the last decade, failure by farmers to meet contracted credit, protracted domestic price wars, constrained fiscal budget and heavy reliance on the cotton sector for rural livelihood. Productivity gains are of paramount importance to the farmer, and the nation.

In Zimbabwe, agricultural efficiency studies are scarce despite the fact that a lot of work has been done globally. The lack of such studies indicates that policy is not research based and shows the need for more research agricultural efficiency. Mushunje at el. (2003) and Dangwa (2011) examined technical efficiencies in cotton and maize production respectively. The former reported that technical efficiency of cotton farmers in Mutanda area varied widely, from 22 % to 99% with an average of 71%. Dangwa (2011) found similar results, indicating technical inefficiencies between 21.2% and 95.6% though the maize crop is quite different from the cotton crop. Mushunje's study further reports that technical inefficiencies were

significant at 25 % and identify family size, age of household head, farm size and education as variants of technical inefficiencies. The two studies indicate the possibilities of output gains in small holder farming in Zimbabwe.

Despite the fact that the Mushunje (2003) points towards technical gains in cotton production, it is a statistical mistake to say technical inefficiencies are significant at 25 %. In addition, the finding that technical inefficiencies increase with education level is both argumentable or counterintuitive. Statistically, a variable is significant at 1% and 5% while weakly significant at 10 %. Education as a human capital investment cannot cause a rise in inefficiencies; otherwise it may fail to have an impact by being statistically indifferent from zero. Thus, without dismissing the study we question its reliability and argue the results could have been influenced by omitted variables, inadequately measured variables and unaccounted environmental factors. This study provides check to the aforementioned study, adding into technical efficiency literature by answering the question on whether cotton farmers are technically inefficient or not?

Empirical studies by Bravo-Ureta and Pinheiro (1997), Hussain (1989), Bravo-Ureta and Evenson (1994), Belbase and Grabowski (1985), and Khan and Saeed (2011) reveal that inefficiencies do exist in agriculture. Bravo-Uretta and Pinheiro (1997) indicated that TE in peasant farming in the Dominican Republic varied widely, from 42 % to 85 % across the farmers. The study, reporting an average TE score of 70 % showed the possibility of technical gains in output of 18 % to an average farmer by simply removing inefficiencies. The most inefficient farmer has the potential to increase output by 50 % if technical efficiency is improved. These estimates were close and within the range of similar studies referred above (Hussain, 1989; Evenson, 1994; and Balbase and Grabowski, 1985). In 2011, Khan and Saeed found that on average tomato farmers in Northern Pakistan were 65 % technically efficient while a similar study by Islam *et al.* reported an average of 72 %. Despite studies above indicating the existence of TE inefficiencies in agriculture, Henderson and Kingwell (2002) argued that Broadacre farmers produce at their maximum level of technical efficiency.

Efficiency studies have been mostly common in rice production neglecting other farming industries such as maize, cotton and wheat. Some studies (Bravo-Ureta and Pinheiro, 1997; Huang and Bagi, 1984; Taylor and Shonkwiler, 1986; Rawlins, 1985) have looked at multi-product farming which is exposed to the assumption that inputs are applied homogeneously to all outputs. In addition, standardization of outputs by using output value instead of quantiy produced means that the price aspect is factored in technical efficiency yet it is an issue of

allocative efficiency. This weakness of including prices in the calculation of TE is found in other cotton specific studies (Bravo-Ureta and Evenson, 1994; Mushunje et al., 2003). The empirical studies have considered different crops in different countries and gave different results. It is therefore difficult to precisely conclude on the level of technical efficiency of cotton farmers in Zimbabwe. However, it can be noted that smallholder farmers are generally inefficient.

One of the most important variant of technical efficient is human capital investment. Where human capital investment in the form of education, formal training through cotton farming courses and training through extension services exist, farmers are equipped with technical skills that will help them avoid wasteful production. This further point out that human capital accrued through experience will play an important positive effect in enhancing technical gains by farmers. In the long run such farmers are expected to be efficient producers. Empirically, on-farm training was reported to be significantly related to technical efficiency of rice farmers in Bangladesh (Islam et al., 2011). Furthermore, Belbase and Grabowski (1985) argued that education is significantly related to technical efficiency of Nepalese farmers while there is no relationship between farming experience and technical efficiency. Several studies (Bravo-Ureta and Evenson, 1994; Kalirajan, 1981; Kalirajan and Shand, 1986; Shapiro and Muller, 1977) reported a robust and significant association between technical efficiency and extension services. This study therefore proposes that human capital plays a central role in enhancing technical efficiency. It enables farmers to have better knowledge and application skills of cotton inputs. We therefore deduce that cotton farmers in Zimbabwe are technically inefficient given their low levels of education.

Adding to human capital investment is the land; size and quality. Cotton farmers have been undertaking land fragmentation as they apportion land among members of the family. Land fragmentation affects the efficient use of inputs particularly farm assets. This thesis argues that it is land fragmentation that has exposed cotton farmers towards wasteful production. Small farmers are most expected to be efficient; however their level of efficiency is not given. Land on which cotton takes place is highly fertile. However, failure to carry out soil fertility tests before the application of chemical fertilizers is to have serious effects on crop efficiency. With soil fertility tests, the farmer is expected to apply the rightful type and quantity of fertilizer; otherwise there will be a wasteful use by the farmer.

Empirical examination favours less fragmented land or large land size if technical efficiency is to be achieved. Saed and Khan (2011) stated that the modal class with efficiency levels of 71-80 % had better technical efficiency than the lower classes. The study reported that for

Tomato production in Pakistan, better efficiency was achieved on relatively large farms. However, this variant interacts with higher levels of schooling, farmers comparatively younger, and had a relatively higher number of contacts with extension workers. Technical efficiency variants were the same for farmers with the highest levels of efficiency, between 81 and 90 %. In relation to subsequent claims, Islam et al. (2011) argued that less fragmented land provides more efficient cultivation, irrigation and harvesting. Land quality had been much referred to as an environmental factor with which the farmer has little or no control at it. We therefore hypothesis that cotton farmers on small pieces of land are likely to be inefficiency as described above.

Investment in infrastructure is a key variant of technical efficiency. Theoretically, well connected roads and network systems provide with vital activities such as transportation of inputs and movement of information within the community. Infrastructure also provides the base for human capital investment. An efficient and well connected road and communication infrastructure insures that farmers access agricultural offices and markets. Furthermore, extension officers are able to meet the farmers regularly. This king of road and communication network also provides with transportation of goods and services at low cost. In general Zimbabwean infrastructure is poor. Most communal roads are gravel in nature with breaks, potholes and at times muddy. These roads and communication networks will be at standstill during the rainy season which coincides with cotton production. As a result extension officers may fail to carry on time crop monitoring, farmers may fail to agricultural trainings as well as important farming meetings. Infrastructure investment therefore interconnects with variants such as human capital investments to influence farmers' technical efficiency. Undoubtedly, infrastructure has a positive relationship with TE of farmers as farmers are likely to better their knowledge of cotton inputs.

Technical efficiency of farmers may be affected by various demographic factors that include age, family size, gender and marital status. The impact of family size is debatable. A large family size can exert pressure on the farmer's decision making process forcing the adoption of conservative approach. The farmer will shy new farming techniques and as a result produce below the frontier. Additionally, a large family size may provide a consistent and timely pool of labour that may enhance the efficient production of cotton, a crop which is labour intensive.

Age of the farmer does have implications on technical efficiency of cotton producers. In Zimbabwe's communal areas where cotton production takes place, there is pressure as young, less educated and experienced cotton farmers emerge. These young farmers are school drop

outs therefore have less education. While having been in cotton production as family members, when they own their household they assume the decision making aspect of cotton production. This is a role they did to have before, thus they are less experienced to it and likely to experience wasteful production. These young farmers are scarcely trusted by contractors and are not likely to be given enough inputs and great attention compared to the old farmers who are highly trusted and perceived less risk. However, these relatively younger farmers are likely to adapt to new technology than old farmers who may resist new ideas in favour of their old techniques. The impact of age in cotton contract farming is not conclusive and this study hopes to bridge the gap.

In Zimbabwe, farming practices, particularly in cotton cannot be completely efficient the country is in a transition from a decade of economic crisis that occurred between 1998 and 2008. The transitional phase is characterised by shortage and late distribution of cotton seeds, fertilizers and other agricultural inputs, poor roads and communication infrastructure. In addition contract farming arrangement is weak given the regulatory environment it operates presenting opportunistic behaviour by the farmers. The imperfect nature of cotton production sector under contract farming further presents the potential exploitation of market power by contractors suppressing quantity of seed cotton and price. We argue that, if farmers are of less schooling years, operate in a community with dilapidated infrastructure and poor network system they cannot be efficient in both production and negotiation of seed cotton prices. These factors coupled with the few buyers of seed cotton likely accelerate the exploitation of farmers.

Chapter Three: Methodology

3.0 Introduction

This chapter serves to outline the SFA for estimating technical efficiency of smallholder farmers and the concentration and analytical approach on examining market power wielded by contractors. The chapter explains in detail the empirical model used, sampling procedure, sample size, data collection and estimation techniques.

3.1 Technical Efficiency Analysis

3.1.0 Technical Efficiency Models

Based on Kopp and Diewert (1982) the Stochastic Frontier Analysis begins by specifying a deterministic model below:

$$Y_j = f(X_{ij},\alpha) + e_j \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(1)$$

Where Y is the output, X is a vector of inputs used in production, α is a vector of parameters to be estimated and e_j is a term capturing inefficiencies in the deterministic sense; j and i are firm and input subscripts. The Stochastic Frontier Model is specified by decomposing e_j as follows:

$$e_j = v_j - u_j \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(2)$$

Where v is a two-sided normally distributed random error term which captures statistical noise: discrepancies in cotton output due to factors outside the farmer's control, for example weather, natural disasters and luck, and measurement errors. The term u is a one sided positive error term capturing deficiency in observed output (Y_i) from the frontier output ($f(X_{ij},\alpha) + v_j$) due to farmer inefficiency. As shown in applied literature, u_j is half normally distributed and is independent from v_j.

The Maximum Likelihood estimation gives efficient estimates of α, λ and σ^2, where $\lambda = \sigma_u / \sigma_v$ and $\sigma^2 = \sigma_u{}^2 + \sigma_v{}^2$. According to Bravo-Ureta and Pinheiro (1997) and Jondrow et al. (1982), the inferences of technical inefficiencies are found taking cognisant of the conditional distribution of u_j given the fitted values of e_j and the respective parameters. Following the distributional assumptions of u_j and v_j and holding the independence assumption, the conditional mean of u_j given e_j is given by;

$$E(u_J / e_j) = \sigma_* \left[\frac{f^*(e_j \lambda / \sigma)}{1 - F^*(e_j \lambda / \sigma)} - \frac{e_j \lambda}{\sigma} \right] \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 3$$

Where $\sigma_*{}^2 = \sigma_u{}^2 \sigma_v{}^2 / \sigma^2$, f^* is the standard normal density function and F^* is the distribution function, both functions are evaluated at $e\lambda / \sigma$. e, σ_* and λ are replaced in equation (3) by their estimates from equation (1) to derive estimates of v and u. Subtracting v from both sides of equation (3) yields the Stochastic Production Frontier.

3.1.1 Empirical Models Estimated

Imposing the Cobb-Douglas production function, equation (1) above was empirically estimated as below;

$$\ln Y_j = \ln \alpha_0 + \sum_{i=1}^{N} \alpha_i \ln X_{ij} + e_j \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(4)$$

In the frontier model, Y_i is the cotton output measured in kilograms. X_1 is the land in hactares devoted to cotton production; it is measured in hectares, X_2 is the amount of fertilizer in kilograms used in the production of cotton, X_3 is the labour endowment of the farmer. This includes family members aged between 16 and 65 years, and units of hired labour during the production season. X_4 is the amount of cotton seeds in kilograms, X_5 is the number of cattle owned by the farmer, X_6 are farm implements in units. Farm implements include hoes, cultivators, ox-drawn ploughs, and sprays. X_7 refers to the amount in litres of pesticides and herbicides applied X_8 is the number of loads of manure applied in the cotton field. α is a parameter to be estimated.

3.1.2 Determinants of Technical Efficiency

Estimated inefficiencies from equation (4) will be modelled as a function of demographic, human capital, socio-economic and farm specific forces as below;

$$u_j = \beta_0 + \sum_{l=1}^{10} \beta_l Z_{lj} + w_j \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5)$$

Where u is the estimated inefficiency for farm j, Z_1 is the education level of the household head, Z_2 is the age of the household head, Z_3 is the household size, Z_4 is the farm size in hectares, Z_5 is the farming experience in years, Z_6 gender of the household head, Z_7 is the

income of the household, Z_8 is access to extension services, Z_9 is the access to roads and Z_{10} is the contract input package of the farmer.

3.1.3 Empirical Estimation Procedure

The study begins by estimating model (4) above using the Maximum Likelihood Method. Secondly, we solve for σ_u and σ_v using the simultaneous equation approach given estimates λ and σ^2 from model (4). The third step is to estimate σ_*^2 using the estimates of σ_u, σ_v and σ^2. Model (3) is then estimated by substituting the estimates of e, σ_* and λ to find the technical inefficiency of each farm in the fourth step. Model (5) was then estimated using Ordinary Least Squares approach in the final stage.

3.2 Market Power and Exploitation of Farmers

The study computed the concentration ratio of the largest four contractors for the period 2010/11 to 2013/14. A CR4 ratio above 40% indicates significant market power and that above 80% resemble monopsonistic behaviour. Additionally, the Herfindahl-Hischman Index (HHI) is also computed with an index between 1000 and 1800 indicating moderate market power and that above 1800 indicating significant market power. Market share as measured by the seed cotton production intake of each firm was also correlated by the seed cotton price of each firm between 2012/13 and 2013/14 production seasons. The research used reviews and reports on cotton production from AMA to calculate concentration ratios in cotton buying.

An analytical framework of policy orientation to detail market power wielded by contractors in seed cotton pricing is also considered through the evaluation of farmer production possibilities and alternate income sources. Data is collected from the contractors on the seed cotton pricing structure using questionnaires. Interviews with the contractors primarily focused on how prices of seed cotton are determined; risk and profits sharing model, effects of non-existent spot markets of cotton, measures against side marketing, collusive behaviour of buyers and its effects on prices, differentiation of seed cotton through quality and its effects on prices, and the key terms of the contracts relating to pricing and output. This data was conceptualised by the researcher against the farmer operating environment to establish the likelihood of farmer exploitation.

3.3 Sampling Procedure and Size

Purposive stratified random sampling procedure is used to draw a sample population of small holder farmers while views of a few contractors are sought to determine the seed cotton pricing structure. The approach to determine a sample of smallholder farmers is purposive in the sense that only seed cotton farmers will be interviewed while stratification caters for

distinct cotton producing areas in the district. The areas differ in terms of rainfall, soil type and fertility. In addition, the sampling procedure was designed to capture farmer distribution; areas with more cotton farmers need more representation in the sample. The first step is therefore to identify cotton farmers from non-cotton farmers in the district. Cotton farmers are then grouped into non-overlapping sub-cotton producing strata. A proportionate random sample is then selected from each stratum using the random sampling approach.

Cotton contractors to be interviewed are Cottco, Cargil, Olam, Grafax, SinoZim and China Africa. This sample include contractors with wide and vast experience in cotton production support such as Cottco and Cargil, and others that are relatively new to the industry that is Olam, Grafax, SinoZim and China Africa.

The sample size (n) of smallholder cotton farmers used in this study was established using Cochran (1977) formula for determining sample size given below. The margin of error (d) of 10 points had been assumed and the acceptable error of probability (α) is 5% and σ_i^2 of 0.2025 is used based on Mushunje's (2003) cotton output standard deviation of 0.45.These values are imputed in the following sample size formula;

$$n = \frac{\sum_{i=1}^{L} N_i^2 \sigma_i^2 / w_i}{N^2 V + \sum_{i=1}^{L} N_i \sigma_i^2} \quad \text{..} \quad (6)$$

Where, $V = d^2 / z^2$, z is the upper point $\alpha / 2$ of a standard normal distribution function, w_i is the fraction of observations allocated to stratum i, N_i is the stratum population and N is the total population. Using the above formula, a sample size of 195 (approximate of 194.71 farmers) was drawn from a population of 24 877 farmers. However, to cater for incomplete data, it was found noble to increase each strata sample by 2 farmers.

Table 3.1: Population and Sample Distribution

Cotton Farming Area	Number of farmers	Sample of farmers
Chireya	2,057	16
Dambamazura	1,896	15
Gandavaroyi	2,154	17
Kana	786	6
Kuwirirana	1,998	16
Mamvurachena	837	7
Nembudzia	3,342	26
Nyaurungwe	2,987	23
Sanyati	2,459	19
Sawirangwanda	923	7
Tsungai	1,977	15
Zumba	3,461	27
Total	**24,877**	**195**

Source; Data Compiled from Contractors' reports for 2013

3.4 Gokwe North District

This is the district from which the smallholder farmer population sample was drawn. The district is located around Nembudzia Growth point within the latitude of negative $17^{0}31^{1}48^{11}$ and longitude of $28^{0}54^{1}36^{11}$. The district has an estimated 24 877cotton farmers and houses 305 982 people. The main cotton producing areas are Chireya, Dambamazura, Gandavaroyi, Kana, Kuwirirana, Mamvuramachena, Nembudzia, Nyaurungwe, Sanyati, Sawirangwanda, Tsungai and Zumba.

Gokwe North district is a part of Gokwe area, one of the leading cotton producing areas which is located in the Midlands Province of Zimbabwe. Gokwe is divided into three administrative districts namely Gokwe Centre, Gokwe South (close to the town) and Gokwe North (close to Nembudzia). In the area, cotton is produced in the two districts, Gokwe North and Gokwe South while Gokwe centre is a commercial and residential zone. Gokwe has a population of 576 362 which is 35.52 percent of the total population in the Midlands province as shown in table. The province is the third populous province in the country with 13 percent of the total Zimbabwean population while Harare (16%) and Manicaland (14%) are the first and second respectively (ZimStat, 2012).

Table 3.2 Midlands Population Distribution   **Figure 3.1 Map of Midlands Province**

Region	Population	Percent
Gokwe	576,362	35.52
Kwekwe	312,214	19.24
Gweru	251,361	15.49
Shurugwi	99,916	6.16
Zvishavane	115,372	7.11
Mberengwa	186,164	11.47
Chirumhanzi	81,087	5.00
Midlands	**1,622,476**	**100.00**
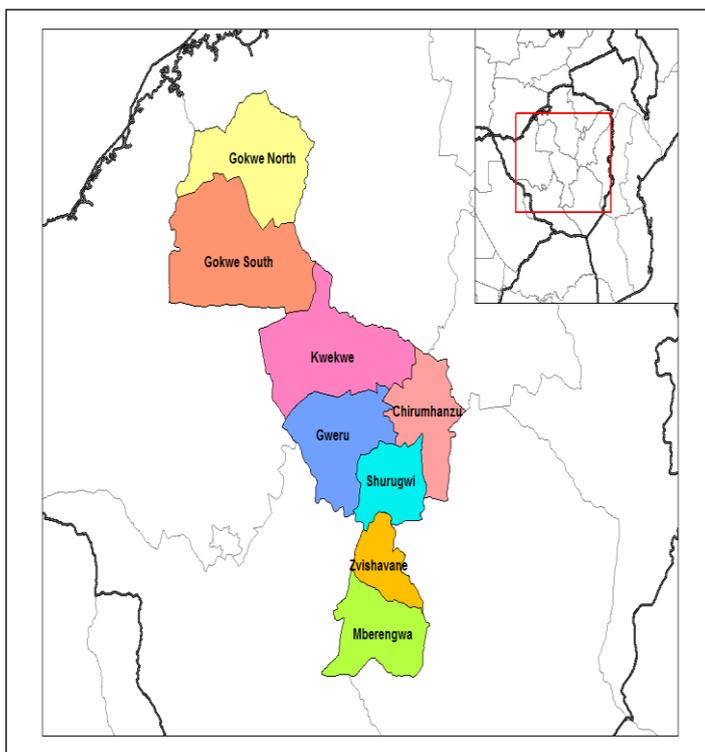
Source: ZimStat, 2012   *Source: ZimStat, 2012*

Soils in the district vary from heavy clay soils to sandy loam soils all capable of producing optimum seed cotton. Rainfall varies between 500mm and 800mm each year with pronounced dry spells of one to two weeks in each year. The district also faces high temperatures of above 18^oc during the seed cotton production season. Thus generally, the district is generally dry; conditions which suit cotton production given that it is a drought resistant crop.

Gokwe North district has been selected because it is the largest and populous region in the Midlands province of Zimbabwe which is also the largest province that produces seed cotton. Subsequently, cotton is the main cash crop that provides this large population with power to access other goods and services that include food and healthcare. Table 1 above confirm that farmers in Gokwe largely depend on cotton (90%) as a source of income than any other crop thus unviable production of cotton will negatively affect many families as they will fail to access food, education and healthcare.

3.5 Data Collection

The paper and pencil method was utilized for data collection using a questionnaire as the medium of data collection. Two questionnaires were drafted for the purposes of our study. The first questionnaire captured demographic and socio-economic characteristics of

smallholder farmers in Gokwe District. The inputs and output for the cotton production are given specific attention while sources of income, other crops produced and membership to farmer organizations and qualitative views on the seed cotton pricing will provide the basis for our analytical examination of farmer exploitation.

The second questionnaire sought to solicitate the seed cotton pricing structure, and the key terms of contracts (in relation to prices and output) from contractors; data sufficient for in-depth analysis of market power wielded by contractors and farmer exploitation through pricing. The questionnaire sought contractors' views relating to domestic spot markets, and the regulation of seed cotton production and contracts.

Interviews were done in the second half of the month of October 2014; it took 13 days to cover the whole study area from the 13th to 29th of October 2014 (excluding travelling days). The timing of interviews coincided with the beginning of agricultural season; hence enhanced accuracy of data as farmers were already preparing for their new agricultural season hence refreshed memories of the previous season. Thus farmers were either interviewed at home or in their fields. Five enumerators conduct the interviews after a day of training to familiarise other researchers on the questionnaire. We also pre-tested our questionnaire to check time required to complete it, consistency and vagueness of questions.

The methodological and model specifications above are followed with the presentation and assessment of study results below. Thus, section four will summarise study results on technical efficiency and market power, and critically provide the implications of the results on the contentions of farmers being technically inefficient and contractors holding market power in relation to cotton pricing disputes.

3.6 Descriptive Statistics

Technical efficiency analysis data used in the study was collected from Gokwe North district, Midlands Province of Zimbabwe in the last two weeks towards the end of October 2014. Six researchers administered structured questionnaires for the two week period. Farm Level data was collected from the areas as indicated in Table 3.1 of the preceding chapter. However, instead of 195 respondents being interviewed, a total of 217 respondents were interviewed. The number of respondents used for the study was however reduced to 202 after a rigorous process of data cleaning, deleting data with some impurities and inconsistencies. At the time of interviews, farmers were undertaking land preparations and contractors were in the process of registering farmers for the 2014/15 cotton production season.

Cotton and maize were the major crops grown by farmers in the 2013/14 agricultural season with 71.8 percent (see Table 3.3 below) of the farmers citing the crop as most preferred crop given its income generation capacity. Maize was the second most preferred crop by most farmers indicating its importance as a source of food. Farmers suggested a possible shift from cotton to maize if the current cotton pricing disputes persist. Production of ground nuts, cow peas, round nuts, sorghum and other small farm crops were found to be common but practiced on an insignificant scale.

Table 3.3: Respondents' Most Preferred Crop

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Maize	34	16.8	16.8	16.8
	Cotton	145	71.8	71.8	88.6
	ground/round nuts	14	6.9	6.9	95.5
	Sorghum	7	3.5	3.5	99.0
	Other	2	1.0	1.0	100.0
	Total	**202**	**100.0**	**100.0**	

The descriptive statistics of the data are presented in Table 3.4 below. Average yield (output/hectare) for the surveyed farmers was found to be 1273.68. There is large variation in seed cotton output as shown by a large standard deviation of 1447.07. At-least 51 percent of the farmers operate below the mean output level and their average yield is 1067.91kgs per hectare. Production of cotton takes place on small land measuring from 0.5 hectares to about 6.5 hectares. These small pieces of land provide farmers with the opportunity to optimise input use intensive production.

Table 3.4: Descriptive Statistics

Variable	Obs	Mean	Sdt. Dev.	Min	Max
sc_output~kg	202	3212.25	1447.07	400.00	6300.00
seed~kg	202	26.17	9.34	10.00	45.00
farm_size~ha	202	2.52	1.23	0.50	6.50
fertiliser~kg	202	214.11	115.84	50.00	600.00
carbaryl~kg	202	3.72	1.26	1.04	9.36
acetamark~lt	202	0.13	0.01	0.08	1.02
fenkill~lt	202	3.85	1.49	1.04	9.36
chemical~lt	202	7.57	2.28	2.08	17.17
Cultivators	202	1.20	0.71	0.00	3.00
Ploughs	202	1.43	0.68	0.00	3.00
Hoes	202	5.67	3.49	2.00	20.00
Cattle	202	9.37	6.90	0.00	37.00
Sprays	202	1.38	0.74	0.00	4.00
Equipment	202	9.67	4.59	2.00	27.00
Familylabour	202	1314.98	939.84	88.00	3852.00
Hiredlabour	202	38.04	92.52	0.00	680.00
offfarm_y	202	100.26	417.97	0.00	3500.00
Age	202	50.68	15.99	16.00	88.00
extenstion_visits	202	1.54	1.76	0.00	10.00
distance of_farm	202	3.68	2.39	0.02	9.00
household_size	202	5.93	3.04	2.00	27.00

Small holder farmers are constrained in application of fertilizers. A minimum of 50 kgs of fertilizer are used on a minimum farm size of 0.5hectares. Based on the average fertilizer use of 214.11 kgs and average farm size of 2.52hectares, farmers are using 84.96kgs of fertilizer per hectare which is far from the expected 250kgs per hectare. Chemical application for the control of pests is intensive as indicated by the mean of 7.57 litres of carbaryl, fenkill and acetamark being used. The wide and extensive use of chemicals to control pests is important to avert crop damage; it signifies the importance of availability and timeous supply of these inputs to farmers.

The descriptive statistics point that farmers are in a state of overdependence on cotton. Their average income from other sources is US$100.26 despite an average family size of 6 members as shown in Table 3.4 above. Table 3.5 below shows that 44.1 % of the surveyed farmers have access to alternative sources of income in the form of remittances and off-farm businesses. This is supported by the statistic that 71.8 % of the farmers cite cotton as their most preferred crop and source of income. Over reliance of farmers on a the cotton crop for their livelihoods as in this case has been cited in the literature as the potential source of

farmer exploitation by their contractors in the contract farming arrangements. In addition, it is shown that the average age of the farmers is 50.68 years indicating that the sector is dominated by farmers of the old age. Possibly this is explained by the crisis in the sector hence the shift by the younger and more flexible farmers into other ventures.

Table 3.5: Respondents' Sources of Income

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Business enterprise	21	10.4	10.4	10.4
	None	113	55.9	55.9	66.3
	Remittances	34	16.8	16.8	83.2
	Off-farm jobs	34	16.8	16.8	100.0
	Total	202	100.0	100.0	

Farmers are quite endowed with farm equipments. The least equipped farmer has only two hoes while the most endowed farmer has 20 hoes, three cultivators and three ploughs. Some of the farmers do not own cattle which are an important source of animal power in the production of cotton; however, 95 percent have a herd of at-least 3 cattle. Farmers with a herd of at-most 2 cattle were found to have an average output of 597.5kgs which is far below the average mean output for the sampled group as reported above.

Chapter Four: Presentation and Analysis of Results

4.0: Introduction

In this chapter we focused on computing the CR4 ratio for the years between 2010 and 2014 which is used as a proxy of the Lerner measure of market power. We correlated each contractor's market share for the cotton purchased during the 2012/13 and 2013/14 marketing season with price charged. We further estimated the cotton production frontier using the stochastic approach. Inefficiency hypothesis was tested and variants of inefficiency amongst farmers were estimated using the OLS approach.

4.1: Market Power Exploitation

The computed CR4 ratio shows that more than 50 percent of cotton is bought by four seed cotton buyers in each marketing season. The lowest CR4 ratio of 56.06 was recorded in the 2012/13 marketing season signalling significant market power in the cotton industry. Murphy (2006) noted that a CR4 ratio above 40 % is an indicator of significant market power while that above 80 % indicates monopsonistic behaviour. The cotton sector is therefore highly concentrated with a handful of the contractors controlling cotton buying and production. The results presented in the Table 4.1 below shows that Cottco consistently leads cotton buying while Cargill and Olam dominates the second and third positions. The fourth position was dominated by firms that include China Africa, Grafax, Romsdal and Alliance.

Table 4.1:CR4 and HHI Concentration Ratios

Seed Cotton Buyer	% Market Share of Seed Cotton Intake			
	2010/11	**2011/12**	**2012/13**	**2013/14**
Cottco	41.3	43.09	23.93	31.36
Cargill	17.9	14.55		15.91
Olam	10.5	10.89	11.89	
China Africa				13.22
Grafax			11.07	8.47
Romsdal	7.1			
Alliance		8.24	9.17	
CR4	**76.8**	**76.77**	**56.06**	**68.96**
HHI	**2291.56**	**2344.77**	**1263.51**	**1650.1**

The HHI also points to the existence of market power among cotton buyers. Computed HHI for years between 2010 and 2014 are moderate, falling between 1263.51 and 2344.77. Between 2010 and 2012, the HHI was above 1800 indicating highly concentrated sector where market power is high while between 2012/13 and 2013/14 production seasons the index declined to levels below 1800 but above 1000 which indicates moderate market power in the sector.

Correlating the market share (annual seed cotton production intake) of each company to the price offered for seed cotton in the 2013 and 2014 marketing seasons, we found a weak Pearson's correlation coefficient below 0.35 (see Table 4.2 below). This means there is weak association between price offered for seed cotton and the resultant seed cotton bought by a firm. So, how is cotton bought? As farmers have pointed out, cotton is bought in the contract (by the supply of inputs) which is open to prices. The contracts specify that farmers are supposed to supply all their produce at an average yield of 1200kg per hectare of supplied inputs while there is no price attached to this supply. That is, once a farmer is contracted and supplied with inputs, the quantity of seed cotton to be supplied is not responsive to price but at any price offered by the contractor, the farmer has to supply all the quantity produced. This means that, through seed cotton contracting, farmers face a highly inelastic supply of seed cotton. Contractors' market power in the production and marketing of seed cotton is therefore vested in the contract. They are able to secure favourable terms at the expense of farmers. Thus all contractors despite their market share can buy seed cotton at any price but their constraint is the ability to meet the costs of supplying inputs. In this concentrated market structure price competition is distorted by contracting.

Table 4.2: Correlation Coefficients for Market Share and Cotton Prices

	market~share	average price
market~share	1.00	
average price	0.26	1.00

Data Source: AMA, 2014

4.2 Cotton Pricing

Contractors determine the cotton price each season based on the cotton lint price (P_{dt}) on the international market. The contractors deduct the total costs of financing cotton production (PFC), ginning of seed cotton (GC) and marketing-distribution costs (M&DC) from the lint price and equally share the excess with the farmers. Cotton production financing costs include inputs costs, transportation of inputs, labour costs, managerial and sundry costs incurred in the process of acquisition of inputs and distributing them to farmer access points. Ginning costs are costs incurred in the ginning of a tonne of seed cotton which includes costs of transporting cotton from the buying point to the ginnery, the costs of ginning the cotton, labour and machinery maintenance. Marketing and distribution costs are also factored in the calculations where the costs of exporting the lint or transportation to domestic markets are added to other costs to arrive at the total costs (TC) of producing, ginning and marketing of cotton.

Based on the description above; the total costs of cotton can be expressed as:

$$TC = PFC + GC + M \& DC$$

Once these costs are determined, the excess lint revenue (P_{dt}) can be formulated as below and this represents the shadow price of cotton.

$$P_{dt} = P_{it} - TC_{dt}$$

P_{dt} is the revenue to be shared equally between the contractors and the farmers. Farmers' share will then be passed in the form of the market price of seed cotton by proportionately weighing down from lint price to its equivalence un-ginned seed cotton. The formula was found to be silent on the amount of risk factored in the calculations as contractors incur risk in the financing and marketing processes. Additionally, the formula deduces a price of seed cotton based on the international ling price despite that the by-products of cotton; thus seeds can be processed into oil and stock feeds earning contractors additional income. There is no information pertaining to the extent to which this additional revenue is shared.

Five contractors out of a total eleven were interviewed and their arguments were similar. Those interviewed are Olam, Grafax, Parrogate, Cottco and Cargill. Contractors interviewed argued that seed cotton prices are highly transparent as domestic prices are linked to the international price during the marketing season. They were however restrictive in clarification of the pricing formula citing competition concerns. Differences in the prices

offered for domestic cotton prices were mainly linked to differences in overhead costs. The price of seed cotton is also not specified in the contract because contractors are not in any futures contracts with international buyers. Additionally, it was responded as impossible to share the risks incurred by farmers due to drought and dry spells as the contractors argue that they take the greatest risk of default by farmers and since 2010, the default rate has grown to above 60 percent.

Contractors had different views on whether cotton contracting should be mandatory as stipulated in the current regulations or not. On one side there is a feeling that free cotton, that is non-contracted or excess of contracted cotton should be auctioned. This view stems from the fact that contracting is only there to ensure that cotton will be available on the market. However, if farmers are able to finance themselves, they will produce cotton and sale it through auction. On the other hand, some contractors feel that all cotton buyers should be forced to contract to ensure smooth provision of the crop. Strict regulation should ensure every one contracts and that farmers honour contracts at law. However, it can be noted that a mix of the two is quite preferable as it combines the attributes of the other two options in strengthening itself as a viable option.

An analysis and evaluation of the above pricing model unequivocally points to the existence of market power in cotton pricing. The pricing structure is restrictive, it only consider lint price of cotton excluding the price of seed which can be turned into important by products; stock feeds and oil. Additionally, contractors are able to pass inefficiencies in ginning and production financing to farmers while farmer risks in the form of poor rains and drought are not considered. Contractors' strong preference for contract financing model killing the spot/free cotton market indicates the preference of non-competitive pricing of cotton. Given the reasoning above, the study concludes that contractors exercise market power in the pricing of cotton hence the existing disputes in the marketing and pricing of cotton.

4.3 Technical Inefficiency analysis

4.3.1 Stochastic Frontier model

The Pearson's correlation coefficients for the independent variables reported in Table 4.3 are below 0.8. The study therefore rules out the possibility of collinearity among the variables included in the production function. The correlation coefficients show strong positive relationships between the amount of seeds, fertilizer, chemicals, and farm size used and seed cotton output produced. The relationship between equipment and seed output produced is generally weak but positive while that corresponding to family labour is weak and negative. The production frontier model is therefore estimated under the absence of multicolllinearity.

Table 4.3: Pearson's Correlation Coefficients

	sc_output	seedkg	farm_size	fertilizerkg	chemical	Equipment	family_labour
sc_output	1.00						
Seedkg	0.76	1.00					
farm_sizeha	0.68	0.55	1.00				
Fertiliserkg	0.79	0.60	0.56	1.00			
Chemical	0.79	0.55	0.62	0.73	1.00		
Equipment	0.43	0.42	0.39	0.34	0.35	1.00	
Familylabour	-0.20	-0.14	-0.08	-0.23	-0.18	-0.03	1.00

This study failed to reject the hypothesis that cotton farmers in Zimbabwe are technically inefficient. Table 4.4 presented the results of the study. The least farmers are found to be 98 percent technically inefficient while the best farmers were operating close to the frontier with about 6.7 percent level of inefficiency. On average farmers included in the study were found to exhibit about 30.09 percent technical inefficiency.

Variability in cotton output across farmers is largely explained by technical inefficiency than randomness. The relative variance of the two sources of variation (lamda) of 6.97 implies that 98% $[6.97/(1+6.97^2)]$ of variation in cotton output is due to inefficiency. The Log Likelihood ratio test reported a critical value of 26.75 and a p-value of 0.0000 implying that the null hypothesis of an inefficiency variance term indifferent from zero cannot be accepted at the 1 percent level of statistical significance. In addition, the model used for the study was correctly specified. Using the Linktest, the study failed to accept the hypothesis that the prediction squared has some explanatory power at 5 percent level of significance. Thus, the specification of the model was satisfactory.

Table 4.4: The Stochastic Frontier Model

Variable	Coefficient
lseedkg	0.2932***
	(0.0444)
lfarmsize	0.092**
	(0.0388)
lfertilizers	0.1625***
	(0.0304)
lchemicals	0.4822***
	(0.0664)
lequipment	0.0099**
	(0.026)
lcattle	0.0037*
	(0.002)
lfamilylabour	-0.003**
	(0.0014)
Constant	5.4293***
	(0.1702)

Note   : ***, ** and * imply significance at 1%, 5% and 10 % respectively.
         : ( ) are standard errors

Basing on the results above, the production frontier for cotton production can be specified as:

$$lsc\_output = 0.29lseedkg + 0.09lfarm\_sizeha + 0.16lfertilizer + 0.48lchemical + 0.0099lequipment$$
$$+ 0.0037lanimal\_power - 0.003lfamily\_labour + 5.4293$$

The seed cotton production frontier is defined by the amount of seeds, fertilizer, chemicals, family labour and animal power used on a given farm size. Seeds, fertilizers and chemicals were statistically significant at the 1 percent level while farm size, equipment, family labour and animal power were found to be statistically significant at the 5 percent level of statistical significance. The study presents coefficients before and after correcting for heteroskedasticity in the inefficiency term emanating from differences in farm size. Most of the coefficients presented in Table 4.4 above are positive as expected with the exception of family labour which is negative. Each variable is discussed below.

Farmer's cotton output is largely influenced by the amount of chemicals used. The responsiveness of seed cotton output to a percentage increase in chemicals used was found to be 0.48. This reaffirms the importance of pests control chemicals in the production of cotton. Damage that stems from failure to access and appropriately apply chemicals in the production of cotton will be substantial.

Fertilizers and seeds were also found to positively influence farmer production frontier. Their respective coefficients of 0.16 and 0.29 shows that farmers' output vary with the amounts of

seeds applied while addition of fertilizer to the crop help to improve the productiveness of the other factors of production, hence output.

Farm size was found to have a positive impact on production frontier. Farmers with large farm sizes were found to have more output. However the coefficient of 0.09 shows weak responsiveness of output to growth in farm size. The study therefore found that farmers cannot gain much output from increasing the land size, thus it may be better to intensify production.

Seed cotton output negatively responds to additional labour hours devoted to the production of the crop. Results report a negative coefficient of 0.003 for family labour. It means that an additional percentage point for family labour hours will reduce seed cotton output by 0.003 percent. While the responsiveness is weak it points towards the fact that family labour has been used beyond its optimal level in the production of cotton. Stevens and Jabara (1988) have noted that there are situations where negative marginal returns and hence decreasing average product of labour exist in peasant agriculture. This result supports the notion by Porter and Phillips-Howard (1997) that farmers producing on contract turn to self exploitation through extended working hours and child labour due to due to asymmetries of power and contracts manipulation in contract farming.

4.3.2 Inefficiency Model
The second model was estimated where inefficiency was regressed with farm size, education levels, farm training, farming experience, extension visits, and distance to farms, sex, marital status and household size as the variants of inefficiency. Among these, farm size, education level and farm training are significant at 1 percent level of statistical significance while farming experience, household head age and distance to the farm at 5 percent. Extension visits were significant at the 10 percent level. The model was estimated using the OLS technique. As reported in Table 4.5, the model was statistically significant at 1 percent level with an F-statistic of 22.80. The adjusted R-squared of 0.5912 was reasonably high and t-ratios are fairly high. The specification of the model was however satisfactory and results presented are interpreted below.

Table 4.5: OLS Results for the Inefficiency Model

Variable	Coeficient
farm_sizeha	-0.0260 **
	(0.0186)
age	-0.005***
	(0.0016)
Iedu_level_0	0.0957**
	(0.040)
Ifarm_ed_0	0.1037***
	(0.0378)
farm_exp	-0.0049**
	(0.0022
ext_visits	0.0181*
	(0.0109)
d_farm	0.0262***
	(0.0079)
cons	0.5053***
	(0.0758)
F (7, 194)	22.80***
R-squared	0.6159
Adj R-squared	0.592

Note: ***, ** and * imply significance at 1%, 5% and 10 % respectively.

  : ( ) are standard errors

The inefficiency model based on the above results can be explicitly stated as:

$$Inefficiency = 0.51 - 0.03\,farm\_size + 0.01\,age + 0.1\,Education\_Level + 0.104\,farm\_education - 0.005\,farm\_\exp + ext\_visits + 0.03\,d\_farm$$

Age and farming experience have negative coefficients of 0.026 and 0.005, respectively. This means that a point increase in age and farmers' years of experience in cotton production is likely to reduce technical inefficiency by 0.026 and 0.005 units. The results imply that, better knowledge, skills and production techniques are enhanced through age and have a positive contribution to farmers' level of output. As farmers increase their years in production of the same crop, they got to have better knowledge on the mix of their inputs, hence better management practices, improved production techniques, will and effort, and reduced production damages.

This study found a negative relationship between inefficiency and both the household head's level of education and farm specific training. The coefficient for household head's education was 0.0957 and for farm training was 0.1037. This means a household with secondary education was more efficient than a household with primary education by about 9.57 percent. Similarly, households with specific training on cotton production are more efficient than

those without by 10.4 percent. Education is an important variable that can help farmers' capabilities to adjust towards efficient use of resources as they are relatively inefficient.

Farm size was found to be negatively related to farm inefficiencies. A percentage increase in farm size is found to improve farm efficiency by 0.03 percent. On large pieces of land farmers can better utilize their abundant labour units and hours compared to small pieces of land.

The study also found distance from the market to the farm (proxy of infrastructure) to have a positive impact on technical inefficiency. As the distance to the farm from the market place increases, farmers tend to be less efficient. Farms close to markets have better access to inputs while those far away are deprived of timely access of inputs. The importance of roads and communication networks has been mentioned by Norton et al. (2010) who argued that improved roads and other means of communication can help reduce transactions costs of financing and providing inputs.

4.4 Assessment of Results

Results of the study as presented above validate both the contentions that farmers are technically inefficient and contractors wield market power in the determination of cotton pricing. Similar to any form of production, technical inefficiency by farmers is thereby translated and reflected in their demand for higher prices as they seek to improve their revenues depressed by subdued output. Contractors are able to simply buy cotton through input supply and offer low prices as price competition is minimal and highly insignificant to consider in determining the amount of seed cotton to be bought by each contractor. In addition, as 89.7 percent of farmers are not registered with farmer associations and 93.1 percent are ignorant of the terms of contracts they enter into with contractors, contractors are able to manipulate and set contracts in their favour. Contractors are thereby setting prices lower than competitive markets. The gap between prices offered by contractors and those demanded by inefficient farmers widens, hence pricing disputes in the production and marketing of the cotton under contract farming.

The importance of farm size, education, farmer training, experience and age of the farmer, and distance to markets imply that it would be incorrect to simply argue that there exists moral hazard problem on the part of the farmer. We reason that the established variants of inefficiency are important in explaining variation of output between farmers compared to random issues of opportunistic behaviour, input diversion and intentional production of poor quality crops. Contractors however, are in the position and have the power to violate contract

agreements through late and inadequate supply of inputs factors that are not weighted for in the pricing of the final product. This is exacerbated by farmers' lack of information, power and knowledge to negotiate contracts and education for them to be informed and articulate the terms and specifications of contracts. Agricultural policy should therefore be tailored towards improving the technical, economic and production knowhow of smallholder farmers and specific address of contract farming education. Improving competition among seed cotton contractors, especially the abandonment of cotton buying and supply of inputs under the CGA will ensure that farmers receive a better price.

Chapter Five: Conclusions and Policy Recommendations

5.0 Introduction

This Chapter summarised the study by giving the overall purpose of the study, research findings and policy recommendations. The Chapter further provides with limitations of the study and suggests future areas research.

5.1 Conclusion of the Study

The study was premised on the need to establish the underlying causes of pricing disputes in the cotton sector of Zimbabwe. It was an attempt towards validation of the contentions that either farmers are technically inefficient or contractors wield market power in the pricing of cotton or both. The study concludes that both technical inefficiencies and market power exploitation in contract farming contributes to the current pricing disputes in the marketing of the crop. The study concluded that more than 90 percent of variations in cotton output across farmers are due to technical inefficiency. It was found that frontier output of cotton is determined by seeds, fertilizers, chemicals, animal power and labour. The study also found that labour is being fully utilised in the production of cotton as the additional hours are likely to yield negative returns. Farmers are found to be inefficient at the 1 percent level of hypothesis testing. Variations in efficiency are accounted for by farm size, differences in education, farmer training, farmer experience, age of the farmer and distance to the market. Addressing these factors through policy is therefore likely to positively contribute towards resolving disputes in the marketing and pricing of seed cotton, and its negative effects of impoverishing farmers and lame of forward and backward linkages with the manufacturing sector.

The computed CR4 index and the HHI indicate that contractors hold moderate market power in the production and marketing of cotton. This culminates to reduced cotton prices than the likely competitive prices. To indicate the effect of market power on prices it was found that, cotton prices charged by each firm are not correlated with the share of seed cotton purchased by each contractor. One aspect that explains this is the fact that cotton is bought in the contract agreement which is open to prices. Once a farmer is supplied with inputs, the farmer is contractually bound to supply the cotton produce at any price during the marketing season. Thus, the contract farming arrangement is a force through which market power is exercised as farmers face a perfectly inelastic demand curve for their product.

The contractor is able to charge a price which transfers inefficiencies on their part to the farmer. That is, inefficiencies in ginning, marketing and distribution are transferred to the

farmer through the backward cotton pricing model. This is because (1) the farmer signs an open contract that does not guarantee price, and (2) the contractors face little competition once they comply with contracting. Differences in prices thereby reflect differing overhead costs and barriers to entry into the sector are mainly the contracting costs. The study therefore concludes that there is market power exploitation by seed cotton contractors.

5.2 Policy Implications and Recommendations

As modelled in the study, frontier and efficiency production can be induced by availability of seed cotton inputs, farmer education and improved rural infrastructure. Policy should address availability of inputs in the form of seeds, chemicals and fertilizers as these are primarily important in influencing cotton output growth possibly providing a solution to the challenges in the cotton sector.

The education policy should integrate agricultural education to strengthen the role that education plays in promoting cotton production. More importantly, government has to pursue policy that will reduce the high rates of rural drop outs from formal education. Farmer training through specific agricultural training for cotton farming is important. An efficient education system will promote the flow of knowledge and skills and provide technical knowhow thereby ensuring farmer efficiency, hence improved output and likely fewer disputes in marketing and pricing of seed cotton. Thus, the education system should be strengthened to help farmers in adjusting their resources as they are relatively inefficient and improve productivity through quality management.

More importantly, extension provision needs to be restructured and remodelled for it to be able to ensure technical efficiency of farmers. The non significance of the variable in promoting efficiency signal the inadequacy of the extension programmes to motivate farmers, improve decision making, and provide farmers with the requisite technical and practical information on cotton and contract farming. The programmes implemented have failed to play the complementarily role in speeding up knowledge transfer and improve farmer efficiency. There is also need to consider the technical, economic and farming competences and communication skills of the extension officers. Thus extension workers need training and retraining.

Government should step up efforts towards the provision of adequate infrastructure in the rural economy. Policy should promote the establishment of roads and communication networks to improve the crucial well functioning of the agricultural system which will mean that transaction costs are reduced. The availability and quality of rural infrastructure impact

on transportation, marketing and distribution costs and improve access to information thereby improving farmer efficiency. In general, improved infrastructure that will reduce transportation costs as they bring farmers closer to the markets are likely to improve farm planning, decisions making, reduced production wastage and improved farmer efficiency.

There is need to ensure competition in the marketing of cotton, and policy should be directed at curbing the non-competitive behaviour in the sector. Agricultural policy should be tailored towards preventing the collusive behaviour of contractors through the Cotton Ginners Association and ensure that contractors compete in their cotton prices. Interviewed contractors indicated that in the 2013/14 marketing season, cotton prices were highly competitive following the court ruling that restricted common buying by contractors. In addition, price competition is likely to ensure that contractors with inefficiencies in their ginning, production and financing of cotton will have to improve or they will be forced out of the industry. While they are fears that this might negatively impact on the future production of the sector, the current status is already unsustainable and there is no justification to continue the system.

5.3 Limitations of the Research

This study was a novel contribution to the analysis of cotton disputes in Zimbabwe; however there are some significant challenges mainly in data collection and measurement of the labour variable. Cotton farmers were highly responsive during the interviews with their responses motivated by their desire to have the current pricing disputes in the cotton sector resolved, contrary; contractors were less willing to engage the researchers with some contractors such as Sino Zimbabwe Cotton completely refusing to shade any light towards the study. As a result, only five contractors were interviewed out of the intended eleven contractors thereby restricting the amount of information fed into the research. Contractors were also reluctant to shed light on and discuss the seed cotton pricing structure. The labour variable was difficult to measure in the sense that the process of cotton farming extensively uses labour in the various processes which are land preparation, planting, weeding and cultivation, and harvesting time. It was complex to precisely measure the amount of labour hours spent in these activities, thus results are subject to labour hour measurement error. The study also failed to secure data that permits the measurement of market power using the Lerner index and also to compute CR4 ratios for longer period of time as well as cotton prices of all the contractors over loner time period. That is the current study was somewhat handicapped.

5.4 Areas of Further Research

In light of the above study limitations, future studies may be carried out on the same area with improved and more comprehensive data set. Various studies may attempt to innovate and navigate away from the current problems of data measurement. In addition, studies can be undertaken in different study (sample) areas; that is other districts and provinces which produce cotton. There need for more research in this area of contract farming including its impact on farmer incomes as contract farming has become a common model of agricultural financing widely supported by governments in developing countries.

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