ESSAYS ON THE EU TRADE POLICY REFORMS AND THE NAMIBIAN BEEF SECTOR

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ABSTRACT

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Linking farmers to dynamic high value agricultural commodity markets is viewed as important for economic growth and poverty reduction in a global economy. Yet, many factors on the supply side and demand side combined with protective trade policies hinder broad-based participation of many smallholder farmers in developing nations. Namibia's beef exports to the European Union (EU) market presents an interesting case of a mixed success story whereby a small country consistently meets high EU market requirements, yet supply constraints combined with uncertainties related to EU trade policy reforms undermine participation of cattle farmers.

In the first essay, utilizing primary data, a double hurdle model is used to estimate the participation of cattle farmers in the beef export channel. In the first stage a probit model is used to measure the impact of transaction cost related variables and socio-economic variables on participation. In the second stage a factional logit model is applied to measure the intensity of participation. Grade uncertainty, being a male-headed household, having a land title, ownership of a transport equipment and membership in a farmer's association were found to significantly influence the participation of farmers in the international beef export channel. Payment delay, grade uncertainty, and distance to the market, premiums, part-time farming and cost per head of cattle significantly influenced the intensity of a cattle farmer's participation. Having indirect contracts with the export abattoirs and herd size are particularly important to communal farmers' supply decisions.

The second essay estimates EU import demand of beef from Namibia in response to five trade policies scenarios. Beef is treated as a differentiated product composed of both high and low quality beef varieties in all five scenarios: (1) Preferential Market Access, (2) the Economic Partnership Agreement (EPA) and its alternatives, (3) the standard generalized system of preferences (GSP), and two enhanced GSP options (4) GSP^{+} and (5) GSP^{++}. Results show that the trade alternatives have different effects on the composition of beef imports. The results are consistent with the Alchian-Allen conjecture that demonstrate how per unit transaction cost lowers the relative price and increases the demand for high quality goods, resulting in exporting high quality goods, and selling lower quality goods domestically. Overall, the results show that the EPA trade policy is the optimal option for the EU and Namibia.

In memory of my Beloved Kaomoo, Gottlieb Pule Uatanaua Katjiuongua
Thank you for your pure and endless love.
I miss you!

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LIST OF ABBREVIATIONS

ACP	African Caribbean Pacific
AFDB	African Development Bank
AGOA	Africa Growth and Opportunity Act
EBA	Everything But Arms
EC	European Commission
ECOWAS	Economic Community of West Africa States
EPA	Economic Partnership Agreement
ESA	Eastern and Southern Africa
EU	European Union
FANMEAT	Farm Assured Namibian Meat
GATT	General Agreement on Tariffs and Trade
GSP	Generalized System of Preferences
LDC	Least Developed Countries
MFN	Most Favored Nations
NCA	Northern Communal Area
PMA	Preferential Market Access
S&D	Special and Differential Treatment
TRQ	Tariff Rate Quota
SACU	Southern African Custom Union
SADC	Southern African Development Community
USAID	United States Agency of International Development
WTO	World Trade Organization

CHAPTER 1: ESSAYS ON THE EU TRADE POLICY REFORMS AND THE NAMIBIAN BEEF SECTOR

Increasing developing countries' participation in the global trading system is considered by many development organizations (including the World Bank and WTO) to be an important element for economic development and poverty alleviation. According the WTO (2010), developing countries that trade successfully tend to be those that have made the most progress in alleviating poverty and raising living standards. While there is debate about the extent and the pathways through which trade and trade liberalization alleviates poverty, the broad empirical evidence supports the presumption that trade is poverty alleviating (Hertel, 2004). There is general agreement that trade is better than autarky in enhancing incomes and economic development. As a result, linking the poor to more dynamic higher value markets and trading activities in the international markets and regional markets has become an important aspect of economic development. Many developing countries accessed international markets through preferential market access (PMA) trading arrangements. The most notable example of PMA agreements includes the European Union (EU) and many of its former colonies in various African Caribbean Pacific (ACP) countries.

The EU has had a special trading relationship with ACP countries since 1975 under the Lome convention. This trading arrangement allowed ACP countries to export various commodities including agricultural commodities to the EU market on a duty-free basis. The EU preferential trading agreements in addition to its beef protocol, guaranteed Namibia market access at guaranteed internal prices that were set artificially high to protect EU producers. This

benefited Namibia enormously because the beef sector is a key sector in the Namibian economy. More than 60% of the population depends directly or indirectly on income generated from the beef sector and it accounts for 25% of Namibia's foreign exchange earnings.

Due to increased global competition, the preferential trade arrangements between the EU and ACP countries were challenged under the WTO rules of non-discriminatory trade provisions. The driving force behind this idea is to enforce compliance to the WTO rules of non-discriminatory trading arrangements (i.e. all developing countries at the same level of development benefit from the same trade preferences). Consequently, the Lomè Convention was replaced with the Cotonou Agreement (2000) that aims to establish a new trading relationship between the EU and the ACP group through its proposed Economic Partnership Agreements (EPAs). The EPAs are free trade agreements with the salient feature of reciprocity in contrast to the Lomè Agreement that was non-reciprocal (Steven, 2004). Reciprocity entails that trade preferences extended by one country or a group of countries (e.g. EU) to another country or group of countries be designed with an obligation being placed on the second group of countries to grant trade preferences to the first group of countries. Under the non-reciprocal trade preferences of the Lomè Convention, the preferences were granted on a one-way basis. In other words, in return to favorable access to the EU market, the ACP countries were not obligated to treat imports from the EU more favorably than imports from other extra-regional suppliers (ODI, 2006).

After almost three decades of preferential market access to the EU market, there is great concern about the potential effects of the trade policy reforms on sensitive agricultural sectors of

ACP countries that have historically enjoyed preferences. With the end of preferential trade there is uncertainty regarding the potential economic effects of the new proposed agreement on the Namibian beef sector. In light of the sensitive role the beef sector plays in the Namibian economy and its food security, any new trading arrangements that will arise deserve close analysis and empirical estimation.

There are no empirical studies on the potential economic effects of the proposed trade policy reforms on the Namibian beef sector. In general, there are few studies on the potential impact of the EU-ACP trade reforms on specific agricultural sectors. The empirical evidence that does exist utilizes partial equilibrium and computational general equilibrium (CGE) approaches. While CGE models provide important welfare results on the impact of the trade policy reforms on the larger economy and related sectors, they typically do so by a great deal of data aggregation. Thus, detailed information is lost due to large commodities aggregation. Also, most of the existing studies do not take product quality into account, yet quality is an important element in terms of the value of trade and the broader implications of participants in the beef supply chain.

This dissertation is unique in three ways: 1) it is the first to empirically examine the potential economic impact of the proposed EPA and its alternatives on the Namibian beef sector; 2) it treats beef as a differentiated product, and 3) it looks at both the demand side and supply side of beef trade between the EU and Namibia.

It consists of two essays. The first essay (chapter 2) focuses on cattle farmers' participation in the international beef export market. It empirically tests how transaction costs and other socio-economic variables determine a cattle farmer's choice to participate, and their intensity of participation in the beef export channel. Analyzing primary data from a producer survey, a double hurdle model using a probit model was applied to estimate the farmers' participation in the beef export channel, and then a fractional logit model was applied to measure their intensity of participation. The results show that transaction costs and farmers' productive assets (notably land) matter significantly. The findings suggest that cooperative support for farmers' associations by various stakeholders in the beef industry is critical to addressing the barriers that hinder smallholder farmers' participation in the international beef export market.

In the second essay (chapter 3), the study estimates EU import demand for Namibian beef in response to the (EPA) agreement and its alternatives, the standard generalized system of preferences (GSP) and two enhanced GSP options. Specifically, it measures the impact of the trade agreements on the quantity and import composition of beef imports from Namibia to the EU market. Results show that the proposed trade alternatives affect import demand for high and low quality beef differently. Overall, results show the EPA trade policy option to be the most optimal trade alternative for both the EU and Namibia.

CHAPTER 2: FARMERS' PARTICIPATION IN THE INTERNATIONAL BEEF EXPORT MARKET: THE CASE OF CATTLE FARMERS IN NAMIBIA

2.1 Introduction

In today's global economy, the European Union (EU) consumer can purchase a high quality lean, hormone-free, free-range and grass-fed steak at a supermarket to prepare at home or they can consume it away from home at a pub or restaurant. This steak could be traced back to a private farm or communal reservation in a small developing country in Southern Africa, Namibia. Linking farmers, especially smallholder farmers, in agricultural based developing countries to high value international export markets has been argued to be important in promoting higher incomes (World Bank Report, 2008).

Even through beef exports from Namibia constitute only 2.9% market share of EU total beef imports, the beef sector is a key sector in the Namibian economy. The agricultural sector contributes approximately 11% to GDP in Namibia, but more than 60% of the population depends directly and indirectly on income generated from the beef sector (AfDB 2002). Further, the beef sector accounts for 25% of Namibia's foreign exchange earnings (Bank of Namibia, 2005). Over the last ten years, Namibia exported approximately 98,963 tons worth $532 million (USD) of beef to the EU market with a majority destined for the UK market. To export to the EU, Namibia must meet stringent EU requirements including food safety standards, traceability regulations, product certifications and animal welfare regulations. Namibia's quality assurance program, Farm Assured Namibian Meat Scheme (FANMEAT) was initiated in 1999 to meet EU requirements and only FANMEAT certified meat is sold to the EU. Much of the Namibia's

success in penetrating the EU market is attributed to this program as it signals hormone free, hygienic meat and good practices of welfare standards. In addition, Namibia gained access to the EU beef market under Beef/Veal Protocol of the former Lome preferential market regime.

Beef destined for the EU market is exclusively sold to export abattoirs that are HACCP and ISO9002 certified. This supply chain has high food safety requirements, hence, it is not clear which types of farmers can participate in the beef export channel and to what degree farmers participate. One would expect the answer to be largely commercial cattle farmers, since they make up 90% of export abattoir's forward contracts. But small communal farmers also sell their cattle to export abattoirs directly through contracts and indirectly through other commercial farmers, albeit at a relatively smaller scale. Understanding barriers that undermine small farmers' participation and their intensity of participation in the international beef export market is an important policy issue for the government since small farmers make up the majority of farmers in Namibia (over 70 %). If participation in the international beef market is to help raise incomes, increasing small communal farmers' participation is paramount.

Among other barriers, transaction costs are argued to be the most significant barriers that make it difficult for smallholder farmers, especially in Sub-Saharan Africa, to gain access to certain marketing outlets (Marlene, 2007). Transaction costs are costs that arise when individuals exchange ownership rights for economic assets (Eggertson, 1999). Transaction costs in markets can negatively affect the efficiency of exchange and reduce incentive to participate in certain market outlets (Williamson, 1986). Transaction costs theory categorizes the causes of transaction costs as information, negotiating and bargaining, and monitoring and enforcement costs (Coase,

1937; Williamson; 1975, 1985). There is a rich body of literature on the effects of transaction costs on marketing agricultural products (de Janvry et al, 1991; Sadoulet & de Janvry, 1995; Jaffee *et al*, 1995; Makhura, 2001 & Alene *et al*, 2008) and market channel choice (Goetz, 1992; Key *et al*, 2000 & Makhura *et al*, 2001). Several of these studies show that high transaction costs have significant negative effects on market entry for smallholder farmers, and that screening and transfer related costs significantly increase the cost of marketing agricultural products.

Several researchers (including Hobbs, 1997; Bailey and Hunnicutt, 2002; Ferto and Szabo, 2002; and MacInnis, 2003) analyzed the factors that influence agricultural marketing channel selection in transition and developed economies: Hobbs (1997) focuses on the factors that influence the choice of marketing cattle between live-ring auctions (live weight) and direct selling of cattle to packers (deadweight) in the United Kingdom. He finds that TC related costs influence marketing choice of sellers: for example, grade uncertainty and non-sale risk decrease the proportion of cattle sold at packers. Bailey et al (2002) investigated the role of transaction costs in the market selection of commercial cattle feeder operations in Utah. Their findings showed that relationships, ensuring that payment is made quickly and the level of trust with the seller plays a critical role in market selection. Ferto and Szabo (2002) studied the choice of marketing channels among fruit and vegetable producers in Hungary. Although their findings are mixed, their results show that sellers who sell to the wholesale markets are strongly and negatively affected by information costs, bargaining and monitoring costs. McInnis (2003) investigated the role of transaction costs in marketing of organic produce in the US. He finds that distance from farm gate to market to be significant barrier to entry.

Others (Reardon et al, 2008; Hernandez, 2009 & Reardon 2006, Weatherspoon & Reardon, 2003; Reardon et al, 2003; Kirsten et al, 2002; and Reardon & Barrett, 2000) analyzed market participation and channel choice in agricultural marketing using value chain analysis, supply chain cost analysis and various econometric methods. This emerging literature focuses on market participation in modern marketing channels such as supermarkets and large-scale distributors of high value agricultural commodities. Their analyses shed light on the procurement approaches and requirements of these marketing channels and their implications for smallholder participation. Even in these studies, transaction costs related factors such as grade uncertainty and contracts play an important role participation of producers

There is a dearth of quantitative empirical research on cattle marketing in Namibia. Kakujaha-Matundu (2002) provides a detailed analysis and discussion on common pool resource management among livestock pastoralist in Eastern Namibia, but no empirical results on the factors that influence Namibian farmers marketing decisions. Given the importance of the beef sector on rural household income and subsistence, urban employment from the beef processing industry, and on foreign exchange and revenue earnings, this study will help policy makers to better understand the bottlenecks in cattle marketing, and to better target resources to assist communal cattle farmers' participation in the international beef export market.

This paper assesses the effects of transaction costs and other socio-economic factors on not only participation, but also the degree of Namibia cattle farmers' participation in the international beef export market. To assess these two decisions in the context of transaction costs, we apply the double hurdle model. But unlike many previous papers that use the tobit

model for the supply intensity hurdle, this paper applies the fractional logit model to investigate the role of transaction costs in the intensity of cattle supply in the export channel. Based on the data we analyze monitoring, negotiation transaction costs related variables and other variables that indirectly measure information related transaction costs.

The next section gives an overview of cattle marketing in Namibia.

2.2 Overview of Cattle Marketing in Namibia

Cattle production is the most important agricultural activity for many farmers in Namibia. The beef sector generates over 60% of the livelihood of Namibia's population of 2 million. There are two livestock farming systems in Namibia: commercial and communal. The key distinction is that commercial farming is operated on private land and commercial farmers hold land titles, while communal farmers live on communal land shared as common property among many households. Approximately 70% of Namibia's population lives in rural areas located on communal farmland and depend on livestock farming for their livelihoods. There are approximately 4,000 commercial farmers in Namibia each holding an average of 7,000 hectares of land located below the North veterinary line[1]. There are about 68,000 communal farmers spread across the country with a greater proportion located North of the veterinary line.

Selling cattle is a significant source of cash for many livestock communal farmers. In addition, the number of cattle that a farmer owns is an important symbol of wealth for many

[1] Veterinary cordon (VC): this cordon extends west to east in the Northern part of Namibia; it was put in place to control foot and mouth disease (FMD) in livestock, but its size and location has a political history. The black dash line on the map (Appendix 2A) indicates the VC.

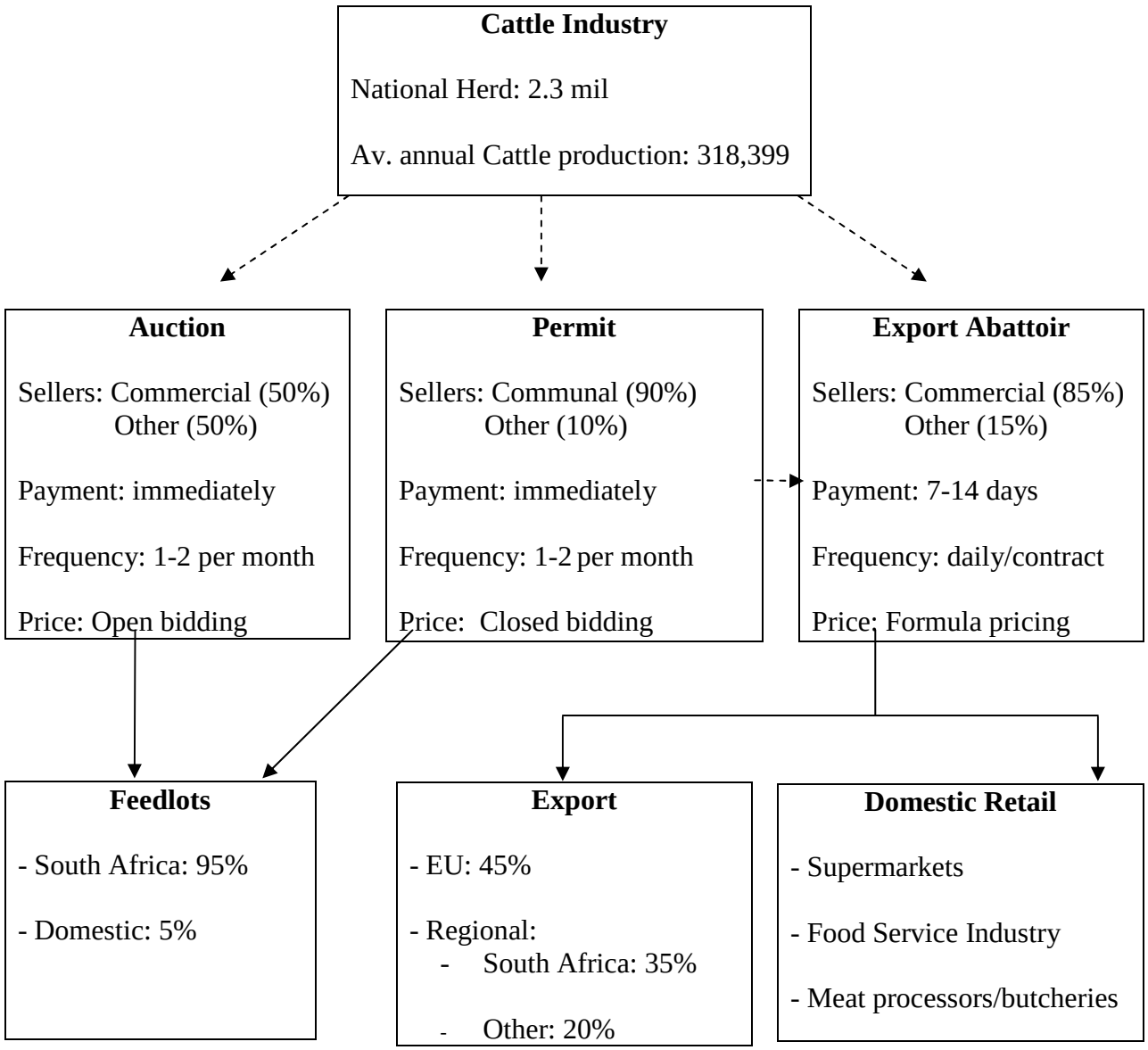
communal farmers. Similar to previous observations (Barrett et al, 2006; Lybbert et al, 2004; Little et al, 2001) of pastoralists' behavior in Eastern Africa, livestock communal farmers in Namibia prefer to hold wealth in the form of livestock. In addition to cultural reasons including the sentimental value attached to cattle, holding cattle for milk, the lack of trust in the commercial banking institutions may explain the preference of a 'walking' bovine bank. The absence of a banking tradition among many communal farmers means that communal farmers primarily sell their cattle when they need cash (e.g., to pay for school fees, hospital fees and funerals). In spite of this, key informants indicate that in the last ten years they have observed an increased (but slow) commercial mindset among communal farmers especially among the Ovaherero pastoralists. On the other extreme, there exists a strong commercial farming sector and commercial farmers control approximately 52% of Namibia's arable land.

Many cattle farmers in Namibia sell their cattle in multiple channels for a variety of reasons, including the desire to diversify sources of income to better manage finances, and having to finance emergencies such as funerals or medical needs. Also, the time-lag in getting paid in the different marketing channels combined with the different timing and frequencies of sales enables the farmers to sell in multiple channels to meet different financial needs and to respond to various market conditions. Furthermore, Namibia's semi-arid climate is prone to frequent droughts which influence farmers' marketing decisions. For example, when there is a prolonged severe drought farmers may prefer to sell weaners[2] and older cows to minimize losing cattle due to wasting and to minimize the costs related to cattle feed and supplements. During

[2] In Namibia a weaner producer refers to a cattle farmer who predominantly produces and markets young calves (6-10 months); a calf of that age is called a weaner.

such times they may sell more at auctions and permits. Figure 2a depicts the cattle marketing channels in Namibia.

Figure 2a: *Cattle Marketing in Namibia*



A cattle farmer in Namibia can sell cattle at an auction, a permit[3] or to export licensed abattoirs. At an auction multiple buyers bid for the cattle offered and the highest bidder takes all. Auctions are held once-twice a month in some locations and every three months in other locations. Prospective sellers announce their intention to sell and buyers announce their intention to buy. The permit outlet usually has one buyer. However, there is a bidding process in the permit channel: multiple buyers make written offers and the highest bidder is given the opportunity to buy as a single buyer. The Meat Board of Namibia[4] publishes[5] auction and abattoir prices on a weekly basis, thus the general public has an idea of what the market would pay for what they intend to sell. The buyer bidding to buy at a permit day will have to benchmark their bidding offers against the market trend. This process allows the producer to have a floor price to bargain with and the buyer cannot pay below what he/she offered in the bidding document. In addition, the buyer usually travels to the farmers' location to buy the cattle.

The auction and permit outlets are similar in that cattle prices are based on live weight. Communal farmers make up approximately 90% and 40% of the sellers at permit markets and auctions respectively. Communal farmers dominate the permit channel because buyers come to their location, and this reduces transaction and transport costs for the farmers. In addition, for a

[3] The permit system resulted from livestock market liberalization in the 1980s to enable commercial farmers to fulfill their quotas at abattoirs. Prior to this, as part of the apartheid laws in Namibia, White commercial farmers were not allowed to buy cattle in Black populated communal areas. The system is dubbed 'permit' because potential pastoralist sellers had to obtain a permit from the Department of Veterinary Services and invite a commercial farmer to buy cattle in their communal area.

[4] This is a marketing board that facilitates export of livestock, meat and products, Namibia's traceability farming scheme.

[5] Average weekly prices are announced over the radio.

variety of reasons including cost and risk considerations, communal farmers are mainly weaner producers; hence they tend to sell more at auctions and permits; while abattoirs buy young cattle to fatten at their feedlot, they generally prefer to buy heavier[6] cattle. Buyers at auctions and permits are predominantly speculators who buy cattle for feedlots where cattle are fattened up and then sold to abattoirs (90% are sold to SA feedlots).

In contrast to auctions and permit channels, prices for cattle sold to the export channel are based on deadweight carcass and grade. With a market share of over 60%, Meatco is the dominant export abattoir. To ensure that Meatco does not pay producers below what they would fetch in SA, a formula was agreed upon to determine a parity price[7]. Thus, Meatco usually pays above the SA parity price and the additional payment depends on the grade and weight of the carcass. Most sellers sign delivery agreements and deliver the cattle to the abattoirs. Only 10% of communal farmers sell cattle directly to export abattoirs under contracts. On the other hand, commercial farmers make up about 90% of contracted suppliers at Meatco.

The export of live cattle to South Africa (SA) poses strong competition to Meatco. To minimize hold-up problems and assure a profitable operational capacity of its plants, Meatco provides incentive programs[8] for cattle suppliers. For example, (1) premiums are paid to suppliers if they deliver a certain proportion of the cattle that they promised to deliver under the

[6] Cattle that weigh 320 kg or more.

[7] To determine the SA parity price, data are generated from abattoirs in SA to determine what producers could get in RSA minus transport, SAMIC levy (statutory levy in RSA) and adjustment for veldt hide.

[8] Tjimune (2010): Meatco procurement manager.

delivery contract; (2) as part of profit-sharing, producers who delivered cattle in a particular financial year receive bonuses (equal to dividends) from that year-end financial profits, and (3) producers who sign a contract and deliver cattle earn points under a merit point system, this point system provides a means for producers to compete for slaughter allocation especially during the peak season. In addition, to encourage communal farmers to sell their cattle to its abattoirs, Meatco holds 'farmers' days' where they go to communal areas to buy, instead of requiring farmers to deliver the cattle.

Key informants[9] (industry experts) report that it is expensive to export to the EU market because: export abattoirs face two to three unannounced inspections per year; frequent changes in standard specifications including strict requirements and frequent changes in the slaughter methods; carcass and water testing which increase laboratory expenses; and regular annual upgrading at the processing plants. Furthermore, the EU recently required that cattle have double ear tags[10]; such a requirement adds significant costs for farmers and many industry informants do not see the additional benefits in terms of food safety and product quality.

Appendix 2B shows the number of cattle sold in the different channels. The average cattle sold live (auctions and permit) in the last seven years are 165,664, and the average number of cattle sold to export abattoirs is 135,332. During this period, 45% of beef slaughtered at the export abattoirs was exported to the EU and the remainder to South Africa and other regional markets. Only cattle purchased south of the veterinary cordon shown in appendix 2A, and that

[9] Koos Claassens (Meatco); Tujendapi (Meat Board of Namibia).

[10] Ear tags cost $N6.20/tag (about $0.90 USD/tag); all animals being sold must be tagged.

meet the grades A and AB are sold to the EU. This is important because grades A and AB fetch the highest producer prices as shown in appendix 2D. In the last five years, grades A and AB made up about 13% and 25% of the average grades respectively, while grades B and C constituted 62% of the average grades collectively (shown in appendix 2E).

Based on the data and analyses by key informants in Namibia, transaction costs are a major problem for cattle farmers and limit supply of cattle to export abattoirs. Given the importance that transaction costs play as a barrier to entry in high value markets for smallholder farmers we will analyze cattle marketing in Namibia within the transaction cost framework. The next section provides a simple conceptual framework of cattle marketing in Namibia under transaction costs.

2.3 Transactions Costs of Cattle Marketing in Namibia

This section provides a formal description of the cattle marketing in Namibia in the context of transaction costs. It presents a simple framework to illustrate how transaction costs influence cattle marketing decisions. The equations in this section are not used as the estimating equations, but I simply use them to mathematically conceptualize the farmer's problem. There are three channels in which farmers sell their cattle: export channel (EC)[11] auction (A), and permit (PE).

Let $\prod_x$ denote profit and q_x amount of cattle sold in marketing channel x. The amount of cattle produced is determined by channel specific technologies. Thus, a farmer who primarily

[11] Cattle farmers sell cattle to export abattoirs in the export channel; export abattoirs and export channel are used interchangeably.

participates in the export channel faces different costs of production compared to a farmer that primarily sells cattle at a permit market. However, making channel specific production decisions does not preclude the farmer from selling cattle to the other marketing channels. For simplification, assume that production decisions are pre-determined, and the farmer is only making a marketing decision. Further assume that per period profit function is additively separable in the marketing channels. This assumption does not preclude the effects of outcomes from previous periods. Given these assumptions, profits are determined by output prices, amount of cattle and channel specific transaction costs.

Channel specific transactions costs depend on channel characteristics (*EC*, *PE*, *A*); for example, $T_{EC}(EC,Z)$ represents transaction costs in the export channel. Socio-economic characteristics of the farmer such as farm size are denoted by (*Z*)

$$\prod_{EC} = \prod(P_{EC}, q_{EC}, T_{EC}(EC,Z)) \quad (1)$$

$$\prod_{PE} = \prod(P_{PE}, q_{PE}, T_{PE}(PE,Z)) \quad (2)$$

$$\prod_{A} = \prod(P_{A}, q_{A}, T_{A}(A,Z)) \quad (3)$$

The profit of selling in marketing channel x is given by:

$$\prod_{X} = q_X(P_X - TC_X(Z,X)) \quad (4)$$

Since farmers sell cattle in multiple marketing channels, we can view the problem in terms of proportions. Let Y_X^* be the optimal proportion of cattle sold into marketing channel x and let $P_{EC} \geq \max[P_{EC}, P_A]$ and assume that $T_X > 0$, then:

$$y_{EC}^* = 0 \Rightarrow T_{EC}(EC,Z) > \max[T_{PE}(PE,Z), T_A(A,Z)] \quad (5a)$$

$$y_{EC}^* = 1 \Rightarrow T_{EC}(EC,Z) < \max[T_{PE}(P_{EC},Z), T_A(A,Z)] \vee P_{EC} > \max(P_{PE}, P_A) \quad (5b)$$

$$0 < y_{EC}^* < 1 \Rightarrow T_{EC}(EC,Z) \leq \max[T_{PE}(P_{EC},Z), T_A(A,Z)] \quad (5c)$$

In summary, equation (5a) shows that if the price offered by export abattoirs is greater or equal to the maximum of the price offered in the other two channels and the farmer's chosen optimal quantity to export abattoirs is zero, then it must be that the transaction costs associated with the export channel are greater than the transaction costs associated with the other two channels. But if the farmer chooses a proportion between zero and one, as shown in equation (5c), then it could mean that the transaction costs associated with the export channel are less or equal to the transaction costs associated with the other two channels. A farmer may sell all cattle in the export channel (5b) under two possible scenarios: firstly, if the transaction costs associated with the export channel are strictly less than the transaction costs associated with the other two channels, or secondly, if the price offered in the export channel strictly exceed the price offered in the other two channels even if the transaction costs of doing is a little higher than the transaction costs of either of the other two channels. In addition, if the price offered in the export channel strictly exceeds the transaction costs of all channels, $P_{EC} > TC_X, \forall x \in (EC, PE, A)$, such that the price P_{EC} offsets all costs of selling cattle to the export channel, then a rational farmer may sell all cattle in the export channel.

Direct observation of the profits for each marketing channel is not possible. Participation in the export channel is identified by the farmer's indication of whether he/she sells cattle to an export abattoir. It is a binary response that takes on the value one to indicate participation and zero to indicate non-participation. The proportion of cattle that the farmer sells to export abattoirs measures the intensity of participation in the export channel. It takes on values between 0 and 1 (100 per cent). The higher the value, the higher the proportion of cattle sold through the export channel and the lower the proportion sold through the other two channels (auction or

permit). The next section provides the empirical model to measure farmers' participation and their intensity of participation in the beef export channel.

2.4 The Empirical Approach: Double Hurdle Model

Given the description of cattle marketing outlets, we expect data to take strictly positive values. Since some farmers never sell directly to export abattoirs, and some sell all their cattle to export abattoirs, the dependent variable takes zero values with positive probability and the data are likely to be censored at both an upper and lower limit of zero and one (0 and 100 per cent). The tobit model has been used widely to address this type of data, and applied to questions of marketing channel selection (Holloway *et al,* 2002; Gong *et al*, 2007, Reardon *et al,* 2006 & Abdulai *et al*, 2009). However, the tobit model attributes censoring to corner solutions (Yen *et al*, 1996). Thus, it would not be clear whether a value of zero indicates that the farmer does not sell cattle in a particular channel or that she does, but did not sell in the particular period. Further, the tobit model does not adequately characterize the two decisions that occur in market channel selection: participation and intensity[12] of participation. A realistic approach is to separate these two decisions: first, the farmer decides to participate; second, the farmer decides how many cattle to sell in the chosen channel. Such a separation is closer to the data generating mechanism of how farmers choose to market cattle through the various marketing channels in Namibia. Furthermore, while the tobit model yields sensible partial effects and non-negative predicted values of the dependent variables, the marginal effect of explanatory variables is constant rather than diminishing (Wooldridge, 2002).

[12] How much to sell once the participation decision is taken.

An alternative approach includes the use of sample selections methods (as used by Alene *et al*, 2008; Hernandez, 2006 & Goetz, 1992). Most of these approaches are similar to the Heckman's (1979) two-stage sample selection model where the participation and supply decisions are modeled sequentially using the same independent variables for the participation and supply decisions. To correctly identify parameters an exclusion restriction is required and this approach precludes corner solutions.

Given this type of data, a more appropriate approach is to model the decision process as a Double-Hurdle model as proposed by Cragg (1971). It allows for censoring at both decision stages: positive outcomes can only be supplied if the farmer entered the market and the farmer is not at a corner solution in the sales decision (Angula, 2010). This model was originally applied to model household consumption. It assumes that the household makes two decisions when purchasing an item: a household first decides whether or not to purchase a good, and second depending on the intensity of the preference, the household decides how much of the good to purchase. Each decision is determined by a different set of explanatory variables, and different set of latent variables is used to model each decision process with a probit part determining the participation decision and tobit model determining the expenditure hurdle (Blundell and Meghir, 1987). The double hurdle model allows for the use of the same independent variables for both decisions. To deal with the exclusion requirement in addressing parameter identification problems, it assumes independent error terms between the two decision stages. The double hurdle model has been applied widely since its introduction (including work on the supply side by Balagtas, 2007; Aristei *et al*, 2007, Zhang, 2006; Yen *et al*, 1996 and Jones, 1989). Cragg's independent Double Hurdle model is applied by maximizing the likelihood function.

The log-likelihood function of the double-hurdle model with independent error terms is given as:

$$LL = \sum_{0} \ln\left[1 - \Phi\left(x'_{1i}\beta_1\right)\Phi\left(\frac{x'_{2i}\beta_2}{\sigma}\right)\right] + \sum_{+} \ln\left[\Phi\left(x'_{1i}\beta_1\right)\frac{1}{\sigma}\varphi\left(\frac{p_i - x'_{2i}\beta_2}{\sigma}\right)\right] \qquad (6)$$

where the first term in equation (6) accounts for the probability of passing the participation hurdle and the second term indicates the density of observing non-zero sales. I assume that there are no spillover effects among channels during the current period and examine the problem as static. The double hurdle model can be estimated by maximizing the likelihood functions of the participation and supply intensity components separately. Still, the independence of the error terms is a strong assumption, so to account for possible bias, I first estimated a probit model for the participation in the beef export channel, then generated the inverse mills ratio and used it in the second stage of cattle supply intensity model. In contrast to other papers that use the tobit model to estimate the second hurdle, I use the fractional logit model to measure the supply intensity decision because it is more appropriate for the data that were collected and the nature of cattle marketing decisions faced by the average Namibian cattle farmer. Thus, the second term in equation (6) is estimated by maximizing the likelihood function of the fractional logit model given by equation (13) on page 24. The fractional logit model is discussed in detail in section (2.4.2).

The following section presents a detailed operationalization of the double hurdle model for both the participation and supply intensity decisions.

2.4.1 The Participation Decision

Given the context of the analytical framework described in the previous section, a determination of whether the farmer sells cattle to export abattoirs is analyzed. This is a binary response of the probability that the farmer sells cattle to an export abattoir, given various explanatory factors. The formal probit model is presented in equations (7) through (11).

Let $y_i^* = x_i\theta + e_i$ (7)

where x_i is a vector of independent variables, e_i the disturbance term and it is independent of x_i and e_i Normal (0,1) and θ is a vector of parameters. y_i^* is a latent variable, however, instead of observing y_i^*, we observe y_i which takes on two values: $y_i = 1 \left[y_i^* > 0 \right]$, when a farmer sells cattle to export abattoirs, and $y_i = 0 \left[y_i^* \le 0 \right]$ if the farmer does not sell cattle to export abattoirs.

As shown in Wooldridge (2002) the distribution of $y_i | x_i$ is:

$$P(y_i = 1) = P\left(y_i^* > 0 | x_i \right) = P\left(x_i\theta + e_i > 0 | x_i \right) \left[y_i^* > 0 \right], \quad (8)$$

$$= P\left(e_i > -x_i\theta | x_i \right) = 1 - \Phi\left(-x_i\theta \right) = \Phi\left(x_i\theta \right)$$

and $$P\left(y_i = 0 | x_i \right) = 1 - \Phi\left(x_i\theta \right) \quad (9)$$

where $\Phi(\cdot)$ denotes the standard normal cumulative distribution function given by

$$\Phi(\cdot)=(2\pi)^{1/2}\exp\left(-z^2/2\right) \tag{10}$$

The density of y_i given x_i is

$$f(y_i|x_i)=\left[\Phi(x_i)\right]^{y}\left[1-\Phi(x_i\theta)\right]^{1-y}, \qquad y=0,1 \tag{11}$$

Equations (8)-(11) show the distribution of the probability of a farmer participating in the export channel conditional on the transaction cost related and socio-economic characteristic explanatory variables. We discuss the supply intensity model in the next section.

2.4.2 *Intensity of Supply Decision Model*

As discussed in the description of cattle marketing in section 2.2, many farmers in Namibia sell their cattle in multiple channels. It is thus appropriate to view the dependent variable as fractional in nature, given a farmer's choice to market cattle in multiple channels. Hence, the dependent variable takes on values between the lower and upper values and has a continuous distribution. Modeling such fractional dependent variables directly can be conveniently and appropriately done using the fractional logit modeling approach proposed by Papke and Wooldridge (1996).

Papke and Woolridge's (1996) approach directly models the conditional mean of the fractional response that keeps the predicted values in the unit interval. They applied quasi-maximum likelihood estimation (QMLE) method to obtain robust and efficient properties. Others

(Sivakumar, 2002; Ye, 2004; Hausman *et al*, 1998; Liu *et al*, 1999 & Wagner, 2001) extended and applied this method in several studies.

The estimation procedure follows a quasi-likelihood method as described by Gourieroux *et al* (1984): to motivate, first let $G(\cdot)$ be a well-defined function for $0 < G(\cdot) > 1$ to ensure that the predicted values if y lie in the interval $(0,1)$. Then,

$$E(y_i|x_i) = G(y_i|x_i) = \frac{\exp(x_i\beta)}{\sum \exp(x_i\beta)} \tag{12}$$

and the Bernoulli log-likelihood function is given by

$$L(\beta;x) = y_i \log[G(x_i\beta)] + (1-y_i)\log[1-G(x_i\beta)] \tag{13}$$

Papke and Woolridge (1996) showed that because (13) is a member of the linear exponential family, the quasi-maximum likelihood estimator (QMLE), $\hat{\beta}$, obtained by maximizing equation (13) is consistent and asymptotically normally distributed regardless of the distribution of $y_i|x_i$ provided that equation (12) holds. But the logit QMLE assumes that $Var(y_i|x_i) = \sigma^2 G(\beta, x_i)[1-G(\beta, x_i)]$, and this causes over-dispersion or under-dispersion in the variance of the estimators. To correct for the over and under dispersion in the variance, Papke and Woolridge (1996) estimated asymptotically robust inference for the conditional mean parameters (see appendix 2F). With equations (12) and (13) we can consistently estimate β using the Bernoulli QMLE. The next section provides the estimation equations for both decisions: to participate in the export channel and how many cattle to sells once the farmer decides to participate.

2.4.3 The *Estimation Equations*

The export channel participation estimation equation is given as:

Export Channel

$$\text{Participation} = \alpha + \sum_k \beta\ TransactionCost + \sum_n \eta\ FarmCharacteristics + \mu \quad (14)$$

where the dependent variable is a binary variable and equal to 1 if the farmer participates in the export channel and 0 otherwise. The supply intensity estimation equation is given as:

$$\text{Proportion Sold} = \alpha + \sum_k \gamma\ TransactionCost + \sum_n \theta\ FarmCharacteristics + \varepsilon \quad (15)$$

where the dependent variable is the proportion of cattle that a farmer sold to export abattoirs in the specified agricultural marketing period. In both equations the *TransactionCost* variable is the vector of transaction costs related variables and *FarmCharacteristic* is the vector of farm level and farmers' socioeconomic characteristics variables.

According to Newman (as cited in Angula, 2010) the double hurdle model is not based on any formal choice theory, thus it is difficult to choose which explanatory variables to include in each decision stage. However, the underlying assumption is that the first (participation) stage is often the result of socio economic variables. With this in mind, a large number of variables were regressed against the dependent variables then tested for their individual and joint significance. I dropped the ones that were not significant, but kept those that I expect to have a direct relationship with the dependent variables.

2.5 Data and Definition of Variables

2.5.1 Data and Definition of Variables

The primary data used in this study come from a random sample of 201 cattle farmers in the following three regions of Namibia: Otjozondjupa, Omaheke and Erongo. All three regions are located south of the veterinary line in Namibia. Livestock farming is the main agricultural activity, and it is the principal source of income in many of the communal areas in these regions. The data were collected from June through November 2007. Pre-tested structured questionnaires were used. Enumerators were hired to assist in administering the questionnaires. In addition, interviews with key informants including industry and farmer association representatives, and key policy makers were conducted.

The data cover a range of variables including transaction costs related factors, cattle marketing information, household assets and other descriptive information. Table 2b shows the variables, summary statistics and their expected direction of influence on participation and intensity to supply based on a priori expectations. *Ex post* monitoring transaction costs include grade uncertainty and payment delay; negotiations related transaction costs include the premium (the payment that suppliers receive over the sales price for supplying the delivery promise) and the type of contract that a farmers has with the export abattoir. *Ex ante* information transaction costs include membership to a farmer association and whether a farmer farms part-time or full-time. Other *ex ante* transaction costs include distance to market, ownership of transport equipment, premium, and the type of contract that the farmer has with the buyer.

Table 2b: Variables and Summary Statistics

Variable	N	Mean	Min	Max	SD	Expected sign Participation	Expected Sign Supply Intensity
Dependent Variables							
Sell to export abattoir (yes=1)	201	0.507	0	1	0.501	N/A	N/A
Proportion of cattle sold to export abattoirs	201	0.177	0	1	0.265	N/A	N/A
Explanatory variables							
TC Related variables							
Grade uncertainty (yes=1)	201	0.691	0	1	0.463	–	–
Payment delay (yes=1)	200	0.91	0	1	0.287	–	–
Distance to market (km)	201	46.442	3	205	56.323	–/+	–
Transport equipment (yes=1)	201	0.716	0	1	0.451	+	+
Farmer group member (yes=1)	201	0.821	0	1	0.384	+	+
Premium (yes=1)	201	0.497	0	1	0.501	+	+
Type of contract (own=1)	201	0.574	0	1	0.501	+	+

Table 2b (continued): Variables and Summary Statistics

Variable	N	Mean	Min	Max	SD	Expected sign Participation	Expected Sign Supply Intensity
Farmer household characteristics							
Total Herd (number)	201	171.6	4	1600	228.2	+	+
Herd Ownership (% of total herd)	201	0.93	0.26	0	1	+	+
Education (years)	200	10.07	0	18	4.67	+/–	+/–
Experience (years)	201	25.66	5	55	11.84	+/–	+/–
Running water (yes=1)	201	0.73	0.44	0.11	2.5	+	+
Land title (yes=1)	201	0.254	0	1	0.44	+	+
Gender of head (female=1)	201	0.338	0	1	0.47	–	–
Relies solely on family labor (yes=1)	201	0.228	0	1	0.421	+	–
Hired labor (number)	201	2.701	0	80	6.17	+	+
Farming time (full time=1)	201	0.766	0	1	0.42	+	+/-
Cost per head (N$)*	179	368.5	11.6	3083	461.1	+/–	+

*N$1=7.54 (USD) at current exchange rate.

In this sample the average participation rate of respondents in the export channel is 50.7%. As expected, commercial farmers participated more: approximately 90% of commercial

farmers participate in the export channel, while only 39% of communal farmers sell cattle to export abattoirs. According to the main export abattoir procurement manager, participation by communal farmers has been increasing over the last seven years because many are now developing a market-oriented mindset.

Overall, the average proportion of cattle sold to the export channel in the 2007 agricultural marketing period was 17%. The proportion of cattle sold to export abattoirs measures the intensity of supply. In this sample, approximately 30% of farmers who sold cattle to the export channel sold a proportion of over 50% and only 6.9% of farmers sold a proportion of exactly unity. In that period, commercial and communal farmers sold on average 37% and 11% of cattle to export abattoirs respectively.

Sixty-nine percent of the respondents said that they face grade uncertainty when they sell their cattle. Grade uncertainty and payment delay are forms of *ex post* monitoring costs. They arise due to uncertainty, information asymmetry and potential opportunistic behaviors. Uncertainties arise from imperfect or incomplete information. Grade uncertainty is hypothesized to decrease the probability of participating in the export channel. Cattle delivered at the export abattoirs must wait 24 hours before slaughter and the grade is based in the dead carcass. Most farmers are usually not present to monitor their cattle during the time of slaughter and while the cattle are transported to the abattoir. Thus, the farmer may approximate the grade of their live animal based on physical inspection including counting its teeth, but the grade based on the deadweight may differ. Holding other factors constant, this uncertainty creates friction and lowers the level of trust between suppliers and the buyer, especially when the farmer gets a

different grade from what he/she expected. Likewise, when a seller is not paid immediately, uncertainty arises as to whether the buyer will honor the promise. The longer the lag between the sale and payment, the greater the uncertainty and this reduces the incentive to sell. Hence, payment delay is expected to decrease the probability of participation and to lessen the intensity of participation in the beef export channel.

The average distance of the main road from the farmer's homestead to the cattle market is 46 km. Approximately 21% of the households in this sample travel less than 10 km to get to the market where they sell their cattle, and about 14% travel over 100 km to get to the market. Being located far away from markets requires more effort to discover market information and makes it difficult to establish closer relations with the buyers. Distance increases the time it takes to reach the market and introduces risk with respect to carcass shrinkage during travel time. The extent of the effect of distance on transaction costs depends on the conditions of the roads and the means of transportation used for traveling; if the road infrastructure is good, the effect of distance may be minimal. On the other hand, shorter distances with bad roads have significant influence on market participation. While theoretically and based on previous findings (Arlene, 2008; Balsevich, 2006), one would expect distance to have a negative influence on participation, we have to evaluate distance in the context of cattle farming in Namibia. Most of the commercial farmland is located farther away from the central district because of the availability of land for large-scale livestock farming. As a result, there is a structural condition whereby, households that have large herd of cattle and who own more grazing hectares of land per cattle tend to be located farther away from the center where export abattoirs are located. As a result, distance may have a positive or negative effect on the likelihood of participating in the export channel. On the other

hand, we expect distance to have a negative impact on the intensity of supply. Ownership of a transport vehicle is expected to enhance market participation through its role in facilitating access to information, in facilitating the transport of cattle to markets and thereby reducing time that it takes for the farmer to arrange for transportation time. Previous studies including (Alene *et al, 2008;* Heltberg *et al, 2002*) found that ownership of transport equipment enhances market participation.

On average, 76% of respondents are full time farmers and 82% are members of a farmer group organization. We do not have variables that directly measure information search costs. But, membership to a farmers' organization enables farmers to gain access to marketing and pricing information, and it allows farmers to pool resources together (e.g., arrange for the transport of cattle as group). Further, it reduces transaction costs including search costs, and makes the exchange or transfer of cattle ownership less costly for farmers. Thus, we use it as a proxy for information related transaction costs and we expect it to have a positive effect on the probability of participation and on the intensity of participation in the beef export channel. Previous studies (by Nyoro and Ngugi, 2007; Poulton *et al,* 2004, Minot & Ngigi, 2004; Reardon *et al*, 2003) found a positive association between market participation and farmer group membership. Alene, *et al* (2008) found mixed results: their results show that membership to a farmers' group decreased market participation, but it significantly enhanced participation intensity for maize farmers in Kenya.

Cattle farmers supplying an export abattoir can sell cattle directly under their own contact or indirectly through another's party's contract. With own contracts, the farmer signs a direct

contract with the abattoir and promises to deliver a specified amount of cattle in a specified period. With an indirect contract, farmers sell cattle under a farmers association's contract or under another individual's contract. Approximately 57% of respondents supply cattle under their own contracts. Contracting is essential for the export abattoirs because of the degree of asset specificity of their physical investments, i.e. their processing plants and feedlots. The use of these facilities is highly specialized; thus, it is not easy redeploy them to alternative uses without sacrificing their productive value. In addition, it is costly for the export abattoirs to operate below a certain level of slaughtering capacity. Hence, contracting is an important institutional arrangement to assure a profitable capacity utilization level by reducing hold-up problems. For suppliers, signing a contract provides a kind of market guarantee for slaughter allocation especially during the peak season. There is a greater element of trust through direct contracts and should the seller fail to deliver the promised quantity, it is easier for the buyer to follow-up. On the other hand, with indirect contracts there is another layer of partners between the buyer and the seller; this makes it more difficult to enforce the contract or to plan if the seller is not able to deliver the promised quantity. In addition, direct contracting reduces transaction costs by reducing incentive for opportunistic behaviors, including diverting the promised quantity to other buyers.

Furthermore, research on the smallholder farmer participation and supply in modern marketing channels of high value agricultural commodities and products highlights the use and importance of contracts in the procurement of products by supermarkets and large-scale distributors. In some cases it is a requirement for market entry. Results in these studies (including Weatherspoon & Reardon, 2003; Reardon *et al*, 2003; Kirsten and Sartorius, 2002;

Reardon and Barrett, 2000) show that signing contracts with the buyer enhances market participation and supply. As a result, we predict that direct contracts will have a positive effect on the proportion of cattle sold to export abattoirs.

The variable that denotes whether a farmer is a part-time or full time farmer indirectly captures some degree of information related cost. Part-time farmers are more educated, and they work and live in urban areas where export abattoirs are located. Thus, they are likely to be better informed about abattoir's requirements and they are on average more likely to access information at a lower cost than a full time farmer who lives in a remote location. As a result, part-time farmers are expected to have a higher intensity of participation in the export channel. However, most full time farmers rely solely on farming as their main source of income. Holding all other factors constant, they are more likely to participate in multiple channels to diversify the sources of the farm income and to respond to their different needs. As a result, we expect being a full time farmer to have a positive relationship with the participation decision, although its influence in the supply intensity decision is ambiguous.

The average total number of cattle per household in this sample is 171. Approximately 29.8% of the households have less than 50 cattle, 14% of the households own over 300 head of cattle, while 5% of households own over 500 cattle. In this sample, the average number of herd size per household was 266 in the Omaheke region, 179 in the Otjozondjupa region and 57 in the Erongo region.

About 27% of households had at least primary school education, but the average number of years of schooling in the Erongo region is just below primary school. Thirty percent of respondents in the sample completed high school and 20% completed schooling beyond high school. Education[13] could enhance or decrease the probability of participation. It could increase the probability of participation because education enhances the probability of accessing and understanding information including market requirement. Arlene (2008) found education to increase participation and supply among maize farmers in Kenya. Angula (2010) also found education to enhance participation among coffee producers in Uganda. Balsevich (2006) found mixed results on the effect of education on market participation of tomato producers in Nicaragua, and Blandon *et al* (2009) found education to decrease market participation among fruit and vegetable smallholder farmers in Honduras. The effect of education on supply intensity could be negative because a more educated individual is most likely to have other sources of income including formal employment.

Female-headed households make up 30% of the sample. We expect female-headed households to participate less intensely in the export marketing channel because most female-headed households in Namibia own less cattle compared to male-headed households: the average total number of cattle in female-headed households is 96 cattle while the average total number of cattle in male-headed households is 210.

[13] Education was only included in the participation decision, but not in the intensity model. It was individually and statistically not significant when regressed against the dependent variable (proportion cattle sold to the export channel).

Having access to grazing land and water is vital in raising cattle, especially in a semi-arid country where cattle graze extensively. On average, 25% of respondents have land titles. Having a land title is expected to increase the probability of participation and intensity of supplying cattle to the beef export channel. Research on household endowments of productive assets such as land show a positive relationship between landholding and market participation (Barrett, 2008; Cadot *et al,* 2006; Heltberg & Tarp, 2002; Nyoro *et al,* 1999). Barrett (2008) indicates that the association between landholding and gross market participation as a seller is striking and clear in several studies on market participation in southern and eastern Africa. Having a land title enables a farmer to access adequate grazing land, fatten cattle to meet the weight requirement of export abattoirs. Compared to farmers on communal land, farmers on private land face limited land degradation and bush encroachment problems as there is relatively less grazing pressure on their land and their cattle face less stress especially during the dry season. Most importantly, land is an important form of collateral that enables farmers to access credit markets, thus enabling them to borrow and the make the necessary investments to increase the productivity and quality of their enterprise. Communal farmers do not possess land titles cannot use land as a means to access credit.

Similar to land, water availability is extremely important given that Namibia has a semi-arid climate. Having running water at the homestead enables a farmer to give water to the cattle without having to trek the cattle over a long distance, and thus it influences the quality and weight of the cattle, and this further can influence a farmer's channel choice. For example, if a farmer in a communal area experiences frequent problems with water availability or there is a drought, that farmer may decide to sell his/her young cattle rather than risk losing them, and

because the young cattle may not meet the weight required by export abattoirs, the farmer may sell the cattle at an auction or permit. Having running water is predicted to enhance participation and intensity of supply of cattle to the export channel. Labor is a critical factor in raising and marketing. Cattle farmers on both communal land and private farms have to trek cattle over long distances for grazing, to find water and to sell cattle. Some communal farmers rent land on commercial land during prolonged dry seasons and need labor to care for their cattle. Also, cattle theft is an increasing challenge to many farmers and workers are needed to find missing cattle.

Hired labor is expected to have a positive relationship with market participation and supply intensity decisions. Reliance on family labor is expected to have a positive relationship with market participation. Family labor includes both adults and children because both engage in different activities related to cattle rearing. Children usually take cattle to water points and to the veldt for grazing, trek cattle to marketing locations; adults engage in all the aforementioned activities, but primarily responsible for cattle marketing, branding, finding lost cattle in distant locations, etc. On average, 22% of respondents rely solely on family labor and 78% hire labor. The average number of hired workers in this sample is 2.7 with a maximum of 80 workers.

The next section presents the estimation issues and is followed by the empirical results.

2.5.2 *Potential Estimation Issues*

Most of the *ex ante* transaction costs are generally exogenous because these costs occur prior to the actual transactions. Before selling, a farmer spent time to find information about prices and product requirements in certain marketing channels. Some *ex post* transaction costs

can be endogenous and should be treated with caution. For example effort to find transportation could be endogenous. While the level of effort could determine the proportion sold to an abattoir, it can also be determined by having chosen to sell to an export abattoir. One way to deal with this is to find a variable that is related to transportation effort, but that is not determined by the marketing channel (after controlling for all the other variables). In this paper distance to the market is used as a proxy for transportation effort, because farmers take their location as given (at least for a particular agricultural period's marketing decisions).

The timing perspective of the dependent variable is important in whether some of the *ex post* transaction costs are endogenous. Since it is measured in terms of historical sales to the export abattoir, the speed of payment may not be a problem because a farmer has historical knowledge of the speed of payment in a particular marketing channel. Likewise, farmers also have historical knowledge of the amount premium payments in the various channels. In addition, we tested whether payment delay and whether a farmer receives a premium are endogenous, and the tests revealed that they are not endogenous.

Most of the farmer characteristics are exogenous. However, herd size could be endogenous. Farm size is an alternative variable to approximate a farmer's capacity to supply. However, it is difficult to measure in the context of Namibia where the majority of farmers live in communal areas where their cattle graze extensively and sometimes in more one communal area. Herd size is more appropriate to measure capacity than farm size in the context Namibia's communal land set up. Herd size was tested for endogeneigty: first, I regressed herd size against

the other explanatory variables and obtained its residuals, then regressed the dependent variable (proportion of cattle sold to the export channel) against the other explanatory variables and the herd size residuals, and then tested significance of herd size residuals from this regression. It was statistically not significant at the 1% significance level. Therefore, I rejected the null hypothesis that herd size is endogenous. The next section discusses the empirical results.

2.6 Empirical Results

2.6.1 The Participation Decision Results

Two participation models were estimated and the marginal effects are provided for the whole sample and for a communal farmers sub-sample. The participation model using the whole sample fits the data well with 61% of participation outcomes being correctly predicted and the Wald test of the hypothesis that all regression coefficients jointly equal zero is rejected. The pseudo R-square for the model is 0.32. The sample size for the whole sample was 200 and 145 for the communal farmer sample. Overall, the model fit the data well and grade uncertainty, membership in a farmers' organization, having a transport equipment, ownership of a land title gender of household head, reliance on family labor, and having running water at the homestead were statistically significant.

The transaction costs variables were all found to be significant in at least one model. Table 2c shows that grade uncertainty is statistically significant at the 10% significance level, and on average, it decreases the probability of participation by 21%. Farmers who were interviewed expressed concern regarding grade uncertainty at export abattoirs. This is because, grading at abattoirs is based on deadweight carcass; upon arrival cattle have to wait 24 hours before slaughter after having been transported over a long distance. In addition, most farmers are not present to monitor the handling of their cattle at the abattoirs, which decreases their level of trust in grading by the export abattoir. Results for communal farmers show that grade uncertainty reduces the likelihood of participating in the export channel, but it was not significantly.

Table 2c: Beef Export Participation Decision (yes=1) Results

Variables	*Whole Sample*		*Communal Farmers*	
Transaction Costs Related				
Grade uncertainty (yes=1)	-0.213*	(0.110)	- 0.0333	(0.137)
Farmer Organization (member=1)	0.440***	(0.0906)	0.397***	(0.0679)
Transport vehicle (yes=1)	0.193*	(0.108)	0.178*	(0.0976)
Distance to market (km)	0.000696	(0.00102)	0.00224*	(0.00136)
Farmer Characteristics				
Land Title (yes=1)	0.286**	(0.124)		
Family labor (relies solely=1)	0.234**	(0.0980)	0.227**	(0.106)
Gender (female=1)	-0.195**	(0.0917)	-0.217**	(0.0864)
Running water (yes=1)	0.162*	(0.0958)	0.169*	(0.0895)
Farming time (full time=1)	0.0992	(0.112)	0.0376	(0.118)
Own Herd (% total herd owned)	0.175	(0.195)	0.221	(0.185)
Education (years of schooling)	0.00845	(0.0107)	0.0177	(0.0108)
Experience (years in farming)	0.00367	(0.00394)	0.000576	(0.00427)
	N=200		N=145	
	Pseudo R^2=0.32		Pseudo R^2=0.24	
	Wald $\chi^2(12)$ =60.42***		Wald $\chi^2(11)$ =33.75***	
	% correctly predicted: 61%		% correctly predicted: 52%	

Note: *, **, *** represent significance at 10%, 5%, and 1%; land title was dropped from the communal farmers' regression

Membership in a farmer organization has a positive and highly significant effect on export channel participation. Farmers who have membership in a farmers' association are on average 44% more likely to sell their cattle to the export channel. The direction of influence of farmer association membership on participation is consistent with *a priori* expectations and previous findings (including Barrett, 2008; Alene *et al* 2008; Minot & Ngigi 2007*)*. Unlike other findings (by Cadot *et al*, 2006; Reardon *et al*, 2003) that show that farmer associations appear to largely benefit large and well-established farmers and do not facilitate entry into commercial farming for subsistence farmers, the results show that farmer associations is a highly significant institution for Namibian communal farmers' entry in the high value beef export market. On average, an individual communal farmer sells fewer cattle, and because of transaction and transportation costs, they are less likely to participate in the processor/export channel. However, when farmers pool cattle and other resources together, and access market information through farmers' associations, they are able to reduce transport and mitigate transaction costs. As a result, membership in a farmer organization increases the probability of participation as it reduces transaction costs. Farmers join farmers associations for a variety of reasons; these results indicate that the main driving force is the reduction of transportation costs by having the export abattoir come to the their location through the farmers' association. Thus, this result must be interpreted with caution.

Consistent with theoretical expectations, having transport equipment has a positive and significant influence on the probability of participation. On average, ownership of transport equipment increases the probability of participation by 19%. Ownership of transport equipment reduces transaction costs in that the farmer does not incur negotiation and search costs to find

means of transporting cattle to the abattoir. This result is consistent with previous findings (by Alene *et al* 2008, Heltberg & Tarp, 2002).

Distance to the market place had a positive and significant effect on communal farmers' participation, but was statistically insignificant for the whole sample. The reason for this direction of influence is because of the livestock farming structural set-up that where most of the farmers who participate in the export channel live on commercial farmland, and these farms are usually located farther away from the main export abattoirs since that is where land is available for large livestock farming. For communal farmers, one additional kilometer in distance from the market increases the probability of participating in export channel for communal farmers by 0.2% on average. Confounding these results may be the fact that some farmers identify themselves as communal farmers because they still live on communal land, but they are actually resettled to private land through the government land reform policy. Thus they partially farm on commercial farmland.

Three of the seven farmer characteristic variables that are statistically significant are having a land title, gender of the head of the household and reliance on family labor. Owning a land title on average increases the probability of selling cattle in the export channel by 28%. Land title is statistically significant at the 1% significance level. Private land ownership plays a paramount role in a cattle farmer's probability of participation. Unlike farmers on communal land, farmers on private land do not face severe problems of overgrazing, land degradation, and water constraints. In addition, farmers on private land buy weaners from communal farmers, fatten them to the desired weight and then sell them to the export abattoirs. Thus, farmers who

have access to private land are more likely to consistently meet the weight requirements desired by the export abattoirs than farmers on communal land. The results on land ownership are consistent with previous findings (including Ruben, 2007; Cadot *et al,* 2006; Heltberg and Tarp, 2002) that found that market participation increases with land ownership.

Being a female-headed household lowers the probability of participating in the export channel by19%. In addition to owing fewer cattle on average, women in rural Namibia are more involved in cattle rearing and livestock production activities, while men dominate marketing and slaughter activities. Thus, even in female-headed households, the marketing aspect of cattle, price negotiation and information is relegated to male relatives. The result of female-headed households and market participation is consistent with findings by Bellemare *et al* (2006) on market participation by female-headed households in Ethiopia; they find female-headed households to be autarkic than to be net sellers.

Family labor is statistically significant and it increases the probability of participation by 23% on average. This result is consistent with previous findings (including Angula, 2010; Alene, 2008). Having running water at the homestead has the expected positive effect and it increases the probability participation by 16%. Experience and education positively influence the probability of participation, but both were not statistically significant**.** Likewise, the proportion of cattle owned by the farmer has a positive but statistically insignificant effect on participation.

Overall, the results on the transaction costs variables were consistent with expectations. They show that grade uncertainty significantly reduces the probability of participation in the beef

export channel. Membership to a farmer organization mitigates transaction costs because farmers gain more access to marketing information and it also reduces transportation related costs. Membership in a farmer association significantly increased the probability of participation in the beef export channel. Distance to the market had a positive but insignificant effect on the probability of participating in beef export channel for the whole sample but it was significant for communal farmers.

2.6.2 Supply Intensity Decision Results

Table 2d contains the results from estimating the supply intensity equation (15) for farmers who participate in the export channel. The dependent variable is the proportion of cattle that the farmers sold to the export channel. Model 1 estimates equation (15) for proportions strictly greater than zero for the whole sample. Model 2 estimates equation (15) for communal farmers who sold strictly greater than zero proportions of cattle to the export channel. The results for communal farmers are provided to show variables that have greater impact on communal farmers' supply intensity decisions but are not significant in the whole sample results.

Table 2d: Supply Intensity Results

Variables	Model 1 *Proportion > 0* *Whole Sample*		Model 2 *Proportion > 0* *Communal Farmers*	
Transaction Costs Related				
Payment Delay (yes=1)	-1.389***	(0.333)	-1.996***	(0.509)
Grade Uncertainty	-0.477	(0.328)	-0.471	(0.833)
Premium (yes=1)	0.850***	(0.256)	0.949***	(0.329)
Contract Type (Direct=1; Indirect=0)	-0.499*	(0.282)	-0.803***	(0.301)
Distance (km)	-0.00343*	(0.00202)	-0.00524	(0.00323)
Farming time (full =1; part =0)	-0.640***	(0.247)	-0.627	(0.410)
Transport Vehicle (yes=1)	0.389	(0.444)	0.665	(0.577)
Farmer Characteristics				
Cost per head (N$/head)	0.000625**	(0.00029)	0.000677**	(0.000281)
Running Water (yes=1)	0.604	(0.382)	0.410	(0.379)
Hired Labor (number)	0.0489	(0.0440)	0.168	(0.158)
Total Herd	0.000775	(0.000670)	0.00275**	(0.00126)
Gender of head (female=1)	-0.211	(0.292)	-0.292	(0.461)
Inverse Mills Ratio	0.377	(0.407)	1.138	(0.796)
Constant	0.293	(0.863)	-0.505	(1.000)
Observations	75		39	
Pseudo R^2	0.403		0.3799	
Wald $\chi^2(12)$	232.36***		167.32***	
AIC	1.261		1.533	
BIC	-249.12		-86.448	

Note: *, **, *** represent significance at 10%, 5%, and 1%

The pseudo R-square of both supply intensity models are good with 40% for the whole sample and 38% for the communal farmers' subsample. The Wald test results show that all the regression coefficients in both models are statistically jointly significant. Payment delay, premium, farming time, having a direct contract with the export abattoir, distance, total herd and cost per head were statistically significant in both models. The results show that transaction costs do matter in farmers' intensity of participation in the export channel. Approximately 71% of the transaction costs variables are statistically significant.

Consistent with *a priori* expectations, payment delay has a negative effect on the proportion of cattle that farmers sell to export abattoirs. Payment delay is significant at the 1% level. Farmers who strongly prefer to be paid immediately supply less to the export abattoirs. This result implies that payment delay strongly deters farmers from selling cattle to export abattoirs. In addition, many communal farmers who sell cattle to pay school fees or to finance emergencies prefer immediate payment. Thus, if export abattoirs want to attract more communal farmers, they must address payment preferences of these cattle suppliers.

Surprisingly grade uncertainty was not significant in both models. Grade uncertainty reduces the proportion of cattle that farmers sell to export abattoirs. It is possible that farmers who have supplied strictly greater than zero proportions to the export abattoirs over a number of years, developed a stronger level trust and relation with the buyer, and thus face less grade uncertainty compared to farmers who do not supply regularly. As a result, grade uncertainty is not significant which is consistent with previous findings (including Reardon *et al*, 2008; Pingali *et al*, 2008; Jaffee *et al*, 2004 & Farina *et al*, 2000.)

Premium has the expected positive effect on the proportion of cattle sold into the export channel. It was significant at the 1% level in both models. Premiums offered by export abattoirs provide incentives for farmers to supply cattle and to meet most of their delivery promise. Premiums are based on the quantity that farmers deliver and farmers receive additional payment when they deliver at least 90% of their delivery promise.

A surprising result is that having a direct contract[14] with an export abattoir has a negative effect on the proportion of cattle that an average farmer sells to export abattoirs. This was significant at the 10% level in model 1 and it was significant at the 1% level for communal farmers in model 2. There are two possible explanations for this result: first, this result shows that farmers who sell under direct contracts sell proportionally less to the export channel. Farmers who sell under direct contracts tend to have more cattle to sell and they are most notably commercial farmers. In this sample, farmers under direct contract sold on average 94 cattle and those who sold under indirect contract sold an average of 22 cattle. Since these farmers sell on average more cattle, they tend to participate more in the other marketing channels, especially auctions, where they are paid immediately. Thus, while on a whole they sell more cattle in absolute value, they proportionally sell less to export abattoirs. Because they have more cattle to sell, they can participate more in the other marketing channels to diversify their sources cash flow.

Second, the results imply that indirect contracts are highly significant in communal farmers' supply decisions to sell to export channel. An individual communal farmer sells on

[14] Contract type was interacted with a size dummy (large=1). The coefficient was positive, but statistically insignificant and the overall results did not change.

average fewer cattle on his own and may therefore not be able to sign a direct delivery contract with an export abattoir. However, when that farmer pools resources together with other farmers and organizes to deliver through the farmers' association he/she can deliver to the export abattoir through an indirect contract. Besides limited capacity, the uncertainty of not being able to deliver the promised quantity of cattle to the export abattoir could hinder communal farmers from signing direct contracts

Distance to the market where cattle is sold has a significant and negative impact on the proportion of cattle sold to the export channel. While distance to the market is negative in both supply intensity models, it is significant at the 10% level in model 1, but it is not significant in model 2. Model 1 captures more farmers who are located farther away from the export abattoirs compared to model 2. The average distance from the farm to the market for farmers who supplied strictly greater than zero proportions in model 1 is 65 km. On the other hand, the average distance for communal farmers who supplied strictly greater than zero proportions is 39 km.

Being a full-time farmer has a negative effect on the proportion of cattle on average farmer sells to an export abattoir. This variable is significant at the 1% level in model 1, but it is not significant in model 2. This result indicates that an average full-time farmer sells proportionally fewer cattle to export abattoirs compared to the average part-time farmer. This result is supported by the data: overall, the average proportion of cattle sold by a full-time farmer is 0.15 compared to 0.25 sold by a part-time farmer. Furthermore, full-time communal farmers participate the least intensely: full-time communal farmers sold a proportion of 0.07 of their

cattle to the export channel compared to 0.23 sold by part-time communal farmers. The reason for this is because part-time farmers are more likely to have access to better marketing information and they are more likely to be better informed regarding the procurement requirements by export abattoirs because most part-time farmers work and reside in urban areas where export abattoirs are located. In addition, the data suggest that part-time farmers have on average more years of schooling compared to full-time farmers: an average part-time farmer completed high school while an average full-time farmer only completed primary school. Also, 77% of the farmers who have completed university[15] training are part-time farmers. These information advantages mitigate transaction costs and enable them to supply more intensely.

Lastly, most full time farmers rely solely on farming as their main source of income. Holding other factors constant, they are more likely to participate in multiple channels to diversify their sources of farm income and to meet their needs at different times of the year. Hence, while they may sell more cattle in absolute number, they sell proportionally less to one particular channel to diversify their farm income sources.

The per unit cost variable includes both variable costs such as farm operational costs (includes diesel, electricity), cattle input costs (e.g., licks, water, vaccination), costs related to improving the quality of cattle (e.g., buying a bull), and fixed costs expenditures such as installing a borehole and costs related to fencing the farm. The results show that per unit cost has a positive effect on the proportion of cattle sold to export abattoirs. It is significant at the 5% level in both supply intensity models. The interpretation of this variable is somewhat problematic

[15] Education (measured by the number of years of schooling) did not have individual nor joint significance in the supply intensity models, and it was thus not included in the final models.

simply because variable and fixed costs are not treated separately in the data set. Barrett (2006) found fixed costs to have a significant positive effect on the quantity of cattle sold in the market among livestock pastoralists from Kenya and Ethiopia, while variable costs had a significantly negative effect on sales volume. The results of this study imply that the more a farmer spends per head, the higher the proportion of cattle the farmer sells to export abattoirs. Furthermore, the implication is that farmers who spend more per head are more likely to meet requirements by export abattoirs including weight and grade specifications. Farmers who sold cattle to the export abattoir spend on average twice per head compared to those farmers who did not sell. The data show that the average annual cost per head for farmers who sold cattle to export abattoirs is $N528, which is about $69 USD at the current exchange rate. On the other hand, farmers who did not sell to the export channel spent on average approximately N$239 (about $31 USD) annually per head. In this data set it is more likely that fixed costs outweigh variable costs for the farmers who sold strictly greater than zero proportions to the export abattoir because the majority of these farmers are commercial farmers who make investments on their land since they own the land. In this case, our results are consistent with previous findings by Bellemare *et al* (2006).

While some communal farmers participate in the export channel, others may choose to forgo the export channel because they would have to spend more money per head. Thus, some farmers may be maximizing their incomes by choosing to forgo the beef export channel due to higher per unit costs[16]. Again, Bellemare *et al* (2006) find fixed costs to have an increasing, but

[16] Per unit cost had a negative effect on participation, but it was individually and jointly insignificant (it was not included from the participation model).

concave effect on market entry. Thus, when costs are extremely high, at some critical amount, farmers may choose not to enter the market.

Total herd size is significant at the 5% level for communal farmers. This result is consistent with previous research (by Barrett et al, 2006; Lybbert et al, 2004; Little et al, 2001). Being a female-headed household has a negative, but statistically insignificant effect on the proportion of cattle sold to the export channel. Thus, female-headed households not only have a lower probability of market entry, but they also supply less intensely once they enter. Female-headed households represent 17% of the respondents who supplied greater than zero proportion of cattle. While farmers' endowment of productive assets including land, labor and running water is significant in farmers' participation decisions, total herd size and the cost of raising cattle for the export channel play a critical role in their intensity of supply decisions.

Overall, the impact of transaction cost related variables on farmers' intensity of participation in the beef export channel is significant. Payment delay, distance to the market and supplying through a direct contract significantly reduce the proportion of cattle that farmers sell to the export channel. On the other hand, premium and being a part-time farmer significantly increase the intensity of supply in the export channel. Total herd size and the type of contracts that a farmer has with the export abattoir are significant in communal farmers' decision on how much to supply the export channel. Access through indirect contracts (e.g. through farmers associations) is key for communal farmers' intensity of participation in the beef export market.

2.7 Conclusion and Policy Recommendations

Primary data collection on cattle farmers in Namibia was used to assess the effects of transaction cost related variables and socio-economics variables on farmers' participation, and the degree of their participation in the international beef export market. This study used a double hurdle model with a probit model measuring participation and a fractional logit model assessing the intensity of supply to answer the key research question.

The results revealed that transaction costs have a significant effect on farmers' market entry and intensity of supplying in the beef export channel. Grade uncertainty had a significantly negative impact on market entry and payment delay significantly reduces farmers' intensity of supply to export abattoirs. Furthermore, membership in a farmer association was highly significant in cattle farmers' participation in the export market and it plays a critical role in intensity of supply for communal farmers. Farmer organizations appear to play a paramount role in mitigating transaction costs and give farmers a platform to pool resources together. The empirical results point to practical, yet important actions that will partially address the limited supply of cattle from communal areas. Export abattoirs should address grade uncertainty and payment delay issues by shortening the lag between payment and delivery of cattle; these actions will give strong incentive for communal farmers to sell more to export abattoirs. Results show that farmers' associations are an important institution for both market entry and the degree of market participation. I recommend that export abattoirs form increased partnerships with farmers' associations, especially in communal areas. This will help both export abattoirs and farmers to improve communication, build trust and address issues like grade uncertainty efficiently, and increase a market-oriented mind-set among communal farmers. Such efforts will

in the medium to long-term benefit the export abattoirs to minimize supply constraint problems as they seek new markets, and they will also increase their operating capacity and bottom line.

The results provide evidence that programs such as premiums that provide incentive for farmers to supply to export abattoirs seem to be working. These programs should be continued and must be innovatively extended to address the different issues facing various cattle farmers. Results reveal that farmers who own land titles participate more, overall, these farmers tend to be commercial farmers. This paper did not directly address or model land distribution issues, but the result on the effect of private land ownership on market entry supports increased access to land as a policy approach for government. I recommend that the government of Namibia revisit its land reform policy[17]**.** Effective land reform policies that result in more land ownership among communal farmers, that assure that the 'right' people are resettled and clearly assign property rights, and that provides post resettlement support for farmers to ensure productive use of the land is key to increasing farmers' participation in the beef export channel and to address supply constraints challenges.

Female-headed households have a significantly lower probability of participating in the beef export market and those who participated supplied less proportion of cattle to export abattoirs. As a result, development projects and private-governmental partnerships must channel resources to increase female participation in the international beef export market. In addition,

[17] The current "willing seller, willing buyer" basis of the policy has not produced efficient and increased land resettlement of communal farmers.

there is a need to further analyze the underlying factors that limit female-headed households participation.

Results show the importance that farmer organizations play in market entry decisions for communal farmers. Investing in and strengthening these type of organizations and increasing their role in marketing and educational information dissemination to farmers is important. While changing the cultural mindset of a pastoral cattle farmer is challenging, efforts that show the benefits of selling cattle when prices are high instead of just when the need arises combined with information on using the well developed banking system in Namibia to save money can slowly change communal farmers' marketing behaviors to improve their incomes, and eventually alleviate rural poverty in Namibia.

Due to data limitations this study did not directly address information related transaction costs. Information related constraints were captured through other variables including membership in farmers' associations and whether a farmer farms full time or part time. Direct proxies for information related transaction would add value to empirical results. The quantitative results do not capture the cultural and sentimental value that farmers attach to cattle. Since these values influence farmers' marketing decisions, further research should incorporate this aspect in the modeling. In addition, farmers participate both as sellers and buyers in the various marketing channels. Due to data availability this paper analyzed the cattle farmers' decision to sell, and not to buy. Further research would be useful to incorporate both aspects.

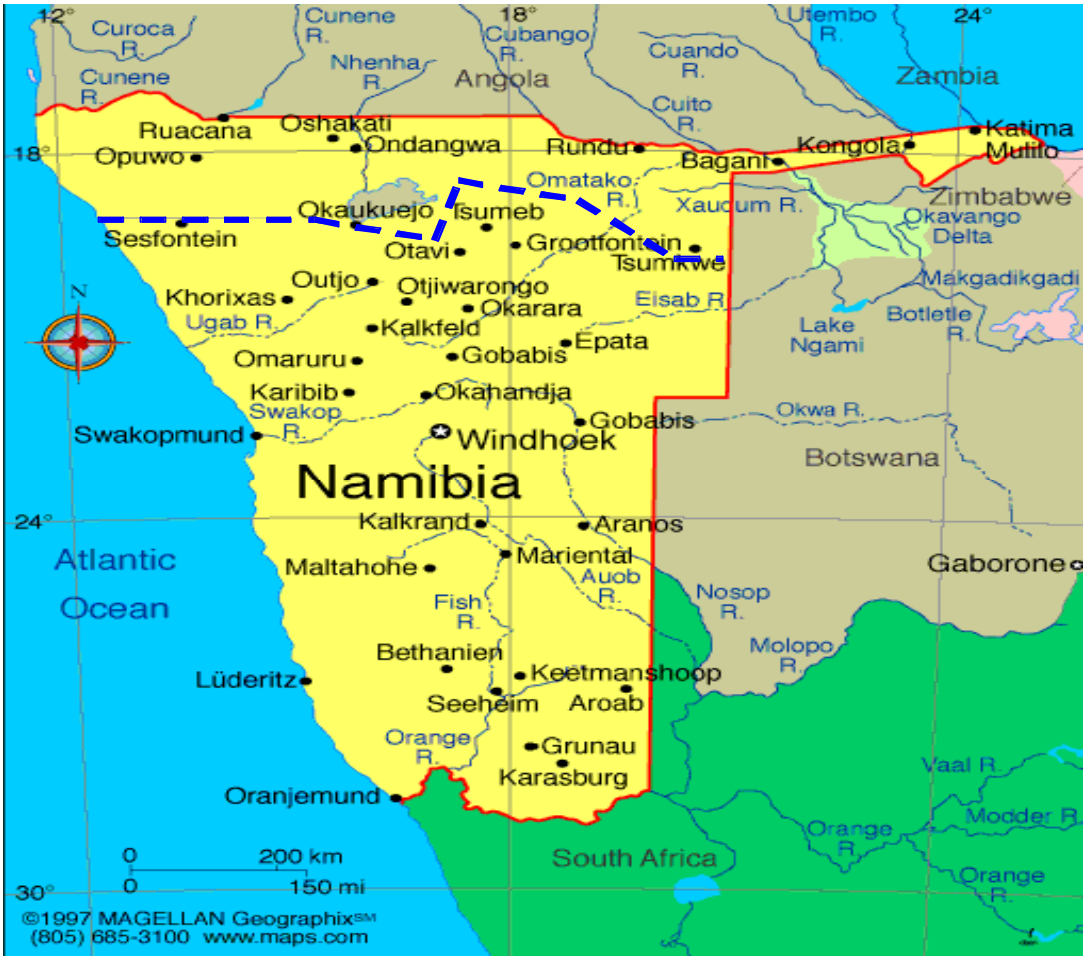
Overall, this paper sheds light on important factors that significantly affect marketing decisions of cattle farmers in Namibia. Its findings reveal practical policy options for various stakeholders in the Namibian beef industry that can increase farmers' participations in beef export channel, and thereby increase rural cattle farmers' incomes.

APPENDICES

APPENDICES

APPENDIX 2A

Figure 2a. Map of Namibia



For interpretation of the references to color in this and all the figures, the reader is referred to the electronic version of this dissertation.

APPENDIX 2B

Table 2a: Number of Cattle Sold (1998-2008)

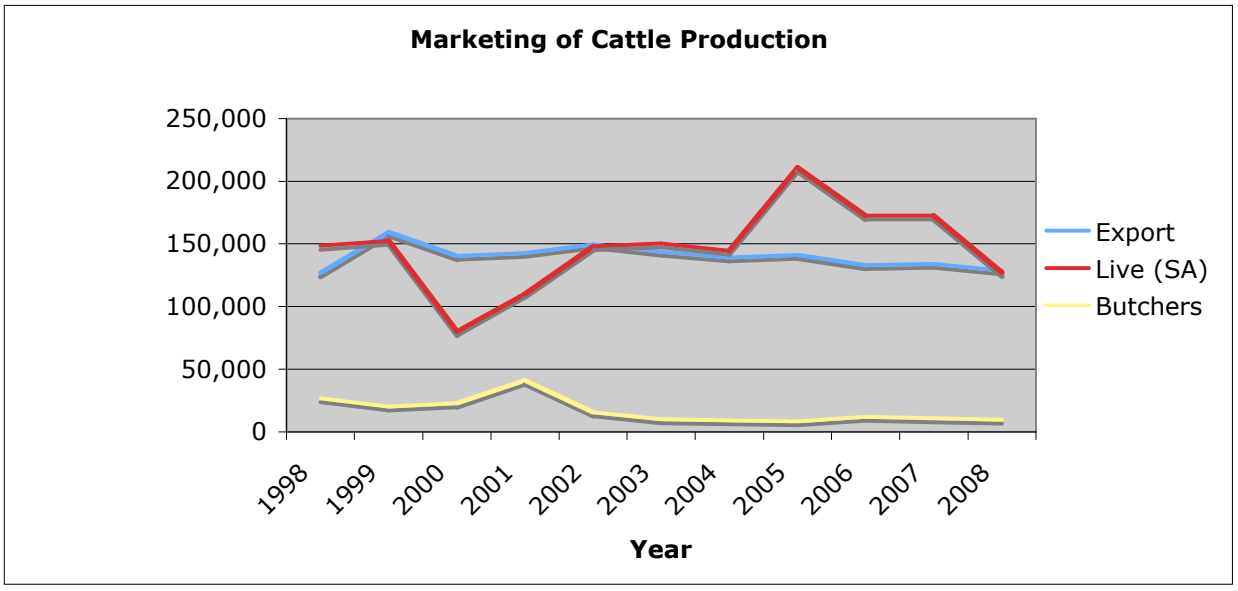
Year	Export Abattoirs	Live (South Africa)	Butcheries
1998	126,824	148,739	26,620
1999	159,522	152,416	20,021
2000	140,589	79,969	22,956
2001	142,624	110,127	41,073
2002	149,833	148,350	15,654
2003	143,885	150,601	9,950
2004	139,162	144,573	9,191
2005	141,348	210,945	8,477
2006	132,991	172,790	12,016
2007	134,341	172,587	10,893
2008	128,819	127,426	9,798

Source: Meat Board of Namibia

Note: Live (cattle bought at auctions and permits), Butcheries: sell processed meat, cut meat further and sell to retailers and end-consumer; abattoirs: buy and slaughter live cattle, sell at a wholesale level.

APPENDIX 2C

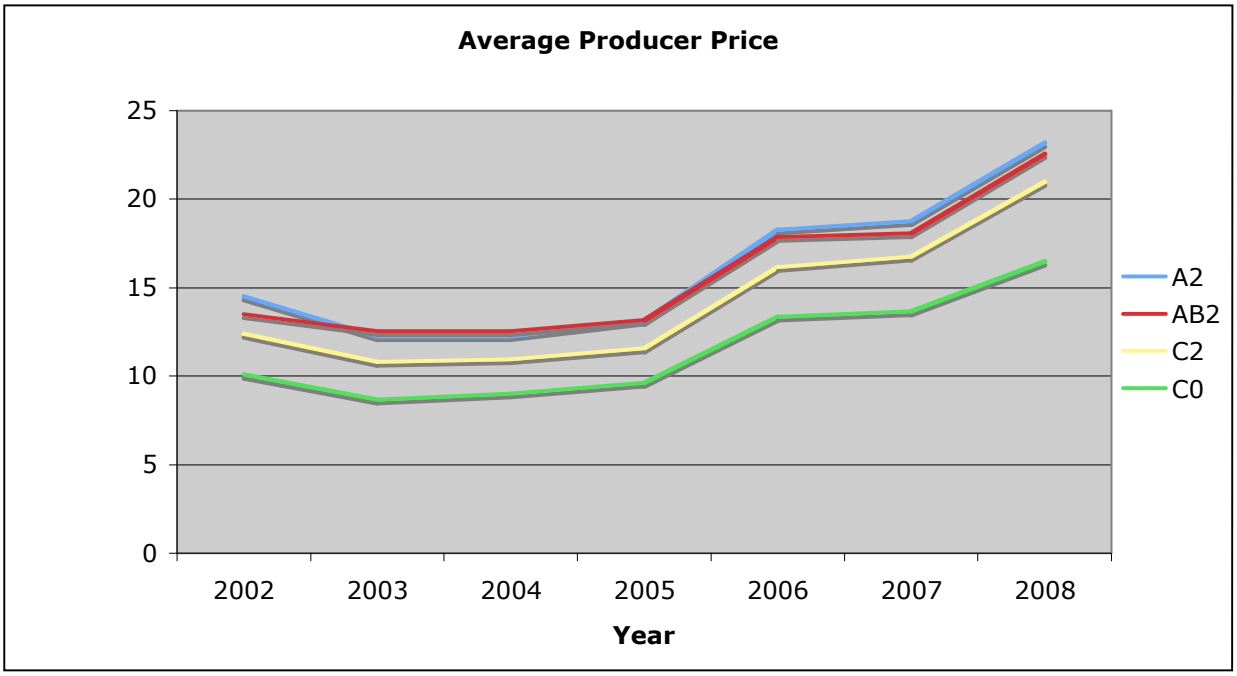
Figure 2c: Marketing of Cattle Production in Numbers (1998-2008)



Source: Author based on Meat Board of Namibia data; "Export" refers to export licensed abattoirs; "Live" includes cattle sold at auctions and permits

APPENDIX 2D

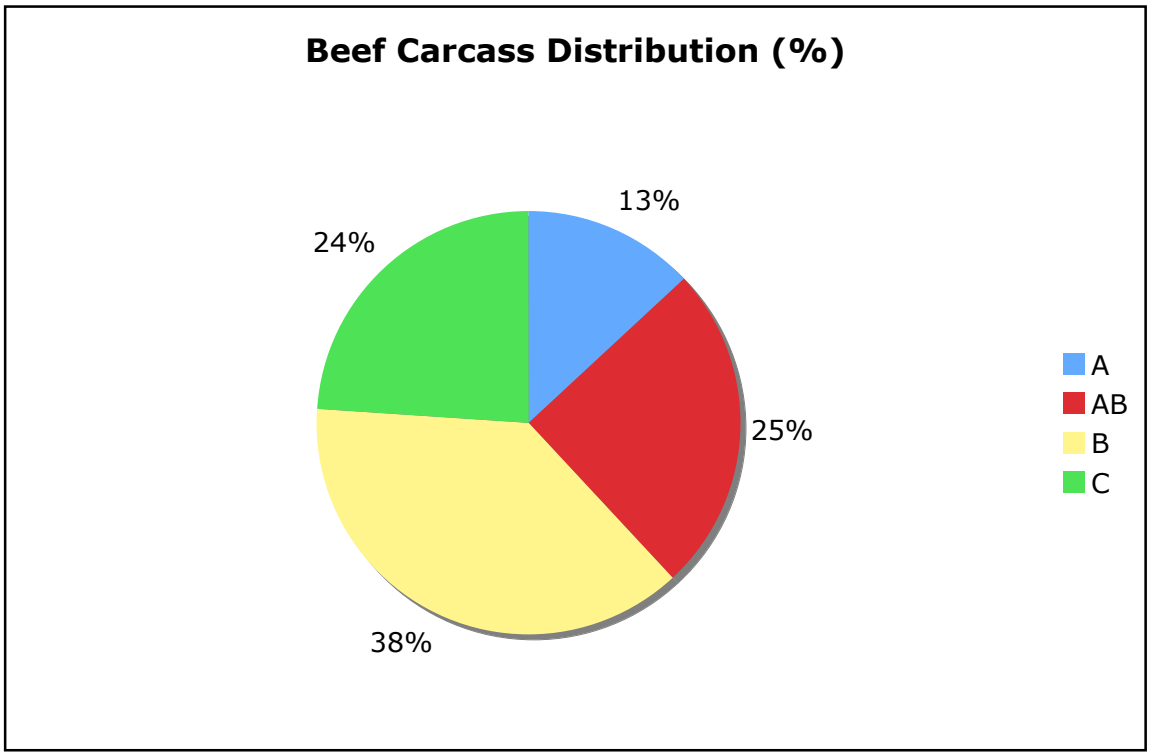
Figure 2d: Average Producer Price (N$/kg) by Grade (2002-2008)



Source: Author (based on Meat Board of Namibia data)
Note: The numbers next to grade refer to number of teeth that the cattle has

Appendix 2E

Figure 2e: Average Beef Carcass Grade Distribution (2005-2008)



Source: Author based on Meat Board of Namibia data; only grade A and AB is exported to the EU market

Appendix 2F: Asymptotic Variance of Estimators in Fractional Logit Model

Papke and Wooldridge (1996) estimate the asymptotic variance of the $\hat{\beta}$ to be

$\hat{A}^{-1}\hat{B}A^{-1}$ where $\hat{A}^{-1}$ is the inverse of the estimated Hessian matrix

where $\hat{A} \equiv \sum_{i=1}^{N} \frac{\hat{g}_i x_i' x_i}{\left[\hat{G}_i\left(1-\hat{G}_i\right)\right]}$, and $G\left(\hat{\beta}, x_1, x_2, ..., x_N\right) \equiv \hat{y}_i$ is the expectation of y_i and $\hat{g}_i \equiv g\left(x_i\hat{\beta}\right)$.

$\hat{B} \equiv \sum_{i=1}^{N} \frac{\hat{u}_i^2 g_i^2 x_i' x_i}{\left[\hat{G}_i\left(1-\hat{G}_i\right)\right]^2}$ is the outer product of the estimated first derivative of the log-likelihood

function, and $\hat{u} = y_i - G\left(x_i\hat{\beta}\right)$.

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CHAPTER 3:

IMPORT COMPOSITION EFFECTS OF THE EU TRADE POLICY REFORMS: THE CASE FOR BEEF IMPORTS FROM NAMIBIA

3.1 Introduction

There is uncertainty regarding the status and potential effects of the EU economic partnership agreement (EPA) with the Southern African development community (SADC). The aim of the proposed economic partnership trade agreement is to establish a new trading relationship between the EU and African, Caribbean and Pacific (ACP) countries that will enforce compliance to the WTO rules of non-discriminatory trading arrangements. As a result, EPAs are free trade agreements with the salient feature of reciprocity[18] in contrast to the former Lomè Agreement that was non-reciprocal (Stevens, 2004). There is concern regarding the potential effects of increased competition for domestic producers and lower trade tax revenue for governments in the SADC region. Moreover, the impact of the trade policy reforms on sensitive agricultural sectors of ACP countries that had historically enjoyed preferences under various commodity protocols is a major concern. This is the case with the Namibian beef sector.

[18] Reciprocity entails that trade preferences extended by one country or a group of countries (e.g. EU) to another country or group of countries be designed with an obligation being placed on the second group of countries to grant trade preferences to the first group of countries. Non-reciprocal trade preferences to developing countries under WTO are allowed, but on a non-discriminatory basis (i.e. all developing countries at the same level of development benefit from the same trade preferences).

Although beef exports from Namibia constitutes only 2.9% market share of EU total beef imports, the beef sector is a key sector for the Namibian economy and the EU is one of the largest trading partners of Namibia. The agricultural sector contributes approximately 11% to GDP in Namibia, but more than 60% of the population depends directly and indirectly on income generated from the beef sector (AfDB, 2002). Furthermore, the beef sector accounts for 25% of Namibia's foreign exchange earnings (Bank of Namibia, 2005) and it is the number one source of employment in the country[19]. Approximately 31% of total Namibian exports destined to the EU are food and agricultural products (COMEXT, 2006), of which approximately 50% constitutes beef products. The combined value of Namibian beef and beef products exports is about US$200 million (USAID, 2003).

In light of the sensitive role the beef sector plays in the Namibian economy, any new trading arrangements that will arise deserves close analysis and empirical estimation. The general objective of this study is to estimate the potential economic effects of the proposed EU-ACP trade policy reforms on Namibian beef exports to the EU market. Specifically, we use simulations to analyze how the three trade scenarios will affect the quantity and the quality composition of imported beef from Namibia into the EU market. To illuminate quantity and quality composition, five trade scenarios are analyzed, they are: (1) Preferential Market Access, (2) the Economic Partnership Agreement and its alternatives, (3) the standard generalized system of preferences (GSP), and two enhanced GSP options (4) GSP^{+} and (5) GSP^{++}.

[19] Employing approximately 35,000 Namibians (Chiriboga *et al 2008*).

3.2 Literature Review

There are no empirical studies on the effects of the trade policy reforms on the Namibian beef sector. The few existing studies are merely descriptive (Meyn, 2004, 2005 & 2007). Tekere *et al* (2002) discusses the challenges that the Southern African Custom Union (SACU)[20] countries face in the EPA negotiations with respect to the South Africa – EU free trade agreement. A descriptive study by One World Action (2006) focused on the Namibian beef industry and it examined the likely impact of EPAs on women's rights and gender equality. In general, there is a dearth of studies

that focus on specific agricultural sectors, and none empirically examine the trade effects of the proposed EPAs and policy alternatives on the Namibian beef sector.

Several studies (Karingi *et al*, 2005; Busse *et al*, 2004; Tekere *et al*, 2003; Milner *et al*, 2005; Meyn, 2004 & 2005; Roza, 2003; Stevens, 2005 & 2006; ATCP, 2005) address the question of the potential effects of EPAs on ACP countries using general and partial equilibrium models. Most of these studies examine the Viner's trade creation and trade diversion effects of regional trade agreements and make inference regarding the impact on welfare depending on the type of trade effects. Results from these studies are mixed. Tekere *et al* (2003) find that trade creation effects outweigh trade diversion effects, and they reported larger positive welfare effects with regional integration than without regional integration for the SADC region. On the other hand, Milner (2005) reports larger trade diversion effects for the East African Community. In almost all the studies large negative tariff revenue losses are reported. Other studies (Martin,

[20] SACU is a custom union among Namibia, South Africa, Botswana, Swaziland and Lesotho.

2005 and Bouet *et al*, 2005) based their trade policy reform analyses on multi-country simulations and concluded that large EU tariff reductions are required to increase EU imports.

It is difficult to assess the import composition effects of a trade agreement using large aggregated data. Yet, there is an important relationship between product quality and the export price that the exporting country receives. Wooldridge (2002) argues that even though export prices are no longer exact measures of quality, they can still be used as indicators of quality. CGE models provide important welfare results on the impact of the trade policy reforms on the larger economy and related sectors, but they typically do so by a great deal of data aggregation. Thus, detailed information available for thousands of tariff lines are reduced to 20 or 30 aggregate commodities (Martin W, *et al* 2003). Ramos (2010) points out those large-scale models that take beef as a single commodity might underestimate the future growth of beef imports by the EU, especially in light of market analysts who point out the growing trend of high quality beef products imports into the EU market.

It is important to consider the quality composition aspect of beef exports in the context of Namibia because of the dual nature of its agricultural system. There are two livestock farming systems in Namibia: commercial and communal. The key distinction is that commercial farming is operated on private land and commercial farmers hold land titles, while communal farmers live on communal land shared as common property among many households. Approximately 70% of Namibia's population lives in rural areas located on communal farm land and depend on livestock farming for their livelihoods. There are approximately 4,000 commercial farmers in Namibia holding an average of 7,000 hectares of land each located South of the veterinary line.

There are about 68,000[21] communal farmers spread across the country with a greater proportion located North of the veterinary line. Due to the dual system, commercial farmers dominate Namibia's beef export channel as they have greater capacity to fatten cattle to meet the weight requirements demanded by the beef export abattoirs for cattle that yield more of the prime cuts. On the other hand, communal farmers face many constraints and they tend to have less heavy cattle that yield less prime cuts. Thus, an increase in the import demand of high quality beef could result in the exclusion of certain types of suppliers, such as small communal farmers. If so, this is an important factor to consider in the trade reform analyses so that capacity-building measures can be put in place to address such an outcome.

Ramos (2010) studied the import composition effects of the ongoing EU-Mercosur trade agreement on beef exports. This paper applies her approach to analyze the potential economic and composition effects of the trade policy reforms on Namibia's beef export to the EU market. Since negotiations between the EU and ACP countries on the proposed trading regime are still ongoing, this study has practical value in estimating the potential economic effects of the EPA and other alternative trading policies on the Namibian beef sector.

The following section provides a background on the EU-ACP trade policy reforms, discusses the five aforementioned trade policy alternatives in detail, and provides a background of the Namibian beef exports.

[21] Figures on communal farmers are difficult to come by; the 68,000 figures are based on a survey by the Namibia National Farmers Union (a communal farmers' organization).

3.3 Policy Background

3.3.1 Preferential Market Access

Trade preferences for many ACP countries were formalized under the Lomè Agreement in 1975. In addition, separate trading protocols for bananas, sugar, and beef and veal became an integral part of the EU-ACP trade relations. For example, with the beef and veal protocol, the EU refunded the relevant ACP countries 90% of the tax that was normally paid for beef imports (Eurostat, 2005). Agricultural products not included in specific commodity protocols were subject to import duties that were far below those specified in the GSP (Bergtold, 2004).

Many countries would like to maintain preferential market access to the EU market, but many question if it improved economic performance of ACP countries. Bergtold (2004) argues that the use of non-reciprocal trade as a mechanism to stimulate export growth in the ACP countries was unsuccessful, but he attributes low export performance primarily to supply-side factors. Brenton and Ikezuki (2006) argue that the costs of satisfying the rules of governing preferences reduce the extent to which they raise the actual returns in developing countries and they conclude that preferences have done little to stimulate the export of a broader range of products. McQueen *et al* (1999) attribute the export of primary commodities that tend to have low income elasticity of demand as a major reason for the poor export performance of ACP countries.

In a small number of countries such as Mauritius, preferences resulted in relatively strong economic performance and diversification. Commodities that were granted preferential market access under various EU commodity protocols have played a significant role in Mauritius' rural

employment (Subramanian and Roy, 2003). While Panagariya (2005) is not a proponent of preferential trading, he argues that through preferential market access many low income countries have had access to EU internal prices kept artificially high to protect EU producers, but depressed world market prices for various agricultural commodities such as sugar and beef. This, he argues, benefits both exporting and importing countries of these agricultural commodities.

The one-way preferential provisions were challenged under the rules of WTO and preferences granted for specific developing countries can only be maintained in a GATT-consistent manner, on the basis of reciprocity (Milner, 2006). Consequently, with the expiration of the Lomè IV convention in 2000, the EU initiated a new trading regime. In the Cotonou Agreement that followed, the EU proposed various negotiations of EPAs to place trade between the EU and ACP countries on a reciprocal footing under various regional configurations. Under the proposed EPAs, ACP countries are expected to remove tariffs on "substantially all" (i.e. most, but not all) imports from the EU during an implementation period (Kennan, J. *et al*, 2005). Some countries entered into interim EPA agreements with the EU, but the nature of the new interim trade regime has not been concluded yet. This uncertainty raises questions: will non-reciprocal preferential market access be extended? If not, what degree of reciprocity will be adopted in the final EPA agreement? What other trade policy alternatives may be pursued if an agreement is not reached? And which trading scenario will most likely emerge? Based on the interim EPA agreement, it is almost certain that non-reciprocal preferences will not be continued. The next two sections provide a detailed description the proposed EPA trade agreement and its alternatives.

3.3.2 **EU-ACP Post Cotonou Trade Regime Alternatives**

3.3.2.1 Economic Partnership Agreements (EPAs)

The current interim EPA provides duty-and quota-free market access for ACP countries into the 27 EU member state. Since most ACP exports entered the EU market at relatively lower duties, most of the trade liberalization will be required from ACP countries. Based on other free trade agreements, s*ubstantially all trade* has been defined as ranging from 86-90% of their traded products (Ochieng, 2007). The expected economic effects of EPAs include loss of preference margin, increased competition from the EU products, and government tariff revenue losses. The proposed EPAs include an economic development component that aims to enhance foreign direct investment, production and supply capacity of ACP countries.

There are three regional EPA groupings in Africa, namely Eastern and Southern Africa (ESA), Economic Community of West Africa States (ECOWAS), and the Southern African Development Community (SADC) of which Namibia is part of. Members of the EPA- SADC configuration, except South Africa signed an interim EPA agreement with the EU in December 2007. However Namibia voiced several concerns that it wants the EU to address before it signs the full EPA.

According to Weidlich (2008), the contentious issues that Namibia has reservations about include the most favored nation (MFN) provisions demanded by the European Commission (EC), which compels non-least developed countries (non-LDCs) including Namibia to extend the same conditions to the EU as are contained in future trade agreements with any other countries. In addition, Namibia voiced concern about the EC's demand that export levies and taxes on

Namibian goods be scrapped as the country uses these as incentives for local value addition. The EC further demands the abolition of internal quantitative restrictions on EU exports to the rest of the Southern African Customs Union (SACU), which may be inconsistent with the regional trade arrangements under both the SACU and SADC agreement. Negotiations are currently ongoing to resolve these contentious issues, and to finalizing the interim EPA agreement.

These concerns attest to the tension inherent within the WTO between the principles of reciprocity, and special and differential treatment (S&D)[22]. This is at the heart of the differences between the EU and ACP countries over the desirability, applicability and interpretation of 'reciprocity' (Ochieng, 2007). ACP countries prefer to maintain some preferential market access justified under special and differential treatment of the WTO Enabling Clause[23], but the EU prefers to satisfy the WTO rule of non-discrimination with the reciprocity requirement. What the final full EPA agreement will entail remains uncertain, however it is most likely to mirror the stipulations of the interim agreement with respect to market access, but it will have an additional component related to the service industries, and a development and aid package. Failure to sign a final EPA could result in the imposition of the standard (GSP) duties on export to the EU market (Agritrade, 2007).

[22] WTO Agreement contains provisions that give developing countries special rights and which give developed countries the possibility to treat developing countries more favorably than other WTO members.

[23] It was adopted under GATT in 1979 and forms the legal basis for GSP and regional arrangements among developing countries [Decision of 28 November 1979 (L4903)].

3.3.2.2 The Generalized System of Preferences (GSP) and Enhanced GSP

Should negotiations fail, the GSP is an alternative trade regime between the EU and ACP countries (Meyn, 2007; Agritrade, 2008). The concept of the GSP system is that industrialized countries will autonomously grant developing countries special trade preferences, which will exempt their exports from the normal custom duties. This creates incentive for traders to import them and increase their competitiveness on the international markets (George, 2006). The Enabling Clause of the GATT system in 1979 provided the legal foundation for the GSP system and it was to be reviewed every ten years. Under this clause, preferential treatment provided under the GSP must be 'non-discriminatory, non-reciprocal and autonomous'. Tariff levels are linked to the most favored nation (MFN) tariff levels for four categories of products, namely: very sensitive, semi-sensitive, sensitive and non-sensitive.

The GSP system provides enhanced market access for LDCs under the Everything But-Arms (EBA) initiative, but Namibia is classified as a lower-income developing country and is not eligible for the EBA initiative. However, Namibia can try to get LDC classification on the grounds that the calculation of its average income per capita does not take into account the highly unequal income distribution[24] and the number of people who live in poverty. For example, in 2002 the Namibian minister of finance requested the USA to treat it as a LDC nation under the Africa growth and opportunity act (AGOA)[25] (Namibia Economist, 2006). As a result,

[24] Namibia has the world's most skewed income distribution with a Gini coefficient of 0.70 (UN Human Development Report (2007-2008).

[25] AGOA is a trade agreement between the US and Sub-Saharan African countries.

the 2006 AGOA IV granted Namibia LDC-like status making it eligible for the "Special Rule"[26] provisions. Therefore, it is reasonable to envision a possible scenario under which Namibia can qualify for LDC provisions provided under the enhanced GSP system. We model two enhanced GPS options: GSP^{+} and GSP^{++}. Both include a reduction from the MFN tariffs tariff levels. The GSP^{+} has a quota but no specific tariffs and the GSP^{++} is quota-free, but includes specific tariffs, and both have *ad valorem* tariffs.

Under the standard GSP alternative, Namibia's beef export could face the MFN rates applied to other developing countries. On the other hand, under the enhanced GSP options, Namibian beef exports could face *ad valorem* and specific tariff rates reductions[27] under the sensitive good category. Trade provisions under the GSP are usually not unconditional. Conditions related to labor and environmental issues, and contingency of preferences on minimum value addition rules apply and make the qualification process under the enhanced GSP difficult. According to Panagariya A. (2002), these "side conditions" introduce a certain element of uncertainty for exporters: the benefit may be withdrawn at any time under the pretext of a specific standard not being fulfilled.

In spite of the current delays and tensions over its various components, the proposed EPA trade policy regime is the most likely outcome of all three scenarios for several reasons: first, while the reciprocity requirement makes the EPA option unattractive; duty-free and quota-free

[26] Provides LDCs additional preference of duty-free and quota-free access for apparel made from fabric originating from anywhere in the world.

[27] A 3.5. percentage point reduction of the MFN *ad valorem and a* 30% reduction in specific tariff (specified in Council Regulation (EC) No 732/2008: Section1 Article 6).

market access into the EU market as implemented through the interim EPA makes it very attractive to suppliers. Second, the asymmetry in bargaining power between the negotiating parties combined with ACP countries' reluctance to jeopardize their relationship with the EU bolsters the outcome of the EPA trading scenario. Third, the EU may be reluctant to agree to the modified enhanced GSP trade scenario proposition on the grounds that it is more likely to be challenged under WTO rules of reciprocity, even though it could be justified under the WTO 'Enabling Clause'. Finally, as the EU continues to sign free trade agreements with other countries (e.g. Mercosur countries) that grant ACP countries' competitors enhanced market access, ACP countries may experience pressure to finalize the full economic partnership agreement.

Table 3a below summarizes the key trade components of the policy alternatives. The trade policy simulations will be based on one base scenario option, the preferential market access (PMA), and four possible trade agreements that will likely replace the PMA discussed above. The next section provides a background on Namibian beef exports to the EU.

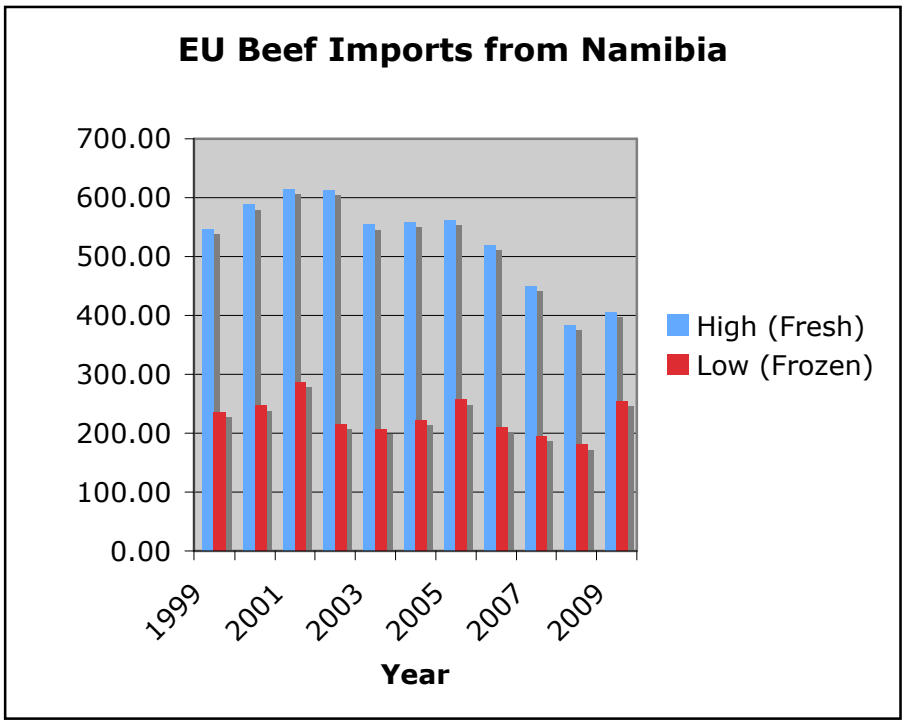
Table 3a Summary of the Trade Policy Alternatives

	PMA	**EPA**	**GSP (standard)**	**GSP^{+}/GSP^{++}**
Key Feature	Non-reciprocal	Reciprocal	Non-reciprocal	Non-reciprocal
Market Access	Highly reduced tariffs Quota	Duty-free Quota free	MFN tariff rates Quota free	Reduced MFN tariffs Quota/quota-free
Trade-offs	- Preferences margin - Enhanced market access - High tariff revenue - WTO incompatible	- Preference margin loss - Enhanced market access - Competition from EU beef products - Tariff revenue losses - WTO compatible - Development support	- Increased competition - Less market access - No tariff revenue losses - High tariff costs: may end beef exports - WTO compatible	- Increased competition - Limited tariff revenue losses - WTO compatible

3.4 Namibia and the World Beef Market

Namibia has an annual total cattle population of approximately 2 million head. Since 1992, an average of 350,000 cattle are marketed annually of which 45% are sold to EU licensed export abattoirs. Of the remaining, 35% are exported (primarily live) to South Africa (Meat Board of Namibia Meat, 2007) and the rest is sold in the domestic market and other regional markets in Southern Africa. The beef is exported as fresh and frozen (all boneless).

Figure 3a: EU Beef Imports in 100kg from Namibia by Category, (1999-2009)



Source: Author (based on Comext data)

As shown in figure 3a, Namibia exported almost twice the amount fresh beef as frozen since 1999. Beef exports to the EU fell between 2006 and 2007 as more cattle were sold live to South African feedlots in response to increased weaner prices and increased demand in South Africa due to the preparation of the FIFA 2010 world cup. Only cattle South of the veterinary cordon (NVC)[28] are sold to the EU market. Approximately 90% of contracted cattle suppliers of the main beef exporters are commercial farmers and the remaining 10% are communal farmers[29] located south of the veterinary line. However, 55% of Namibian communal farmers are located in the northern communal areas (NCA), located north of the veterinary line,

[28] The NVC hampers market access for communal farmers and the political history of the size and location is contentious; the government is debating to relocate the fence further north while keeping in mind the objective of disease prevention.

[29] Other communal farmers supply under their farmers' association contract.

and 95% of cattle slaughtered in the NCA are sold to South African markets and 5% is sold in the domestic market.

In terms of value, the EU market continues to be an important market for the Namibian beef industry. Table 3b below shows the percentage of sales value of the leading Namibian beef exporter by export destination and the EU constitutes almost 40% share of Namibian export value followed by South Africa and then Norway.

Table 3b: Distribution of Sales Value by Export Destination (2009)

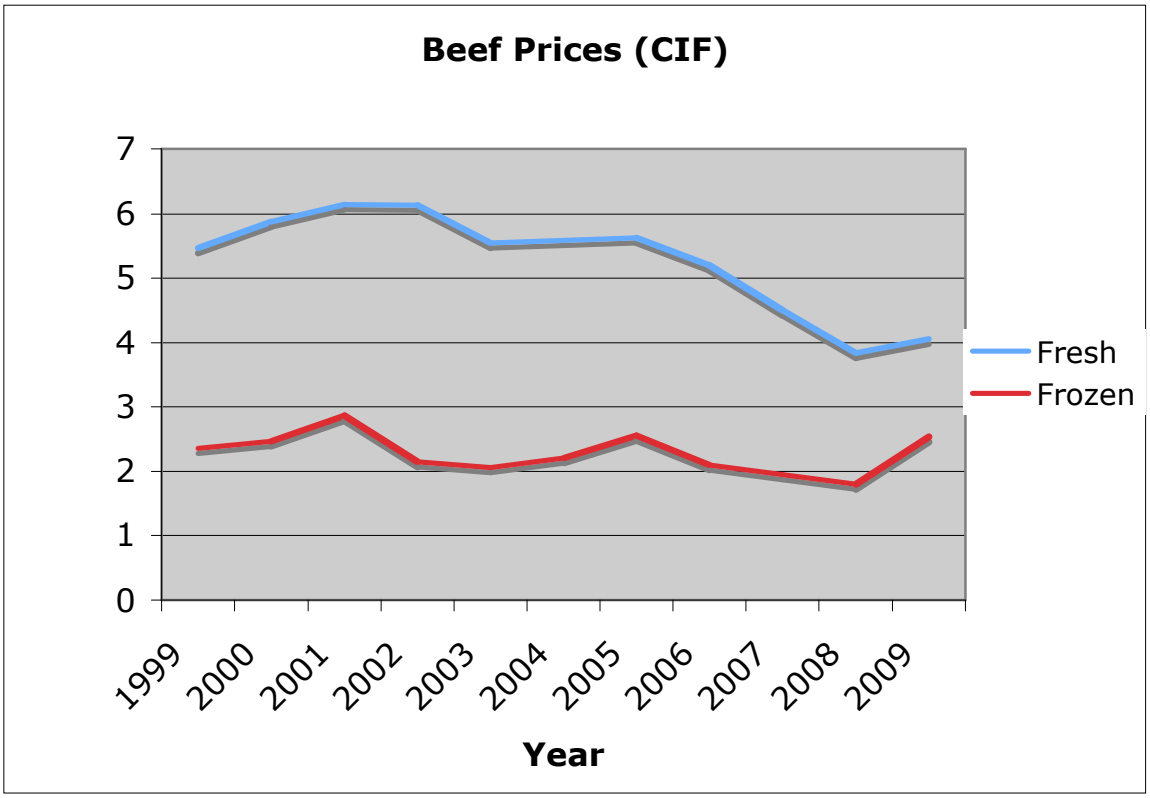
Destination	Percentage of Sales Value
European Union	39.6
South Africa	29.5
Norway	13.5
Namibia	12.8
Reunion	2.4
Switzerland	1.4
Other African countries	0.9

Source: Meatco (2009)

Namibia was the sixth largest exporter of beef to the EU in 2009 (Agritrade, 2010), but Namibia accounted for only 2.9% of total beef imports. Low-cost beef producing Latin American suppliers like Brazil and Argentina pose a competitive challenge to Namibia. Brazil, Argentina and Uruguay collectively supply 80% of all EU imports (Comext, 2007). The EU quota allocated to the Latin American exporters amount to 40,300 tons. Namibia underutilized its quota allocation of 13,000 metric tonnes which Chiriboga *et al* (2008) attributes to various supply constraints including risks related to environmental conditions such as droughts, bush encroachment and land degradation. There was a sharp reduction in Brazilian beef exports to the EU in 2007 due to stricter EU hygiene rules. The competitive threat from Mercosur suppliers is

enhanced by the potential reduction in tariffs on Brazilian and Argentinean beef products through the EU free trade agreement with Mercosur countries. Negotiations between these countries are still ongoing.

Figure 3b: EU Imported Beef Prices (CIF)[30] in Euro/kg by Category (1999-2009)



Source: Author's calculation based on Comext Data

Figure 3b depicts the price of fresh beef and frozen beef varieties. The price of fresh beef has been on average 56 % higher than that of frozen beef between 1999 and 2009. The fall in prices after 2001 is attributed to various measures of the EU common agricultural policy reforms. There was an increase in EU beef carcass prices after 2007, but this is largely due to the

[30] Includes cost, insurance and freight.

fall in Brazilian beef exports to the EU. In addition, only beef that meet grades A and AB is destined for the EU market, the lower grades are sold in the domestic and regional markets.

Market analysts report that there is a growing trend in the EU market of importing increasing volumes of high quality meat products while exporting high volumes of low-quality meat products (Agritrade, 2008). EU beef exports to ACP countries consist entirely of low-quality beef destined to the low-priced end of the market (Agritrade, 2006). For example, Angola and the Democratic Republic of Congo are now among the top ten destinations for EU beef products. The increase in imports of low-priced beef products from the EU poses competition for Namibia in expanding beef exports into the regional sub-Saharan Africa markets and is likely to compete directly with the production of small communal and emergent commercial farmers' production.

This paper does not focus on the cost of exporting to the EU market. However we note that exporting to the EU comes at a high cost of meeting stringent phytosanitary and food safety standards and quality specifications. The leading Namibian beef exporters are HACCP and ISO certified. In addition, the extension of animal welfare rules to all producers who export animal products to the EU market could significantly increase costs of exporting to the EU market. It is the additional specifications beyond HACCP requirements that also add to costs. For example, the EU recently required that cattle have double ear tags[31]; such a requirement add significant costs for farmers and many industry informants do not see the value of such a requirement. Given the overall small volume of beef exports by ACP countries, the cost of setting up

[31] Ear tags cost $N6.20/tag (about $0.90 USD/tag); all animals being sold must be tagged.

compliance verification systems could outweigh the benefits. Key industry informants[32] in the Namibian beef industry argue that the costs of meeting EU standards are high, but the value of exporting to the EU currently outweighs the costs. Thus, there is a revealed preference for the EU market in terms of profits. In addition, protected access to the EU market enabled the Namibian meat industry to upgrade its production facilities and to meet international standards and increased the marketability of Namibian meat products not only in the EU, but also in high-end niche markets in South Africa. The leading export abattoir spends approximately N$1.8 million (about 240,000 USD) in maintenance per plant per year. Despite these heavy investments to meet EU quality standards, Agritrade (2009) reports that Namibian farmers receive a price premium of N$ 183 million (about 24 million USD) above the prices received by comparable South African farmers.

The challenge to Namibia and other ACP countries is: how should they market their beef in the EU market? Given that there is a surplus of low-quality beef in the EU combined with imports from Latin American suppliers targeting the low-end EU meat market, how can Namibia export profitably to the EU's high-end market in light of ever increasing food safety and quality standards? While the answers to these questions remain unclear, the Namibian beef industry is currently adopting a highly differentiated marketing strategy including vacuum packing of individual beef cuts to meet high-end niche markets in the EU.

The discussion in this section points out that the Namibia and other ACP beef exporters receive different values for the different beef varieties they export to the EU market. It is thus important to analyze whether the proposed policy reforms have different implications for

[32] Tujendapi (Meatboard of Namibia) and Koos Classens (Meatco).

different types of beef products. Given this, a theoretical framework that captures the effects of trade policy instruments on quality composition is needed. Section 3.5 presents a conceptual framework and the consumer optimization problem that will be measured by the empirical simulations.

3.5 Empirical Model and Conceptual Framework

3.5.1 *Theoretical Context*

In "shipping out the good apples", Alchian and Allen (1964), demonstrate how per unit transaction cost lowers the relative price and increases the demand for high quality goods. Thus, per unit costs such as transportation costs lead firms to ship out the high quality goods abroad; but sell more of the lower quality goods in the domestic market. Put another way, fixed per unit transport costs results in a higher relative price of the least expensive quality and shifts the composition of imports raising the consumption of the higher priced good (Ramos, 2010). While Alchian and Allen applied their hypothesis in a two-good world, their basic hypothesis was further supported in a multiple-good world (Silberberg *et al* 1978; Umbeck, 1980; Buaman, 2004).

Some trade policy instruments including tariffs and quotas result in the Alchian-Allen effect similar to per unit transportation costs. For example, in a small country scenario, specific rate tariffs alter relative prices and result in export bias toward the higher (priced) quality good (Boorstein & Feenstra, 1991). Furthermore, other authors (Borcherding and Silberberg (1978) and Falvey, (1979) conclude that quota and specific taxes likely cause quality upgrading. On the other hand, *ad valorem* tariffs do not change the relative prices, (Boorstein and Feenstra, 1991),

and thus do not affect import composition. Quotas and quality controls affect both levels and composition of imports (Feenstra, 1991; Aw, 1986).

The EU trade policy of tariff rate quotas (TRQs) uses a combination of all the aforementioned policy instruments. Specifically, an exporter faces varying specific and *ad valorem* tariff rates depending on whether the exported goods are below or above the allocated quota. The EU trade policy is complex and the effects of varying its various components depend on the starting point of the quota fill rate (i.e. if the imported amount exceeds or is below the allocated quota).

Following Ramos (2010), the next section provides the conceptual framework that describes the trading regime of beef products between the EU and Namibia. It presents the optimization problem faced by the consumer under various simplifying assumptions and provides results for measuring import composition changes in response to the varying trade policy instruments.

3.5.2 *Consumer's optimization problem*

Assume a representative consumer who maximizes their utility. Further, assume that the consumer's utility function is homogenously separable. Thus, elementary goods can be consistently aggregated to form composite goods, which can be treated as the elementary goods. In this problem, we focus on the beef sector with three types of goods: a domestic beef product,

b_d, and two imported qualities[33] of beef products, a high quality type denoted by b_h^m and a low quality type denoted by b_l^m. This study assumes the EU to be one homogenous trade region. Since Namibia only has a 2.9% market share of EU beef imports and even less than that of the world beef trade, we treat it as a small country[34]. Thus, Namibia's competitors (notably Mercosur beef suppliers) will not respond to its policy since under the small country assumptions, the actions that Namibia take do not affect world beef prices. Since the EU is formalizing this trade policy with a small country, the same argument is extended to its competitors' response to EU-EPA trade negotiations. As a result, we only consider Namibia in the trade policy analysis and simulations. Further, assume that the consumer solves the utility maximization problem in two separate stages. First, they maximize the overall utility by choosing between the domestic and imported products. Second, they choose between the two imported beef qualities.

Let the first stage of the utility maximization problem be represented by a Cobb-Douglas utility function[35]. I use the Cobb-Douglas to simplify the comparative statics results presented in section 3.6.2. After a monotonic transformation to the Cobb-Douglas utility function, the utility function is written as a function built from sub-utility functions u^d and u^m as shown in equation (1): where u^d denotes the sub-utility function for the domestic beef product and u^m denotes the sub-utility function for the imported beef product.

[33] Both low and high quality beef products are hormone-free, free-rage and pasture-fed.
[34] If the country is "small" in international markets, then it has a very small share of world market for the product, and its policies are unable to affect the world price of the good.
[35] We relax this assumption later.

$$U(b_d, m) = \alpha_d \log(u^d(b_d)) + \alpha_m \log(u^m(b_h^m, b_l^m)) \quad (1)$$

This paper focuses on the trade policy effects and import composition, thus we will analyze the second stage of the maximization problem, namely maximizing (u^m), taking into account that import expenditure equals $R = I - d$, where I denotes total consumer income and d is the expenditure on the domestic good. Let the consumer's relative preferences of the two imported products be represented by a constant elasticity substitution (CES). The CES function in applied work allows direct inclusion of elasticities and price values into the equation (Rutherford, 1995). Equation (2) is the CES utility function for the imported beef varieties where all parameters are positive and $\rho \leq 1$. λ represents the consumer's relative preferences between the high and low quality beef products, and $\lambda_h > \lambda_l$.

$$U_m(b_h^m, b_l^m) = [\lambda_h (b_h^m)^\rho + \lambda_l (b_l^m)^\rho]^{1/\rho} \quad (2)$$

First, solve the consumer's maximization problem under free trade (in the absence of trade restrictions):

$$\underset{b_h^m, b_l^m}{Max} \; U_m(b_h^m, b_l^m) \; s.t \qquad R = p_h^w b_h^m + p_l^w b_l^m \text{ and } b_h^m, b_l^m \geq 0 \quad (3)$$

where p_h^w and p_l^w are assumed to be exogenous world prices[36].

[36] Both do not include tariffs and they reflect what the exporters get.

The associated Langragian function is shown in equation (4).

$$\underset{b_h^m, b_l^m}{Max} \; L(\cdot) = u_m(b_h^m, b_l^m) + \mu\left[R - p_h^w b_h^m - p_l^w b_l^m\right] \tag{4}$$

from the first order conditions (FOC) and after some algebra we derive the usual associated CES Marshallian demand function depicted in equation (5). The full algebraic derivations are in appendix 3A, the general demand equation for the CES utility function is shown in Varian (1992).

$$b_h^m = \frac{(\lambda_h / p_h)^{\sigma} R}{\left(\lambda_l^{\sigma}(p_l)^{1-\sigma}\right) + \left(\lambda_h^{\sigma}(p_h)^{1-\sigma}\right)} \quad \text{and} \quad b_l^m = \frac{(\lambda_l / p_l)^{\sigma} R}{\left(\lambda_l^{\sigma}(p_l)^{1-\sigma}\right) + \left(\lambda_h^{\sigma}(p_h)^{1-\sigma}\right)} \tag{5}$$

where $\sigma = \frac{1}{1-\rho}$ is the elasticity of substitution.

If we divide the Marshallian demand function for the high quality beef by the Marshallian demand function for the low quality beef, we get demand for high quality beef relative to the low quality. This relative demand is given by the expression in equation (6)

$$\frac{b_h^w}{b_l^w} = \left(\frac{\lambda_h p_l^w}{\lambda_l p_h^w}\right)^{\sigma} \tag{6}$$

Expression in equation (6) is used as the quality indicator to show how changes in prices resulting from the different trade policy components change the quality composition of beef imports. The following section provides the specific components of the EU trade policy and it is

followed by a formal presentation of comparative statics on how changing the different trade policy components change the quality composition of beef imports.

3.6 EU Trade Policy

3.6.1 Tariff Rate Quota

As described in the EU trade policy section, the EU trade regime consists of the tariff rate quota (TRQ) and mixed tariff structure. The TRQ is only applied to the high quality good. The TRQ consists of a quantitative ceiling ($\bar{q}_h$), and an in-quota *ad valorem* tariff rate (t_h), which differs from out-of-quota *ad valorem* tariff rate, t and a specific tariff rate (T). TRQ is not applied to the low quality product. The low quality product is subjected to mixed tariffs equal to the out-of quota tariffs for the high quality product and it is not affected by quantitative restrictions.

The above TRQ components introduce several restrictions, and we rewrite the maximization problem as a mixed-complimentarity problem (MCP). The motivation for the mixed complimentarity problem[37] by Rutherford (1995) is provided in appendix 3B. Following Rutherford's MCP the consumer's optimization problem becomes:

$$\underset{b_h^m, b_l^m}{Max}\ U_m(b_h^m, b_l^m) \quad s.t \tag{7}$$

[37] MCP is a mathematical way to formulate an optimization that is not free or that has bounds, which can be solved by finding the Khun-Tucker conditions. It is needed to model TRQs because the utility optimization problem has restrictions that are expressed as inequalities and some variables have two possible results: zero or positive only (e.g. imports in-quota or imports out – of quota). See appendix 3B and Rutherford (1995) for further motivation on MCP.

$$R = p_h^w b_h^m + p_l^w b_l^m \tag{8}$$

$$b_h^m = b_h^{m_{in}} + b_h^{m_{out}} \quad b_h^{m_{in}} < \bar{q}_h; \tag{9}$$

$$t^m \leq \frac{T}{p_h^w} + t - t_h \tag{10}$$

$$b_h^m, b_l^m, b_h^{m_{in}}, b_h^{m_{out}}, t^m \geq 0 \tag{11}$$

where $b_h^{m_{out}}$ and $b_h^{m_{in}}$ are the out of quota and in-quota high quality beef imports respectively; p_h^w and p_l^w are the world beef prices for high and low quality beef respectively and both do not include tariffs' t^m determines the value of the marginal tariff rate and its value depends on whether the quota is filled. The value that t^m takes depends on the three quota fill rates:

(1) in-quota: $t^m = 0$ if $b_h^{m_{in}} < \bar{q}_h$ (12)

(2) at-quota: $0 < t^m < \left(t + \frac{T}{p_h^w} - t_h \right)$ if $b_h^{m_{in}} < \bar{q}_h$ (13)

(3) out-of quota: $t^m = \frac{T}{p_h^w} + t - t_h$ if $b_h^{m_{in}} < \bar{q}_h$ (14)

When the quantity of the high beef products is below its quota, the marginal tariff rate is zero. The marginal tariff is the tariff equivalent quota premium. It is the extra protection over the in-quota tariff that is due when the quota is binding. The at-quota marginal tariff lies between zero and $t + \frac{T}{p_h^w} - t_h$, and marginal tariff in the out-of-quota outcome is $t^m = t + \frac{T}{p_h^w} - t_h$ (this

expression determines the quota rent). The exogenous world price and tariff rates determine the prices for high-quality beef for the in-quota and out-of quota outcomes. When the quota is binding, the value of t^m determines the domestic price for high quality beef product: $p^h = p_h^w(1+t_h+t_m)+T$ where t^m varies with the equilibrium outcome and p_h^w is the high quality beef product price and it approximates cost, insurance and freight (CIF). Composite tariffs affect the low quality beef imports such that $p^l = p_l^w(1+t)+T$, where $p_l^w < p_h^w$ by assumption[38] is the CIF price for the low quality beef product.

To facilitate the use of the mixed complimentarity problem technique and to show how the simulations are set up, we re-write the TRQ restrictions above as the complimentarity conditions in equations (15) – (18). Each TRQ possible outcome is associated with $b_h^{m_{in}}, b_h^{m_{out}}$ and t^m.

$$p^h \le p_h^w(1+t_h) \qquad \perp b_h^m \ge 0; \qquad \left[p_h^w(1+t_h)-p^h\right]b_h^{m_{in}} = 0 \qquad (15)$$ [39]

$$\bar{q}_h \ge b_h^{m_{in}} \qquad \perp t^m \ge 0; \qquad \left(\bar{q}_h - b_h^{m_{in}}\right)t^m = 0 \qquad (16)$$

$$p^h \le p_h^w\left(1+t+\frac{T}{p_h^w}\right) \qquad (17)$$

[38] This assumption is based on price data for fresh/chilled and frozen beef product varieties.

[39] $\perp$ ("perp"): symbol indicates pair-wise complimentarity between the specified variable in front of $\perp$ and the other variables and its bounds. It means that the results on each side are complements in order to fill the equality condition.

$$\perp b_h^{m_{out}} \geq 0; \quad \left[p_h^w \left(1 + t + \frac{T}{p_h^w} - \right) p^h \right] b_h^{m_{out}} = 0 \qquad (18)$$

3.6.2 Trade Quality Composition Effects

This section provides comparative statics on how relative demand (quality composition ratio shown in equation (6), changes in response to changes in the trade policy instruments. The effects of the EU trade policy on the trade quality composition vary according to specific components and the initial trading regime (according to the fill rate of the quota). These results are summarized in table 3c.

3.6.2.1 Quality Composition Effects

The comparative statics analysis below reveals the effects of specific tariffs, *ad valorem* tariff and quotas on quality composition. The relative demand function for the free trade scenario is given by equation (6), $\frac{b_h^m}{b_l^m} = \left(\frac{\lambda_h p_l^w}{\lambda_l p_h^w} \right)^\sigma$. But when we include the different components of the TRQ and mixed tariff structure of the EU trade policy, the relative demand function takes on the various components of the trade restrictions depending on the quota fill rate as shown in the following two equations:

$$\frac{b_h^m}{b_l^m} = \left(\frac{\lambda_h p_l}{\lambda_l p_h} \right)^\sigma = \left(\frac{\lambda_h p_l^w (1+t) + T}{\lambda_l p_h^w (1+t_h)} \right)^\sigma \qquad (b_h^m < \bar{q}_h)$$

$$\frac{b_h^m}{b_l^m} = \left(\frac{\lambda_h p_l}{\lambda_l p_h}\right)^{\sigma} = \left(\frac{\lambda_h (p_l^w (1+t)+T)}{\lambda_l (p_h^w (1+t_h)+T)}\right)^{\sigma} \qquad (b_h^m > \bar{q}_h)$$

Change in In-Quota Ad Valorem Tariffs

In-quota *ad valorem tariffs* apply when the high quality beef imports are below the given quota level or at the quota level. When $b_h^m < \bar{q}_h$ the marginal change in the relative demand of high and low quality beef in response to change in the *ad valorem tariff* t_h is:

$$\frac{\partial b_h^m / b_l^m}{\partial t_h} = -\frac{\left(p_l^w (1+t)+T\right)\sigma\lambda_h \left[p_l^w (1+t)+T\right]\lambda_h / (1+t_h) p_h^w \lambda_l)^{\sigma-1}}{(1+t_h)^2 p_h^w \lambda_l} < 0 \qquad (19)$$

A reduction of t_h has an upgrading effect on the quality composition of imports. However, when the quota is binding, reducing t_h only increases the quota rent. Since, p_h and b_h^m remain unchanged, changing t_h has no impact on quality composition when the quota is binding.

Change in Specific Tariff

When the imports of high quality beef are below the quota level, a decrease in the specific tariff affects only the price of low quality beef imports. Such a change decreases the relative price of low-quality imports; hence, the relative share of low quality imports increases and this leads to a quality downgrading effects as shown (20).

$$\frac{\partial b_h^m / b_l^m}{\partial T} = \frac{\sigma\lambda_h\left(\left(p_l^w(1+t)+T\right)\lambda_h\right)/p_h^w(1+t_h)p_h^w\lambda_l)^{\sigma-1}}{p_h^w(1+t_h)\lambda_l} > 0 \quad \text{if} \qquad b_h^m < \bar{q}_h \qquad (20)$$

When high quality imports exceed the quota, $b_h^m > \bar{q}_h$, reducing the specific tariff also has a quality downgrading effect due to the Alchian-Allen effect. The following equation shows the downgrading effect:

$$\frac{\partial b_h^m / b_l^m}{\partial T}\sigma\left(\frac{\lambda_h}{\left(p_h^w(1+t)+T\right)\lambda_l} - \frac{\left(p_l^w(1+t)+T\right)\lambda_h}{\left(p_h^w(1+t)+T\right)^2\lambda_l}\right)\times\left(\frac{\left(p_l^w(1+t)+T\right)\lambda_h}{\left(p_h^w(1+t)+T\right)\lambda_l}\right)^{\sigma-1} > 0 \qquad (21)$$

When the fill rate of the TRQ is exactly binding ($b_h^m = \bar{q}_h$), changing the specific tariff affects both p_l and the upper bound of the marginal tariff (t^m). This can result in a shift to an out-of-quota import scenario. If so, both b_h^m and b_l^m will increase, but a decrease in T results in quality downgrading because it affects low quality imports (b_l^m) more than high quality imports (b_h^m). If changing T leaves import scenario at the at-quota outcome, then b_l^m will increase resulting in quality downgrading. Overall, equations (20) and (21) show that a decrease in the specific tariff result in quality downgrading since it affects low quality beef imports (b_l^m) more than high quality beef imports (b_h^m) due to the Alchian-Allen effect.

Change in Ad Valorem Tariff

Out-of quota *ad valorem* tariffs, t, is imposed on both types of beef qualities. Its effect on quality composition changes depending on the TRQ fill rate. When high quality imports are below the quota, changing t has a quality downgrading effect because it only affects low quality beef imports and results in an increase in the low quality beef imports as demonstrated below:

$$\frac{\partial b_h^m / b_l^m}{\partial t} = \frac{p_l^w \sigma \lambda_h \left(\left(p_l^w (1+t) + T \right) \lambda_h \right) / \left((1+t_h) p_h^w \lambda_l \right)^{\sigma-1}}{(1+t_h) p_h^w \lambda_l} > 0 \qquad \text{if } b_h^m < \bar{q}_h \qquad (22)$$

If high quality imports exceed the quota, $b_h^m > \bar{q}_h$, changing t has a quality upgrading effect on the average quality.

$$\frac{\partial b_h^m / b_l^m}{\partial t} \sigma \left(\frac{p_l^w \lambda_h}{\left(p_h^w (1+t) + T \right) \lambda_l} - \frac{p_h^w \left(p_l^w (1+t) + T \right) \lambda_h}{\left(p_h^w (1+t) + T \right)^2 \lambda_l} \right) \times \left(\frac{\left(p_l^w (1+t) + T \right) \lambda_h}{\left(p_h^w (1+t) + T \right) \lambda_l} \right)^{\sigma-1} < 0 \qquad (23)$$

Change in High Quality Quota

If the initial import level is in-quota, an increase in the high quality beef quota level does not affect quality composition. This scenario particularly applies to Namibia since it has never exported above its quota level. However, when the quota is binding, increasing the quota level will increase high quality beef imports. Increasing $\bar{q}_h$ reduces the marginal tariff (t^m) and p_h

since $\frac{\partial t_m}{\partial \bar{q}_h} < 0$. A reduction in p_h implies a reduction in b_l^m [if b_h^m and b_l^m are gross substitutes ($\sigma > 1$)].

$$\frac{\partial b_h^m / b_l^m}{\partial \bar{q}_h} = \frac{\left(p_l^w(1+t)+T\right)^\sigma}{\lambda_l^\sigma R} \times \left(\left(\lambda_h^\sigma (p_h^w(1+t_h+t_m)\right)^{1-\sigma} + \lambda_l^\sigma (p_l^w(1+t+T)^{1-\sigma} \right)^2 + (1-\sigma)\lambda_h^\sigma \frac{\bar{q}_h p_h^w}{(p_h^w(1+t_h+t_m)^\sigma} \frac{\partial t_m}{\partial \bar{q}_h} > 0 \quad (24)$$

If the new quota level is larger than the initial high quality equilibrium, then the new equilibrium will be at-quota or in-quota levels, and in both cases, b_h^m will increase while p_h and b_l^m decrease. This results in quality upgrading. Since Namibia has only exported below its allocated quota, we will only focus on the changes at the in-quota and at–quota levels. Table 3c summarizes the effects on quality composition in response to changes in the various trade policy instruments at the three possible trade TRQ equilibria.

3.6.2.2. Summary of Comparative Statics Results

Table 3c summarizes the results of the comparative statics results that we derived in the previous section. Results are summarized according a change in each policy instrument by the three TRQ regimes. The (+) sign denotes quality upgrading and the (-) sign denotes quality downgrading.

Table 3c: Comparative static results summary: Alchian-Allen effect under TRQ

	In-Quota	At-Quota	Out-of- Quota
Ad Valorem tariff (in-quota)	-	0	0
Ad Valorem tariff (out-of-quota)	+	-/+	-
Specific tariff	+	+	+
Quota volume	0	+	0/+

(+) denotes quality upgrading; (-) denotes quality downgrading

The effects on import composition from changing *ad valorem* tariffs vary according to the TRQ regime. Since, the proposed trade scenarios include varying both instruments simultaneously under some policies the overall effect on import composition depends on which instrument has a stronger impact. To assess how the trade policies affect consumers' welfare we discuss one such measure, the equivalent variation, in the next section.

3.7 Equivalent variation

The simulations based on the details provided in the previous sections show how trade alternatives change the composition of beef quality, prices and traded volumes. To provide an indication on how the policy alternatives affect the consumers' welfare, we calculate the

equivalent variation. Equivalent variation can be thought of as the dollar amount that the consumer will be indifferent to about accepting in lieu of the price change. That is the change in her wealth that would be equivalent to the price change in terms of its welfare impact (Mas-Colell, 1995). Equivalent variation is negative if the price change makes the consumer worse off. Equation (25) shows the calculation of equivalent variation in the initial trade regime. In this analysis, the initial scenario refers to the preferential trade regime and it is denoted by the index "0" in the calculation.

$$EV^{O} = E\left(p_W, u^{O}\right) - E\left(p_W, t^{O}, t_h^{O}, T^{O}, \bar{q}_h^{O}, u^{O}\right) \tag{25}$$

Where $E(p_W, u^O)$ is the expenditure function (inverse of the consumer's indirect utility function) and it gives the minimum amount of income necessary to achieve utility level u^O of the initial trade scenario (preferential market access) at free trade price, p_W and the level of protection of the initial trade scenario denoted by *ad valorem* tariffs, t^O, t_h^O for both beef varieties, specific tariff T^O, and quota, $\bar{q}^O$.

To show how equivalent variation changes with the different trade alternatives, I calculate the change in equivalent variation, denoted by ΔEV^i for each trade alternative i. Then one can compare equivalent variation in each trade scenario i to the EV in the initial scenario, EV^O. Therefore, a positive ΔEV^i is a positive net gain for the consumer. Equation (26) presents the calculation of change in equivalent variations, ΔEV^i.

$$\Delta EV^{o} = E\left(p_w, u^{i}\right) - E\left(p_w, t^{i}, t_h^{i}, T^{i}, \bar{q}_h^{i}, u^{i}\right) - E\left(p_w, u^{o}\right) - E\left(p_w, t^{o}, t_h^{o}, T^{o}, \bar{q}_h^{o}, u^{o}\right) \qquad (26)$$

In addition to equivalent variation, tariff revenue is calculated for the EU. Export revenue and quota rent represent some form of welfare measure for Namibia. Appendix 3B shows the expressions we use to calculate the aforementioned measures.

The next section discusses the data used in the simulations and the stylized trade scenarios.

3.8 Data and Stylized Trade Scenarios

3.8.1 Calibration Data

This study utilizes beef imports from Namibia to the 27 EU member countries and their cost insurance freight (CIF) value at the CN 8-digit level of the EU classification (a domestic sub-division of the United Nations Harmonized System). I use secondary trade data. Detailed import quantities from Namibia (in 100 kg) and CIF values (in euros) are used. The CIF price data was calculated by dividing the CIF values by the import quantities. As noted before, the EU is treated as one homogenous region. The different types of beef qualities[40] are classified according to two preservation modes (fresh and frozen) used by the European commission. Fresh boneless represents the high quality variety and frozen boneless beef represents the low-quality type.

[40] High quality includes line 020130 and low quality includes line 020230 from COMEXT database. Note that only meat from beef carcass of grades A, AB and some B are exported to the EU market from Namibia. Thus, these two preservation modes include these grades. The available data do not differentiate according to grade.

The calibration data are based on 2005 beef imports. This benchmark year represents a stable agricultural year in which there were no disruptions in supply due to droughts, and the preferential market regime was still in effect in the benchmark year. The European import values are from the Eurostat's COMEXT database. The baseline is characterized by an in-quota equilibrium whereby Namibian beef exports to the EU are below the quota level. The unit values of imports are used to approximate CIF prices. The high quality beef quota, in-quota and out-of-quota tariff rates are from the TARIC database. The tariff rates for the initial trade scenario are from various secondary sources (including Agritrade, 2007; Meyn, 2006). Table 3d below presents the calibration data for 2005.

Table 3d: Calibration Data (2005)

Variables/Parameter		Variable Definition	Initial Values	Data Source
b_h^w	(100 kg)	Imported beef (high quality)	66,266	COMEXT
b_l^w	(100 kg)	Imported beef (low quality)	30,451	COMEXT
d	(€ billion)	Expenditure on domestic beef	37.5	INRA/OFIVAL
p_h^w	(€/kg)	CIF high quality beef price	4.81	COMEXT
p_l^w	(€/kg)	CIF low quality beef price	2.12	COMEXT
t	(%)	In–quota *Ad valorem* tariff	12.8	TARIC
t_h	(%)	Out-of quota *ad valorem* tariff	0	TARIC
$\underline{T}$	(€/100kg)	Specific tariff	24.2	TARIC
$\bar{q}_h$	(thousand tons)	Quota	13	TARIC
p_h	(€/kg)	Price of high quality imported beef sold in the EU market	5.62	Calculated
p_l	(€/kg)	Price of low quality imported beef sold in the EU market	2.73	Calculated
p_d		Price for domestic beef sold in the EU	1	Assumption
σ	(€/kg)	Elasticity of substitution	3.85	GTAP

The EU domestic beef expenditures figures are from the French marketing board (OFIVAL). The global trade analysis project (GTAP) elasticity for bovine meat, σ=3.85, is used for the elasticity of substitution. Also, we use alternative elasticity values to carry out sensitivity analysis.

As mentioned before, a LES-CES specification is used to replace the Cobb-Douglas utility specification in the numerical simulations. The specification embodies more realistic assumptions[41] concerning the substitution between domestic production and imports (Ramos, 2009). The 2005 base data are used as initial values of the expenditure share in calibrating the coefficients of the LES-CES function and other parameters. The system of equations is solved using the GAMS software package to find the equilibrium solution. The next section discusses the stylized trade scenarios.

[41] It specifies a subsistence quantity where no utility is obtained; the remaining income, after the subsistence expenditure, is allocated between the domestic good and the two imported beef varieties.

3.8.2 Stylized Trade Policy Scenarios

Table 3e shows the stylized trade scenarios used in the policy simulations. We put the rates specified in this table directly into the model developed in sections (4) and (5) to simulate the results for the five trade policy scenarios.

Table 3e: Stylized Trade Scenarios

	Quota	**Specific tariff (€/kg)**	***Ad valorem* tariff (%)**
1. Preferential Market Access: PMA	13 (10^3)	High: 0.242 Low: 0.176	High: 0 Low: 0
2. Economic Partnership Agreement: EPA	0	High: 0 Low: 0	High: 0 Low: 0
3. Generalized System of Preferences: GSP	0	High: 3.034 Low: 2.211	High: 12.8 Low: 12.8
4. Enhanced GSP A: GSP^+	13 (10^3)	High: 0 Low: 0	High: 9.3 Low: 9.3
5.Enhanced GSP B: GSP^{++}	0	High: 2.12 Low: 1.54	High: 9.3 Low: 9.3

*High= fresh beef and Low= frozen beef

The preferential market access (PMA) is the initial trade scenario. The economic partnership agreement (EPA) is based on the interim EPA agreement of 2007. This scenario

involves eliminating all tariffs (specific and *ad valorem)* for both high quality and low quality beef varieties, and quotas. In essence, this alternative is similar to a free trade scenario. In the standard GSP alternative *ad valorem* tariff rate of 12.8% is applied to both beef varieties. In addition, a specific tariff rate of 3.034€/kg is applied to high quality beef, while 2.211€/kg is applied to low quality beef.

The enhanced GSP scenarios include two options: The GSP^{+}[42] has an effective quota of 13,000 tons of beef and a 3.5 percentage point reduction of the MFN *ad valorem* tariff rates, i.e 9.30% in *ad valorem tariff*, and no specific tariff rates. The GSP^{++}[43] is quota-free, and it has the same *ad valorem* tariff rates as the GSP^{+} and 30% reduction in MFN specific tariff rate for both beef varieties. Thus, the high and low quality beef varieties face 2.12 €/kg and 1.54 €/kg in specific tariffs respectively.

The above trade alternatives are compared to the initial preferential market access (PMA) trade regime. The PMA has a quota of 13,000 tonnes, no *ad valorem* tariff rates for both beef varieties, but it applies 0.242€/kg specific rates for high quality beef and 0.176€/kg specific tariffs for the low beef variety. Export volumes are below the quota level in the initial trading situation. The following section presents the results and conclusion.

[42] Specified in Council Regulation (EC) No 732/2008: Section1 Article 6; includes quota, no specific tariffs.

[43] Specified in Council Regulation (EC) No 732/2008: Section1 Article 6.

3.9 Empirical Results

Table 3f reports the quality composition effects of the different trade scenarios at different values σ (elasticity of substitution). This quality indicator is calculated according to equation (6) in the conceptual framework section. The quality composition indicator gives an idea about the import demand of high quality beef relative to low quality beef. When the change in the quality composition indicator from the base scenario to any other trade scenario is positive, then it denotes quality upgrading and when the change is negative then it denotes quality downgrading. The quality indicator also indicates the orientation of trade. When it is greater than 1, then trade is oriented toward the high quality segment and when it is less than 1, then trade is oriented toward the low quality segment. The preferential market access (PMA) scenario is the initial or base scenario. The change in the quality indicator is analyzed relative to the initial trade scenario results.

Table 3f: Quality Composition Effects

Trade Scenario	$\sigma = 3.85$	$\sigma = 2$	$\sigma = 6.5$
PMA	4.785	4.785	4.785
EPA	3.704	4.188	3.104
GSP	7.352	5.981	9.879
GSP^{+}	5.215	5.004	5.534
GSP^{++}	6.411	5.570	7.841

Tables 3g, 3h and 3i report the trade, price and welfare results at different values of σ *at* σ*=3.85,* σ*=2 and* σ*=6.5* respectively.

Table 3g*: Trade, Prices and Welfare Results at* ***σ=3.85***

Variable	Initial Scenario	EPA		GSP		GSP^{+}		GSP^{++}	
		Value	Change	Value	Change	Value	Change	Value	Change
σ=3.85									
p_h^m(€/kg)	5.624	5.624	0	9.378	66.3	5.624	0	8.267	46.9
P_l^m(€/kg)	2.733	2.557	-6.4	5.096	86.5	2.795	2.7	4.335	58.6
b_h^m(10^3 tons)	6.626	6.469	-2.4	3.326	-49.8	6.675	0.7	3.717	-43.9
b_l^m(10^3 tons)	3.045	3.841	26.1	0.994	-67.4	2.814	-7.5	1.275	-58.1
d(10^9 □)	37.5	37.4	-0.3	37.5	0	37.5	0	37.5	0
EV	-0.404	-		-		-		-	
ΔEV (10^6 €)		0.404		-9.888		-0.121		-8.318	
ER (10€)	45.059	46.211	2.6	21.254	-52.8	44.743	0.7	24.170	-46.4
TR (10^6 €)	0.535	-		15.013	2706	0.669	25	12.092	2160
QR (10^6 €)	0	0		0		0		0	

ER = export revenue; TR=tariff revenue; QR=quota rent ; change (%)

Table 3h*: Trade, Prices and Welfare Results at* $\sigma=2$

Variable	Initial Scenario	EPA		GSP		GSP^{+}		GSP^{++}	
		Value	Change	Value	Change	Value	Change	Value	Change
σ=2									
p_h^m(€/kg)	5.624	5.624	0	9.378	66.7	5.624	0	8.267	46.9
P_l^m(€/kg)	2.733	2.557	-6.4	5.096	86.5	2.795	2.2	4.335	58.6
b_h^m(10^3 tons)	6.626	6.555	-1.1	4.152	37.3	6.649	0.3	4.566	-31.1
b_l^m(10^3 tons)	3.045	3.441	13.0	1.526	-49.8	2.922	-4.0	1.802	-40.8
d(10^9 □)	37.5	37.49	-0.0	37.5	0	37.5	0	37.5	0
EV	-0.381	-		-		-		-	
ΔEV (10^6 €)	-	0.381		-13.444		-0.123		-10.556	
ER (10€)	45.059	45.676	1.36	27.260	-39.5	44.875	0.8	30.297	-32.7
TR (10^6 €)	0.535			19.463	3537	0.695	29.9	15.275	2755
QR (10^6 €)	0	0		0		0		0	

ER = export revenue; TR=tariff revenue; QR=quota rent ; change (%)

Table 3i*: Trade, Prices and Welfare Results at* ***σ=6.5***

Variable	Initial Scenario	EPA		GSP		GSP^{+}		GSP^{++}	
		Value	Change	Value	Change	Value	Change	Value	Change
σ=6.5									
p_h^m(€/kg)	5.624	5.624	0	9.378	66.7	5.624	0	8.267	46.9
P_l^m(€/kg)	2.733	2.557	-6.4	5.096	86.5	2.795	2.3	4.335	58.6
b_h^m(10^3 tons)	6.626	6.333	-4.2	2.821	-57.4	6.710	1.3	3.068	-53.7
b_l^m(10^3 tons)	3.045	4.485	47.3	0.628	-79.4	2.666	12.6	0.860	-71.8
d(10^9 □)	37.5	37.4	-0.3	37.5	0	37.5	0	37.5	0
EV	-0.441	n/a		n/a		n/a		n/a	
ΔEV (10^6 €)	-	0.441		-6.809		-0.117		-6.147	
ER (10€)	45.059	47.095	4.5	17.476	-61.2	44.564	-1.1	19.460	-56.8
TR (10^6 €)	0.535			12.186	2177	0.634	18.5	9.640	1701
QR (10^6 €)	0	0		0		0		0	

ER = export revenue; TR=tariff revenue; QR=quota rent ; change (%)

Table 3f reveals that the overall trade orientation is toward high quality beef. Change in the quality indicator reveals quality upgrading in all the trade scenarios except the EPA. In the EPA scenario, moving from preferential market access to the economic partnership agreement, all tariffs and quotas are eliminated. This policy change has a quality downgrading effect on the EU's beef imports from Namibia. The downgrading effect is consistent at all levels of σ. The ratio between high and low quality beef imports shifts from 4.7 to 3.7 at $\sigma = 3.85$ and it is lowest at $\sigma = 6.5$. The price for low quality beef falls by 6.4% and low quality beef imports rise by 26%. This change is consistent with *a priori* expectations. On the other hand, the price for high quality beef remains unchanged, but high quality beef imports fall slightly by 2.4%. Since the starting regime is below quota, the change in import composition is primarily attributed to the elimination in specific tariffs instead of the quota elimination. This result is consistent with the Alchian-Allen conjecture. The removal of specific tariffs lowers the relative price of the low quality beef product and increases the import demand of the low quality product. Overall, this scenario grants free trade access into the EU market and it is most favored by Namibian beef exporters.

The second policy option includes exporting beef under the standard GSP regime. Under this scenario, Namibia would pay the most favored nation (MFN) *ad valorem* tariff rate of 12.8%, and the specific tariffs would increase by approximately 92%. This policy change results in a significant increase in the quality composition indicator. The quality composition changes from 4.7 to 7.35 at $\sigma = 3.85$, and to 5.9 at $\sigma = 2$. This policy change results in quality upgrading. Since, this scenario is quota-free the quality upgrading is due to specific tariffs and *ad valorem* tariffs; i.e. more of the "good beef is shipped out". Prices of both beef qualities increase,

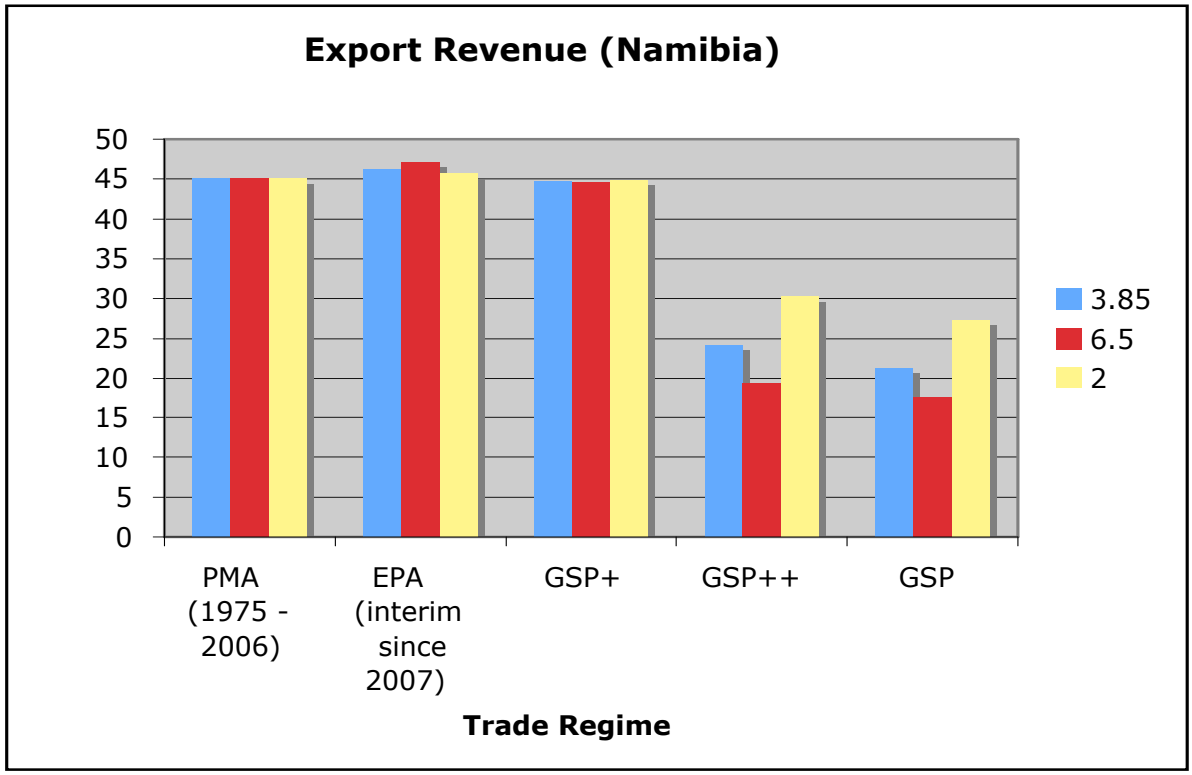
and the imported volume of both beef varieties fall, but the volume of low quality beef falls by 18 percentage points more than that of the high quality beef. It is difficult to differentiate what weight each instrument contributes to the upgrading effect, but it is reasonable to argue that the 92% increase in specific tariffs contributed more to the quality upgrading.

In the enhanced GSP options (GSP^{+} and GSP^{++}), beef exporters pay *ad valorem* tariff rates, specific tariffs are eliminated in the GSP^{+} alternative and not in GSP^{++} option, and the GSP^{+} option has a quota. The ratio between high quality and low quality beef imports increases under both scenarios. The quality composition indicator increases from 4.7 to 5.21 and 6.41 under the GSP^{+} and GSP^{++} respectively. Thus, shifting from preferential trade to the enhanced GSP options has a quality upgrading effect; the quality upgrading effect is stronger in the GSP^{++} option that has both types of tariffs. However, since the *ad valorem* tariffs are the same for both beef qualities under the GSP^{++} scenario, the quality upgrading is due to the specific tariffs.

The level of tariff protection is the same for both beef varieties under the GSP^{+} option, thus the quality upgrading effect is due to the quota which is the only effective protection in this trade scenario. High quality beef import demand increase slightly by 0.7% under GSP^{+}, but fall significantly by 43% under the GSP^{++} option, because the relative high quality beef price increases. Low quality beef imports fall under both options, but it falls more in the GSP^{++} alternative due to the higher tariffs. The demand for high quality beef increases under the GSP^{+}

scenario by 0.7%, but falls in the EPA option by 2.4%. Since both trade scenarios are quota free and specific tariffs are removed, the slight increase in the demand for high quality beef may be due to the 9.3% *ad valorem* tariffs. Overall, the results are consistent with the Alchian-Allen conjecture, and confirm that per unit specific and quantitative restrictions have a quality upgrading effect.

Figure 3c: Annual Namibian Export Revenue Results by Trade Regime and σ at 3.85, 6.5 and 2.



Note: Revenue is in Euro (million)

Figure 3c shows that shifting from the preferential trade regime (PMA) to the economic partnership agreement (EPA) increases export revenue for Namibia slightly by 2.6% at σ=3.85 and by 1.36% at σ=2. On the other hand, shifting to the standard GSP regime decreases export revenue significantly by 52.8%, and Namibia would earn approximately 21 million euros instead of 45 million euros per year under the preferential market trade agreement. Export revenue falls

by 0.7% under the GSP^{+}; regime and by 44% under the GSP^{++}. Thus, from an export revenue perspective, the best option for Namibia is the EPA followed by GSP^{+}; the worse alternatives are the standard GSP, followed by the GSP^{++}. As expected, tariff revenue for the EU increases significantly under the standard GSP and GSP^{++} trading arrangements, while it is insignificant under the GSP^{+} and zero under the EPA agreement.

Change in equivalent variation is negative under all trade scenarios except for the EPA option. Thus, only the EPA trade scenario represents a net gain for EU consumers. The GSP and GSP^{++} represent the worse scenarios for the consumer, because more income would have to be taken away from them at free trade prices, to leave them just as well off as they would be under the initial preferential trade regime. Hence, the EU consumer is better off at the free trade scenario, which, in a sense is represented by the EPA trade agreement[44].

3.9 Conclusion

Preferential market access marked the trading relationship between the EU and ACP countries for three decades. After a successful challenge from other developing countries, the WTO ruled the non-reciprocal preferential trade agreement to be inconsistent with the WTO non-discriminatory trading requirement. As a result, the EU embarked upon a new trading regime, the economic partnership agreement with ACP countries. There is uncertainty regarding

[44] To make a sound conclusion, one has to estimate more welfare measures including changes in consumer surplus, the potential effect of the loss of tariff revenue in the provision of public services, and other cost and benefit analyses.

the potential effects on the proposed agreement on certain sectors that had previously enjoyed significant preferential market access under various commodity protocols. This is the case with the Namibian beef exports to the EU.

The EU tariff structure consists of a combination of TRQs, specific and *ad valorem* tariff rates. Specific tariffs and quotas result in an Alchian-Allen effect and introduce bias in the import composition. These quality composition effects are important to consider as they have different implications to suppliers upstream in the beef supply chain. In this paper we presented a framework to analyze the potential impact of three trade policy alternatives on Namibian beef exports of the EU market. Specifically, we analyze how changes in the various components of the EU tariff regime affect not only trade volumes, but also the quality composition of beef imports.

The EPA trade agreement has a quality downgrading effect on beef imports from Namibia. The results show that all the GSP trade alternatives have a quality upgrading effect and are consistent at all the chosen elasticity levels. Namibian beef exporters currently implement a highly differentiated beef marketing strategy in the EU focusing on the high quality end of the beef market. This strategy is sensible in light of the high volumes of low quality beef varieties from low cost beef producers like Brazil, and in light of the higher prices for high quality beef. However, if Namibia signs the final EPA trade agreement, results show that the EPA has an quality downgrading effect on the demand for beef imports from Namibia. This may make it easier for communal farmers to supply cattle that yield more of the frozen meat category, because most communal farmers especially in the Northern Communal Area have smaller

framed cattle (based on the Sanga breed). Thus, the quality downgrading effect of the EPA agreement could increase communal farmers' participation in the beef export channel, and this has positive implications for rural poverty alleviation.

The key finding is that high and low quality beef imports respond differently to the changes in the EU trade policy instruments. Hence, beef exporters should consider these quality composition effects in their marketing strategy and trade agreement negotiations. For example, focusing on the high quality end of the market makes sense in terms of market positioning, but the EPA results also present an opportunity to expand the frozen beef category. Overall, from a market access perspective, the EPA agreement is the favorable option for Namibian beef exporters and for the EU consumers. The standard GSP trade alternative will significantly diminish the value of the EU beef market for Namibian beef exporters.

These results are based on simplifying assumptions; no changes in world beef prices; the cost of exporting to the EU market; the EU's domestic common agricultural policy reforms are not taken into account. Nonetheless, these findings are important to consider in the trade policy reform analyses and negotiations. Further research should take into account the cost of exporting to the EU market, especially in terms of meeting EU grades and standards and quantifying the cost of non-trade barriers, and should pay attention to imports and domestic production substitution.

The key aspect of this study is that we do not treat beef as just a commodity, but as a differentiated product. Our results show that the different quality varieties of beef respond

differently to the trade policy alternatives. In light of the importance that the beef sector plays in the livelihoods of many Namibians, these results point to an important feature for trade negotiators to consider. These results add value to the debate, because the EPA trade agreements are still ongoing.

3.11 Policy Recommendations

Among the policy alternatives discussed in this study, the economic partnership agreement is the favorable option for the Namibian beef sector. If Namibia and the other SADC countries manage to resolve the remaining contentious issues described in section 3.2.1, it is recommended that Namibia negotiate a full EPA agreement. The next best option is the GSP^{+} and it can only be implemented if Namibia succeeds to attain a least developed country status. The results based on the economic partnership trade agreement provide an opportunity for greater communal farmers' participation in the beef export channel. Increased communal farmers' participation in the beef export channel is necessary for the EPA to have a greater impact on poverty alleviation and rural development. However, to increase communal farmers' participation, supply side constraints and factors that hinder communal farmers participation in the beef export channel must be addressed.

A two-pronged approach is recommended to expand exports from communal areas: the Namibian government should aggressively implement the necessary steps to extend the veterinary line further north, so that an increased portion of the Northern Communal area (NCA) can attain a foot and mouth disease-free status. This will allow more cattle in NCA to be sold to the EU market. Second, a key constraint to communal farmer participation is land availability.

Thus, it is recommended that the government revisit its land reform policy to assure more land resettlement.

Export abattoirs should increase their efforts to increase cattle procurement in communal areas. Measures including stronger cooperation with farmers' association, changing export abattoirs' payment system so that farmers do not wait long for payment after selling their cattle and efforts to create a more market-oriented mindset among communal farmers are important in increasing communal farmers' cattle supply to export abattoirs.

Given the uncertainty of the EPA agreement combined with internal EU common agricultural policy reforms, I recommended that the Namibian beef industry seek other export markets including the Chinese and US beef markets, and regional markets in Sub-Saharan Africa. The Namibian beef industry should invest in creating a strong brand name for its free-range, pasture-fed and hormone-free beef qualities. Beef products of these quality attributes can be sold in niche markets that target health conscious and animal-welfare conscious meat consumers in developed markets.

APPENDICES

APPENDICES

Appendix 3A: Consumer Maximization Problem

$$\underset{b_h^m, b_l^m, \mu}{Max} \qquad L(\cdot) = u_m(b_h^m, b_l^m) + \mu\left[R - p_h^w b_h^m - p_l^w b_l^m\right]$$

$$L(\cdot) = u_m(b_h^m, b_l^m) + \mu\left[R - p_h^w b_h^m - p_l^w b_l^m\right] + \left[p_h^w(1+t_h) - p^h\right] + t^m\left(\bar{q}_h - b_h^{m_{in}}\right) + b_h^{m_{out}}\left[p_h^w\left(1+t+\frac{T}{p_h^w}\right)\right]$$

FOC: set $p_h^w = 1$ $\qquad p_h = p_h^w(1+t_h+t^m)$ $\qquad p_l = p_l^w(1+t)+T$

The Kuhn-Tucker conditions are as follows:

$$\frac{\partial L}{\partial b_l^b} = \frac{\partial U(\cdot)}{\partial b_l^b} - \mu p_l^w \geq 0, \qquad b_l^w \geq 0$$

$$\frac{\partial L}{\partial b_h^b} = \frac{\partial U(\cdot)}{\partial b_h^b} - \mu p_h^w \geq 0, \qquad b_h^w \geq 0$$

$$\frac{\partial L}{\partial \mu} = \left[I - p_h^w b_h^w - p_l^w b_l^w\right] \geq 0 \qquad \mu \geq 0$$

$$\frac{\partial L}{\partial b_h^{b_{in}}} = 1 + t_h + t^m - p_h \geq 0, \qquad b_h^{m_{in}} \geq 0$$

$$\frac{\partial L}{\partial b_h^{b_{out}}} = 1 + t_h + \frac{T}{p_h^w} - p_h \geq 0, \qquad b_h^{m_{out}} \geq 0$$

$$\frac{\partial L}{\partial t^m} = \bar{q}_h - b_h^{m_{in}} \leq 0, \qquad t^m \geq 0$$

Solving the equations above, we get the following Marshallian CES demand functions for low and high quality beef imported products:

$$b_h^m = \frac{(\lambda_h / p_h)^\sigma R}{\left(\lambda_l^\sigma (p_l)^{1-\sigma}\right) + \left(\lambda_h^\sigma (p_h)^{1-\sigma}\right)} \qquad b_l^m = \frac{(\lambda_l / p_l)^\sigma R}{\left(\lambda_l^\sigma (p_l)^{1-\sigma}\right) + \left(\lambda_h^\sigma (p_h)^{1-\sigma}\right)}$$

Dividing b_h^w by b_l^w we get the following relative demand function: $\frac{b_h^w}{b_l^w} = \left(\frac{\lambda_h p_l^w}{\lambda_l p_h^w}\right)^\sigma$

Appendix 3B: Rutherford's Mixed Complimentarity Problem

Rutherford's Mixed Complimentarity Problem is:

Given $F : R^N \to R^N, \qquad l, u \in R^N$

Find: $(z, w, v) \in R^N$

s.t. $F(z) - w + v = 0$

$l \le z \le u, \qquad w \ge 0, v \ge 0$

$w'(z - l) = 0, \quad v'(u - z) = 0$

where $-\infty \le l \le u + \infty$ and F are continuously differentiable. Integrability issues are done away with using MCP, as the formulation does not formerly involve the use of an objective function (Bergtold, 2002).

APPENDIX 3C: Export Revenue, Tariff Revenue and Quota Rent Expressions

We use the following expressions to calculate export revenue, tariff revenue and quota rent.

Appendix 3C.1 Tariff Revenue

$$TR_{EU} = t_h b^m_{h_{in}} p^w_h + t(b^m_{h_{out}} p^w_h + b^m_l p^w_l) + T(b^m_{h_{out}} + b^m_l)$$

Since Namibia beef exports did exceed quota allocation, we only have an in-quota equilibrium.

$$\therefore TR_{EU} = t_h b^m_{h_{in}} p^w_h + t b^m_l p^w_l + T(b^m_h + b^m_l)$$

Appendix 3C.2 Export Revenue

$$ER_{Namibia} = p^w_h (b^m_{h_{in}} + b^m_{h_{out}}) + b^m_l p^w_l$$

At an in-quota equilibrium, export revenue becomes,

$$ER_{Namibia} = p^w_h b^m_{h_{in}} + b^m_l p^w_l$$

Appendix 3C.3 Quota Rent

The quota rent is determined by the marginal tariff. At an in-quota equilibrium, the quota rent given by equation (12): $t^m = 0$ if $b^m_h < \bar{q}_h$.

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