A Quantitative Economic Analysis of the Impact of Price Reform and the Elimination of Subsidies on Poverty among Cotton Producing Households in Rural Uganda.

A thesis presented in partial fulfilment of the requirement of the degree of

Masters

of

Applied Economics

At Massey University, Palmerston North, New Zealand.

Michael Philip Bealing

2007

Abstract:

The benefits of eliminating cotton subsidies for Africa have been studied in terms of a higher world price, greater market share and higher export earnings for Africa. These estimates have focused on macroeconomic gains. This research simulates the effect of increases in the price on incomes of cotton growing households in rural Uganda to assess the impact on poverty levels. The Foster-Greer-Thorbecke measure of poverty is used to analyse the effect price increase on poverty. Results from this research indicate that Ugandan cotton farmers are unlikely to benefit from the elimination of cotton subsidies without price reform within its domestic cotton market. It is estimated that price reform alone can decrease poverty by 5 percent among cotton growing households in the Northern and Eastern Regions of Uganda. The results of the simulations also indicate increasing the price of cotton reduces the income gap for those households that remain in poverty despite the price increase. Thus the price increase decreases the severity of poverty amongst cotton producing households in rural Uganda.

Acknowledgements:

I would like to thank Dr. Shamim Shakur for his patient guidance and encouragement that is greatly appreciated. The research project would not be possible without the generous provision of data from the Ugandan Bureau of Statistics. I would also like to thank the Department of Applied and International Economics at Massey University for funding the research project. Last but not least I would like to acknowledge the support my family and friends provided throughout the research process. Their constant encouragement and care made this research possible.

Contents:

List of Figures and Tables:

Chapter 1: Introduction:

The objective of this research is to provide a quantitative economic estimate of the impact of cotton price increase on poverty among rural households in Uganda. It has been suggested that elimination of cotton subsidies will benefit African cotton farmers through a higher world price, great market share for African exporters, and higher export returns for cotton. The impact of cotton subsidies on Africa was highlighted at World Trade Organisation (WTO) when four African countries, Benin, Burkina Faso, Chad and Mali, joined Brazil's case against the United States (U.S.) cotton subsidy program. Brazil alleged U.S. cotton subsidies were illegal under the rules of the WTO and caused significant loses to Brazilian cotton farmers. The involvement of four of the world's least developed countries caused the issue of cotton subsidies to gain momentum. Such a united front could not be ignored in the context of the Doha Development Round at the WTO.

Goreux (2004) estimated the elimination of cotton subsidies in developed countries would cause the world price of cotton to rise by 12 percent and allow developing country cotton producers to gain market share. Sumner (2003), Gillson et al (2004) and Page et al (2006) also estimated the elimination of cotton subsidies would increase the world price and allow developing countries to gain greater market share. Estimates of economic benefits for Africa have been limited to macroeconomic variables. Poverty reduction has often been suggested as a spin-off. The aim of this research project is to quantify the impact of cotton price increases on poverty among cotton producing households in Uganda as a case study for Africa.

Uganda has been successfully growing cotton since the 1930's. Cotton is an important source of cash income in rural community and influences the level and severity of poverty in rural Uganda. The cotton industry was abandoned during the reign of Idi Amin, in favour of food crops needed for survival. The industry is still recovering, but the majority of cotton is grown on small plots of land using subsistence horticultural techniques. The results of this analysis will therefore estimate the impact of an increase in the cotton price on those most vulnerable to poverty.

Chapter 2.0: Literature Review:

2.1 Trade Distorting Impacts of Cotton Subsidisation.

To begin with it is necessary to demonstrate the economic effects of cotton subsidies. An understanding of the economic distortions they create with the international cotton market is crucial for bring about change. The focus of this research is to quantify the economic impact of cotton subsidies by estimating the change in poverty levels after eliminating cotton subsidies. The introduction of a subsidy distorts the conditions within a market. A subsidy changes the dynamics of supply in the domestic economy where it is applied and it can shift export market share towards a subsidising country. This section briefly demonstrates these distorting effects with a large exporter partial equilibrium model of global cotton trade.

A partial equilibrium model of the effects of a producer subsidy on global production and trade of cotton represented by in a two-country supply and demand framework seen figure 1. Figure 1a represents a large cotton exporting country, country 1, with exports equal to AB in a market without subsidies. Figure 1b is world market that is assumed to be market clearing in all scenarios. Figure 1c represents a cotton importing country 2. Country 2 imports CD and produces OC. The ES and ED curve represent excess supply and excess demand respectively. Total cotton traded on the world market is equal to OE. In equilibrium AB=OE=CD. Suppose country 1 decides to pay a production subsidy to domestic cotton producers. The subsidy influences producer behaviour by increasing total production in country 1 to OB' and exports to A'B'. The increase in exports shifts the excess supply curve to ES'. The world price is driven down by the increase in exports as result of the subsidy because world demand for cotton has not changed. Country 2 now imports C'D' and produces OC', which is less than OC before the subsidy was introduced.

These graphs illustrate the three key effects of producer subsidy. The first and most obvious effect is a lower world price. Cotton producers in the subsiding country receive a price higher than P while non-subsiding countries are faced with a depressed price. A depressed price is beneficial for cotton importing countries but non-subsidising exporters (not shown in figure 1) as they are forced to sell at the depressed price. Taxpayers and consumers in country 1 also bear the cost of the subsidy.

The graphs also demonstrate the trade distorting effects of subsidisation. The second effect is a shift in production. Production increases in country 1 from OB to OB'. Domestic production in country 2 is driven down from OC to OC'. Production subsidises distort trade by shifting the production to away from non-subsidising countries to the country who subsidise.

The third effect is a shift in the distribution of market share amongst exporting countries. This effect is not illustrated in figure 1 but it can be abstractly conceptualised in the following way. The introduction of a production subsidy does not change total demand for cotton i.e. the size of the cotton market is does not change. A subsidy increases the export market share of the subsidising country and proportionally decreases the market share of the non-subsidising countries. Non-subsidising exporting countries suffer a loss in market share and lower price as result of subsidisation.

The magnitude of the price depression and trade distortion due to subsidisation depends on two factors. Firstly price transmission between the world market and domestic market. Price transmission alters the price farmers at the farm-gate level and therefore directly influences their income and expenditure. Price transmission will be discussed in more depth below. Secondly, the elasticities of supply and demand shape the impact of subsidisation as a reflection of producer and consumer responses and the limitations on those responses. The response of a farmer in Uganda is partially limited by the availability of land as a result of population pressure and the absence of credit to fund farm area expansion. The issues related to the assumptions of price transmission, elasticities and the type of model used will be discussed in a later section.

Figure 1: A Partial Equilibrium Model of the Price Depressing and Trade Distorting Effects of a Production Subsidy in a Large Exporter

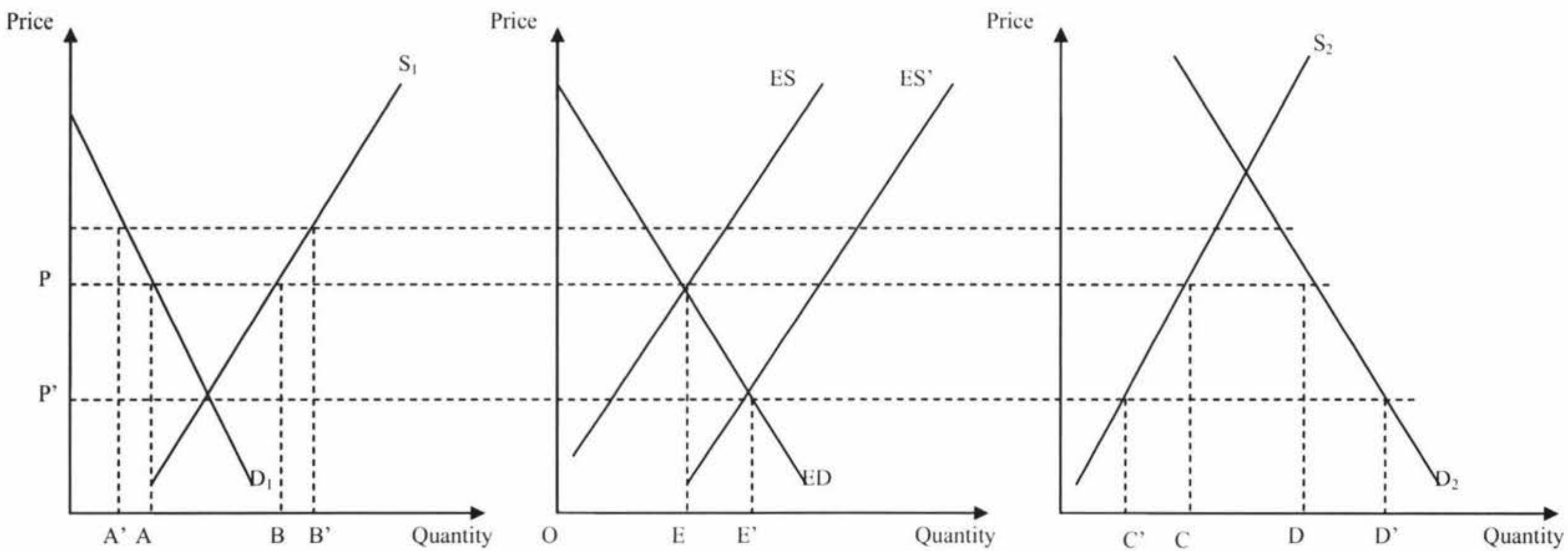


Figure 1a: Cotton exporter with subsidy

Figure 1b: World cotton trade

Figure 1c: Cotton importer without subsidy

2.2 Producer Reviews: The Big Three: US, EU and China

This section will discuss the extent of subsidisation in the United States, European Union and the People Republic of China. The cotton policies of each of these major producers will be outlined to clearly show the complexity and size of subsidisation in these countries. This information allows greater understanding of the difficulties Ugandan cotton producers in face when they compete in the world market.

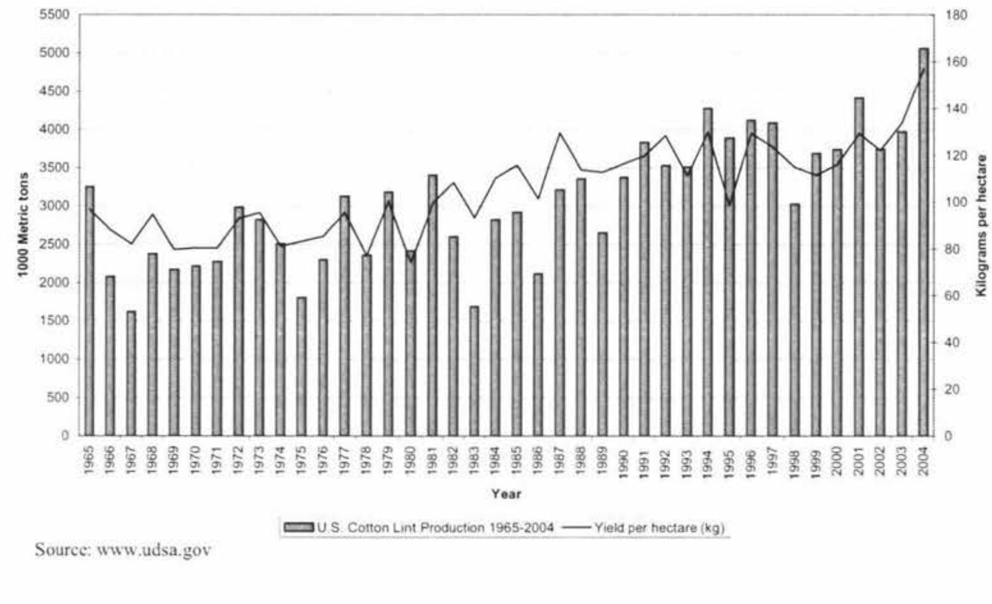
2.2.1 Cotton Production and Policy in the United States:

2.2.1.1 U.S. Cotton Production:

Cotton has been an economically important crop in the United States for the last 200 years. During the 1800's the U.S. was the most important cotton producer and exporter in the British Empire. The U.S. was the cheapest source of cotton in the Empire and cotton became the most important commodity for the southern states. The use of slave labour in the cotton fields was an important factor in America's ability to produce the cheapest cotton.

In 1966, the U.S. produced two million metric tons of cotton. By 2004, cotton production reached a record high of 5 million metric tons. The role subsidisation played in this increase is not precisely known. But without doubt subsidies have affected production decisions in the U.S. Yield improvements may be one explanation for the increase in production. The average yield has trended upwards over the past 30 years. In 2004 yield per hectare reached a record high of 159 kilograms. See figure 2 for more details. These yield improvements will be due to the intensification of farming practices and developments in the plant technology. The emergence of genetically engineered cotton has also lead to increased yields all over the world including production in the United States. The United States cotton exports around 30 percent of the total world cotton trade each year, making it the world's largest exporter of cotton.

Figure 2: U.S. Cotton Production and Yield 1965-2004



Source: www.udsa.gov

2.2.1.2 U.S. Cotton Policy:

The policy situation in the U.S. is complex. Cotton subsidies were first paid to farmers in the Great Depreciation of the 1930's to support farmers during the crippling economic recession. Since then subsidies have become a major source of income for cotton growers in the southern states. There use today is the result of powerful lobbying. The economic conditions of the Great Depression are long gone, yet the subsidies remain and have grown with each farm bill. The cotton growers who receive the subsidies are sometimes referred to as cotton barons, because their farms are enormous, spreading across thousands of hectares and with million dollar incomes to match. These million dollar incomes are the key compliant for cotton producers in developing countries, who tend to farm on two-acre plots without support. Such massive subsidisation to the small group of producers who export about one third of the global exports distorts trade away from cotton producing countries already battling with terrible poverty.

The cotton support program in the US includes a wide range of production subsidies and assistance mechanisms. Production is indirectly subsidised through loan rate payments, which are the difference between the target price and the adjusted market price. Farmers also receive decoupled direct income payments based on historical production areas. Countercyclical payments called emergency payments were introduced in 1998 to compensate farmers for low commodity prices. These payments were entrenched into policy by the 2002 Farm Bill, making them permanent. End-user payments or user marketing payments referred to as Step 2 payments were introduced in the 1990 Farm Bill as part of a program "encourage" the use of domestic cotton. The purpose of the program was to make US cotton more competitive compared to foreign cotton by lowering the cost of domestic cotton for domestic manufacturers. But use of the term competition is misleading. This policy involved under cutting t he price of foreign cotton, and a protectionist import quota. These mechanisms are anticompetitive, wasteful and inefficient for global trade and production. This action once again highlights the fact that the only comparative advantage the US has is its ability to pay higher subsidies than any other country. The Step 2 payments have been the subject of a WTO ruling that will be discussed below. Other forms of assistance for cotton include crop insurance and an export credit guarantee. In the past the export credit guarantee program has protection exporters form loses due to foreign buyers defaulting on contracts. This policy is currently being reviewed and modified as WTO ruled it is prohibited under the rules of the WTO. (WTO, 2006) Cotton producers also receive support through government funded research and development.

Baffes (2005) provides an excellent summary table of U.S. expenditure on cotton assistance. The summary is reproduced in table 1. Baffes (2005) also provides a useful comparison of the proportion of support relative to the price of cotton for several countries. This comparison is partially reproduced in table 2. The seven-year average of government support as a proportion of price was 59 percent in the U.S. This implies 37 percent of income from cotton in the U.S. came from government assistance.

Table 1: Budgetary Transfers to U.S. Cotton Sector, 1995/96-2002/2003 (millions of U.S. dollars)

Year	1995/1996	1996/1997	1997/1998	1998/1999	1999/2000	2000/2001	2001/2002	2002/2003
Decoupled payments	3	0	28	535	1,613	563	2,507	248
Production payments	0	599	597	637	614	575	474	914
Countercyclical payments	0	0	0	316	613	613	524	1,264
Insurance	180	157	148	151	170	162	236	194
Step-2	34	3	390	308	422	236	196	455
TOTAL	**217**	**759**	**1,163**	**1,947**	**3,432**	**2,149**	**3,937**	**3,075**

Source: Baffes (2005) and author's calculations

Table 2: Estimated Government Assistance to Cotton Producers as Percentage of World Price 1997-2002

Country	1997/1998	1998/1999	1999/2000	2000/2001	2001/2002	2002/2003	Average
Estimated government assistance in millions of U.S. dollars							
United States	1163	1947	3432	2149	3937	3075	2617
China	2013	2648	1534	1900	1217	800	1685
Greece	659	660	596	537	735	718	651
Spain	211	204	199	179	245	57	183
Percentage of world price							
United States	18	46	77	46	97	67	59
China	27	45	35	34	24	13	30
Greece	121	142	118	101	187	160	138
Spain	114	151	130	151	253	197	166

Source: Baffes (2005)

2.2.1.3 The Step 2 Program and the WTO Ruling:

The Step 2 subsidy program was designed to make domestic cotton cheaper for domestic end users and exporters. When the domestic price of cotton exceeded the adjusted world price end users and exporters received end user payments as compensation in order to maintain competition. Such a policy is trade distorting.

The Step 2 subsidy is one of the policies being reviewed by the WTO as part of Brazil's cotton dispute with the US. In September 2004, the WTO ruled that the step 2 program was an illegal subsidy under the rules of the WTO. The US appealed the decision. The Appellate body upheld the original decision in March 2005. Therefore the US government is required to stop the Step 2 payments by 31 July 2006. This result represents significant progress in the cotton subsidy dispute.

A US based study used a partial equilibrium model of the US and world fibre markets to estimate the impact of eliminating the Step 2 payments. The model estimated the domestic farm gate price would fall by 2.62% in the short term and 9.25% by 2009/2010. Domestic use by textile producers will fall less than 1% in the long run and domestic production will barely change (-0.23% by 2009/10). (Mohanty 2005) The estimates of the global impact were even smaller. The world cotton price is expected to increase by only 1.66% in the first year after the complete elimination of the step 2 subsidy program. The increases in each year after that are consecutively smaller with a five-season average of 0.48%. The world trade in cotton in expected to fall be less than one percent. One reason offered by the authors of the study for the very small changes is that the flexible deficiency payments will effectively replace the lost income if the cotton subsidy budget is not limited. It is also perceivable that the elimination was expected due to the public nature of the dispute, therefore, the market have anticipated the changes and adjusted accordingly.

2.2.2 The European Union Cotton Industry: Greece, Spain and the Common Agricultural Policy:

2.2.2.1 Production and Policy in the E.U.:

Greece and Spain are the two main cotton-producing countries in the EU. Portugal also produces some cotton, but Portugal's total production is relatively small compared to Greece and Spain. Following the pattern of the literature on the subject, this discussion of cotton production and support in the EU will focus on cotton production in Greece and Spain.

In the 1960's and 70's Europe's cotton production was about 130,000 tons year (Baffes 2005). Cotton production in Europe has grown significantly with the expansion of the European Union. Subsidisation has influenced this increase. Initially cotton production was not subsidised by agricultural policy in the E.U. Cotton subsidies were introduced following the accession of Greece to the regional body. The original purpose of subsidisation was to provide farmers with a fair and stable income. The subsidies have become a form of social welfare for farmers. Cotton farmers represent some of the lowest income earners in Greece. Therefore, income support to an at-risk group has been often used as a justification for the continuation of subsidisation. Cotton production is important for employment and trade in Greece. Raw cotton represents 9 percent of Greece's total agricultural output. (EC 2003 p.9)

Historically cotton support policy was composed of three interactive mechanisms: a deficiency payment, co-responsibility levy and the minimum quantity guaranteed (MQG). The deficiency payment was the difference between the target price and the world market price calculated on a per tonne basis. Support payments were channelled through ginners who were obligated to pass them on to farmers through higher producer prices. This policy was enforced with a required minimum price set slightly below the target price. (Karagiannis 2004, p. 3). The minimum price was linked to the co-responsibility levy and the MGQ. If production exceeded the MGQ the co-responsibility levy directly reduced the minimum price by a percentage related the level of excess according to step-wise structure based on the exceeded quantity. In the period 1981-1985 the MQG was set at 560,000 tonnes, during this period cotton production in Greece rose from 33,000 to 52,000 tonnes. Consequently the co-responsibility never was activated. But if it had, the minimum price would have been reduced by 1% for every 15,000 tonnes above the MQG. The combinations of these mechanisms effectively insulated farmers from market fluctuations. Predictably, such insulation and production support lead to excessive supply quantities relative to market prices.

After Spain joined the EU in 1987, the MQG was increased to 752,000 tons. A floor price was added to protect farmers from fluctuations in the minimum price and variations community wide production levels from year to year. This further insulated farmers from the market conditions. Such insulation released farmers from any kind of market driven production limitations. As result production grew rapidly during the 1986-1991, ranging from 875,000 – 1,200,000 tonnes and it always exceeded the MQG.

By 2001 the MQG and co-responsibility levy was restructured. The MQG was separated into national quantities guaranteed (NQG) in an effort to make farmers from each country more accountable for their production levels. The co-responsibility levy also was transformed to a coefficient that decreased the minimum price by 0.5% for every 1% above the respective NQG's for Greece and Spain. The NQG was set at 1,138,000 tonnes for Greece and 362,000 tonnes for Spain. The total European Union production threshold was therefore 1,760,000 tonnes. Over the 20-year period since the introduction of EU cotton subsidies the effective production limit set in policy tripled.

Total budget expenditure on cotton producer support over 1996-2000 ranged from 740 to 903 million euros. (Baffes 2005) Total direct assistance for cotton in the EU for the 2000/2001 season has been at 716 million US$ by ICAC (ICAC 2002 p.5). According to Baffes (2005) when the average producer assistance levels are compared proportionately to the world price over the period 1998-2003 were 138% and 166% for Greece and Spain respectively. This percentage peaked at an astounding 253% for Spain in 2003. This implies the cotton subsidies effectively more than doubled the price farmers receive compared to the world price over the six-year period. Such heavy production subsidisation must directly influence production and cause production to be significantly higher than it would be it market price levels.

2.2.2.2 Economic Criticism of the Cotton Policy in the E.U.:

Karagiannis and Pantzios (2002) investigated the motivations for Greek cotton farmers deciding whether to comply or not comply with quantities restrictions. The study compared producer surpluses, taxpayer costs and deadweight loses amongst compliance options. While the study concluded that producing up to but not beyond the threshold was a Pareto improvement for producers and consumers, producer behaviour did not reflect this. Karagiannis and Pantzios argued that the production control policy was ineffective due to asymmetric information between producers and the authorities. Burnell (1987) argued that aggregate production restrictions would not influence farmers' behaviour. In the case of aggregate production restrictions the individual farmer becomes a price-taker presented with perfectly elastic producer demand at a reduced price and lower level of marginal revenue. According to Burnell "...the rational individual producer will not act upon these restrictive market signals unless a threshold or quota has been imposed directly on his own production and the price he receives depends directly on his own position relative to this limit. Otherwise, he is a price-taker, and in spite of the threshold for aggregate output, he perceives demand for his own output as perfectly elastic at the going price." (Burnell 1987, p.5)

Burnell (1987) compared the welfare effects of four different production surplus policy tools on producers. The four policies examined were: price reduction; guaranteed threshold with a price reduction in the same year as the threshold was exceeded; guaranteed threshold with a co-responsibility levy effective in the same year as the threshold is a exceeded; and a quota with a super levy on over production. Burnell showed the most preferred (or politically least unpalatable) method of control production oversupply problems, in the context of budget constraints, was the guaranteed threshold with a co-responsibility levy. However, Burnell pointed out that levy needed to be far more restrictive than the policy at the time for it to be effective.

2.2.2.3 CAP Cotton Reform 2005:

The EU has come under increasing pressure to reform its producer support policies. The members of the EU made a commitment to policy reform in Luxemburg 2003. The focus of the reforms was to shift producer support away price support policies which the trade distorting. The original goal of producer support was two fold. Production subsidies in the EU act as a form of economic support to low-income farmers. They are also one method of preserving the traditional lifestyle of boutique farmers. Production is an indirect method of achieving this goal. The reforms are designed to shift the reorientation support payments towards a mix of less trade distorting (blue box) and non-trade distorting (green box) mechanisms. Sixty percent support to cotton growers will be made in a signal yearly decoupled payment based on a 2000-2003 reference period. The proportion of producer assistance is design specifically to directly achieve the goal of income support. The direct nature of this portion is less trade distorting and efficient compared to payments linked to production. The remaining 40% of payments will be an area based production support.

Karagiannis (2004) compared the old policy regime to the mix of a fully decoupled payment and area payment. Karagiannis applied the new policy to a model of the 2000-2003 reference period and found that farmers and tax payers would have been generally better-off if the new policy had been applied in that period. The absolute results vary depending on the magnitude of the elasticity of supply. The analysis indicates that the new policy is more efficient in terms of transferring expenditure from taxpayers to producers. The new policy will decrease transfer losses but not completely eliminate them. The shift away from 100% production support will lead to a reduction in production. As a result the cotton processing industry will be forced into transition.

2.2.3 China's Cotton Industry:

China's cotton industry was totally control by the government's central planning regime between the years of 1953-1978. There was no freedom in the market. The government regulated everything from the price of cotton to the supply and use of fertilizer. Since 1978 the Chinese government has been progressively liberating the cotton market in line with agricultural policy changes. Throughout the last 25 years China's political economy has moved from strict communism to a form of market socialism. Economic growth has been the focus by government policy. The Chinese government increased the regulated price in 1978 and allocated farmers with more fertiliser encourage growth in the cotton industry. Policy makers began significant market reforms in 1980, shifting away from command and control of cotton production and regulated prices. Cotton production output increased as the price of cotton in China corrected upwards towards the world market price. (Baffes 2005) Since 1999, China has allowed its domestic cotton price to be influenced directly by internal and external market factors. The government still provides a reference price, but it is only intended to be a guide to traders. Buyers and sellers are free to negotiate any contact price with restriction or limit.

The Chinese government began a policy of stock reduction in 2000. The government purchased cotton stocks at a high market price and sold the cotton during world market trough suffering a net financial loss. (Sumner 2006 p. 276). ICAC calculated the total government expenditure during the cotton reduction period to be 1.9 billion US$. (ICAC 2002 p.5) The sale of such large volumes of cotton undoubtedly affected the world price over the period which has been considered by some analysts to be equivalent to market intervention and producer support. It has been perceived as stabilisation policy and the issue of market dumping has not been suggested by any of the commentators reviewed. "The general consensus is that China provided a major subsidy to the industry in managing the liquidation of its cotton stocks from the late 1990's through 2001." (Sumner 2006 p.276) There is some indication the cotton market worldwide is undergoing a structural shift. China's stock reduction during a period of declining world prices could have potential contributed to this structural shift in the cotton market. The long-term equilibrium was generally considered to be 0.725 US$/pound. "Average international prices have been below 60 cents per pound for the fourth consecutive season. The average of the last 25 years was 72.5 cents, which used to be considered an equilibrium price for the cotton market. Normally, when prices decline below the long-term average, production declines." (ICAC, 2002, p.6).

China is both an important producer and user in the world cotton market. Its textile industry requires a large and steady supply of cotton. The country fluctuates from being a net-importer or net-exporter of cotton based on its domestic production and the demand of its textile industry. China intervention in the world market through producer support and export assistance is unclear. Sumner describes China's cotton policy as "... complex and unsettled with conflicting information and a lack of transparency." (Sumner 2005 p.276) According to Baffes (2005), China intervenes in the cotton through a number of mechanisms. The reference price set by the government is higher than the world price. While traders have no obligation to buy and sell at this price it will encourage the idea of a higher price in domestic transactions. A higher price is not a bad idea for cotton farmers in the developing world but the reference price can still by considered as an intervention that is potentially market distorting and inefficient. The Chinese government also provides transport subsidies, centrally organised export marketing and public stock management of cotton. Cotton imports face a 3% tariff up to a limit of 860,000 tons. Import quantities above this volume face a prohibitive 90% tariff. There is also evidence that China has used export subsidies in the years leading up its accessing to the WTO. "Maize and cotton have received the largest export subsidies. Interviews in the field during 2001 revealed that maize exporters, especially in northeast China, received subsidies averaging 34% of the export price and cotton exporters received subsidies averaging 10% of the export price." (Huang et al. 2004 p.64)

There is a range of estimates the financial value of China support to the cotton industry. Huang et al. (2004 p.71) estimated the nominal rate of protection in October 2001 to be 17%. The nominal rate of protection is estimated by gathering disaggregate price from inside outside China's borders and then calculating an overall estimate for the difference in price. A higher aggregate internal price leads a positive nominal rate of protection. In the case of cotton the nominal rate of protection implies that if cotton imports could be across the border without cost they would be worth 17% more. The nominal rate of protection is an indication of government support to growers and insulation from the world markets through trade barriers.

Not all studies agree that China subsidies cotton production. Fang and Beghin (2003) estimated a nominal protection coefficient of 0.8 for the period 1997-2000, implying China taxes cotton production. Baffes (2005) describes the disagreement amongst analysts about domestic support in China as evidence of the complexity and obscurity present within Chinese policy. Sumner (2006) also commented that data from China is unreliable, which contributes to confusion around this issue.

2.3 Estimates of the Price Effects of Subsidy Elimination:

The estimates of price change upon the elimination of subsidies discussed in this section form the guidelines for the sensitivity analysis applied in this project. They further highlight the significant impact of cotton subsidies of the world market

2.3.1 Goreux (2004)

Louis Goreux (2004b) presented an estimate impact of cotton subsidies on the world price of cotton by using a partial equilibrium framework. The purpose and motivation of his investigation was to establish a quantifiable estimate of the effect of subsidies on the world price of cotton and then used this estimate to measure the impact of subsidies on poverty in the cotton producers in 13 African countries. He calculated changes to production, producer revenue and export earnings as proxy measures of poverty reduction based of his estimate of the 12 percent increase in the price of cotton as a result of the elimination of subsides. His results indicated that the elimination of cotton subsidies would lead to a market share shift in favour of Africa (and other non subsidising producers.) Goreux's paper has gained international attention. Based on his results Goreux suggested the African countries were deprived of 250 million US$ due to subsidies in 2001/2002 and presented the framework for compensation which has become the WTO's cotton initiative.

The econometric model used by Goreux was designed to simulate the effect of the elimination of cotton subsidies on the world market, the subsiding country and on other cotton producer who do not subsidise. The model is mathematically constructed and composed of log-linear supply and demand equations; net income equations and net export earnings equations. Goreux's model has three limitations. Firstly, it is a partial equilibrium model that doesn't account for dynamic interchanges within the world market. Secondly, a lack of available estimates for demand and supply elasticities in all other countries accept the U.S. forces Goreux to assume constant and uniform elasticities for all countries. Thirdly, there are significant differences in the subsidy figures reported by the WTO, ICAC and other investigative literature on the subject. These limitations will be critically discussed as they arise.

Rather than reproduce these equations, I will graphically illustrate what would happen in the cotton market as a result of the elimination of cotton subsidies. The dynamics of the relationships between subsidisation, price and export market share demonstrate the issues involved in the cotton problem, as it is referred to by John Baffes (2005). This graphical illustration is drawn from figure 3 in Goreux's paper and it captures the issues

Figure 3: A Graphical Illustration of the Effect of the Elimination of Subsidies amongst Producing Countries

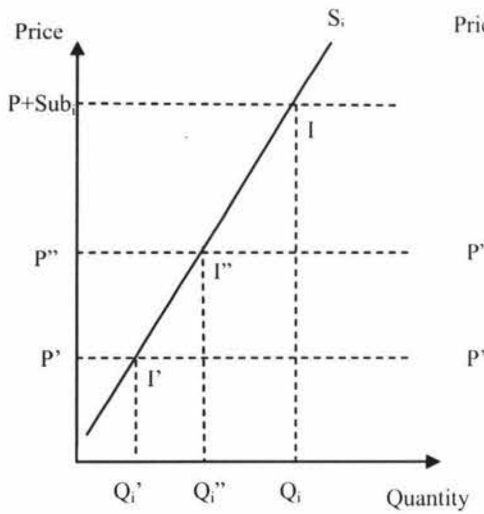


Figure 2a: Subsiding Country

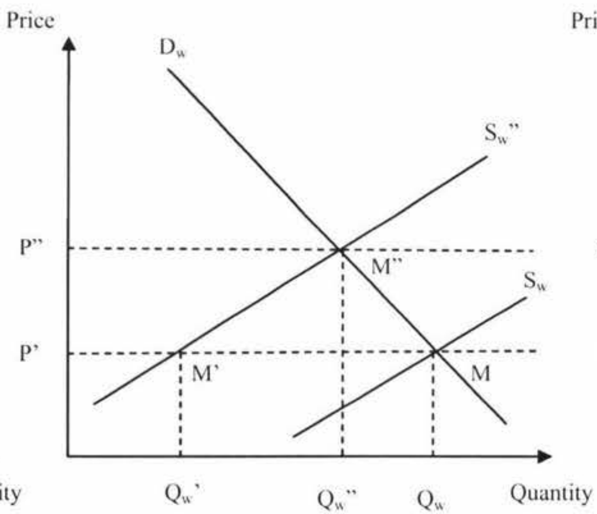


Figure 2b: World Market

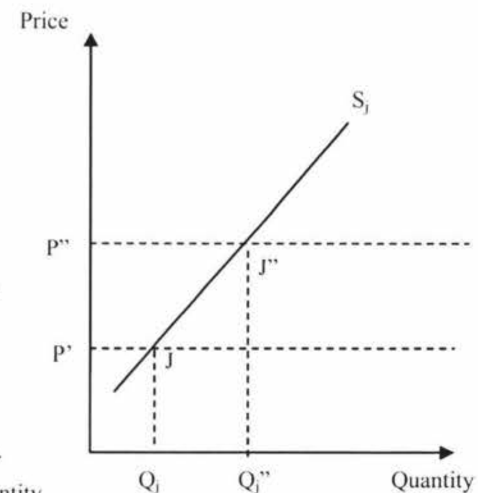


Figure 2c: Non-Subsidising Country

in the cotton subsidy debate. It illustrates the market-share shift amongst cotton producers that is not seen but implied in figure 1 above. Graph 2a represents a country that initially subsidises production of a commodity. Graph 2b represents the world market for that commodity. Graph 2c represents a country that does not subsidise production.

Beginning with the subsidising country, producers receive a price plus a subsidy ($P+Sub_i$) and produce Q_i, when that subsided is removed producers receive P' and they produce $Q_i^{'}$ until the world market responds. In response to the decrease in world supply the world supply curve shifts to the left creating a new equilibrium at M" and new world price P". This new price is higher than P and it represent the real value of the commodity because the price-depressing subsidy has been removed. The supply shortage left in the wake of the elimination of subsidies was partly taken up by a production increase in non-subsidising countries. So non-subsidising countries gain the market share they were denied by the trade distorting effect of subsidisation and the undistorted market-clearing price.

Due to the nature of partial equilibrium analysis Goreux's result is a simplistic description of what could occur if cotton subsidies were eliminated. Partial equilibrium analysis does not account for dynamic shifts within a market. But the advantage of a partial equilibrium is that is offers a picture of what will potentially happen with less data than a general equilibrium. Typically the direction of change is the same in both types of models but the partial equilibrium overstates the result relative to the general equilibrium result.

Goreux was forced to assume uniform price elasticities for all countries because of limited data for production elasticities in all countries expect the United States. This is clearly an enormous assumption and Goreux acknowledges this. He uses a price elasticity of supply of 0.5 and a price elasticity of demand of -0.1. Sensitivity analysis in performed in an effort to tackle this problem. Goreux reports 18 different simulations that use price elasticities of supply ranging from 0.15 to 0.90 and price elasticities of demand ranging from -0.05 to -0.6. Holding price elasticity of demand constant at -0.1 the percentage increase in price varies from 9 percent to 12.5 percent when the price elasticity of supply varies from 0.15 and 0.90 respectively. For each group of simulations Goreux calculated average yearly increases in production, producer revenue and export earnings for the group of African, based of on the five year of 1997 to 2002. For the above range of simulations the average yearly increase in producer incomes ranges from 113 to 153 million US$. The average yearly increase in export earnings ranges from 116 to 254 million US$. Holding the price elasticity of supply constant at 0.5 the percentage increase in price varies from 13.3 to 9.5 when the price elasticities of demand vary from -0.05 to -0.25. For this group of simulations the average yearly increase in producer revenue ranges from 112 to 159 million US$. The average yearly increase in export earnings ranges from 154 to 213 million US$. Goreux's model estimated a price increase of 12 percent using price elasticities of 0.5 and -0.1. In this simulation the yearly average increase in producer revenue and export earnings were 143 and 195 million US$ respectively Taking into account the range of elasticity that the simulations were done for, the result appears more sensitive to the elasticity of supply. Goreux's estimate of a price increase of 12 percent appears to be stable enough to be used as a reliable estimate of the market response to the elimination of cotton subsidies.

Goreux considers the elimination of subsidies in all countries based on subsidy data from the ICAC. Differences in subsidy figures are a common problem in the literature. The ICAC and WTO are the two primary sources of subsidy figures. The ICAC figures are collected more independently than the WTO ones. The problem with WTO figures is they are provided by the individual governments and there is typically a three-year lag in WTO notification. These figures are open to bias because they have political and trade ramifications. It is important to note that subsidy data gathered by the ICAC indicates that cotton subsidies are slightly higher than the WTO notified subsidy figures. Other literature has estimated that subsidies are actually higher in the U.S. than reported by the WTO and the ICAC. Goreux refers to a report by John Baffes (2003) which estimated U.S. cotton subsidies to be 92 percent higher than the ICAC data. Goreux estimated a 17 percent price increase based on this figure which is 40 percent higher than his main estimate.

2.3.2 Gillson, Poulton, Balcombe and Page (2004):

Gillson et al. (2004) set out to analyse the effect of cotton subsidies on developing economies by estimating the effect of the subsidies on the cotton market generally and more specifically the world price. Their analysis was built on the partial equilibrium framework employed by Goreux (2004), extending the analysis by estimating the separate impacts for a range of developing countries and relaxing the assumption of a homogenous cotton supply. Gillson et al. offer the most extensive description of the attributes of cotton and cotton production in different countries and regions. For simplicity cotton from all over the world is assumed to homogenous, the higher consumer price for products made from Egyptian cotton suggests differences in the quality of cotton produced in different regions therefore cotton is a non-homogeneous product. The first estimate of the change in the world price resulting in the elimination of cotton subsidies assumes that cotton is homogenous. The second assumes cotton is non-homogenous leading to rigidity within the demand side of the cotton market. Goreux's (2004) assumption of uniform elasticity of supply is also relaxed. The combination of these two relaxed creates four simulations. The results estimate the removal of all forms of subsidisation in the U.S., E.U. and China will lead to increases in the world price by between 18 and 28 percent.

The model that treated cotton as a homogenous product, estimated greater gains for developing countries. This result is predictable as flexibility or rigidity in demand for cotton for based on country of origin will slow any change in market share and dampen the gains for developing countries.

The authors of this paper begin by pointing out the significant differences in cotton produced around the world. The characteristics of the cotton itself, agroclimatic conditions and processing determine the quality of cotton lint. Staple length, fibre strength, colour and stickiness are all cotton characteristics influencing the quality of cotton. Uniformity and foreign matter mixed with the cotton lint in the bales are related to the processing and sorting of cotton.

Staple length is one of most well-known quality characteristics of cotton. There are four categories of staple length: extra fine; fine and high medium; medium and coarse cotton. Medium length cotton is the most widely produced staple length. This fact alone suggests cotton is not as homogenous as assumed by other model. "The majority of the world's cotton production tends to fall into the category of medium cotton quality defined by staple length. This includes the majority of cotton produced in Sub-Saharan Africa." (Gillson et al., 2004, p.10) Medium length cotton is traded on the Index A market. Coarse cotton is traded on the Index B market. Longer staple lengths such as Egyptian cotton and U.S. Prima are rarer and therefore attract a premium above the Index A price. The Index A market is used commonly thorough out the literature as a measure for the world price of cotton.

Staple length is just the first of a range of product differentials for cotton. Fibre strength is another quality attribute. The strength depends of the seed stock, but it also depends on how the cotton is treated during ginning. Roller ginning has less impact on the strength of the cotton lint, but it is slower than saw ginning. Roller ginning also maintains fibre length better than saw ginning. According to Gillson et al. Uganda and Tanzania may have a comparative advantage in this area as they have reputation for processing cotton with roller ginning, while most of the world uses saw ginning. "Roller gins, as opposed to saw gins, are superior in terms of maintaining fibre length during the ginning process, an attribute for which textile producers have been inclined to pay a premium. As such, Uganda and Tanzania have traditionally occupied a unique position as being two of only a handful of countries exporting roller ginned lint (more than 80 percent of traded cotton is saw ginned.)" (Gilson et al., 2004, p.12)

Stickiness and colour are another two factors affecting the quality of cotton. But the last two factors that are relevant to this research project are uniformity and the presence of foreign matter mixed with the cotton lint. Uniformity is depends on the consistency of the national seed stock and the care taken in the sorting process. Foreign matter in the lint bales usually comes from leaf matter or the polypropylene sacking. Such foreign matter interferes with the spinning and dying of the lint at the textile factors. Therefore presence of foreign matter or the absence of it can affect the price paid for bales of processed cotton. Interestingly, African countries may have another advantage in this area, because the low cost of labour in Africa creates more opportunity for sorting the cotton before ginning to remove foreign matter. Similarly, uniformity is partly a function of the sorting process, where low cost labour could advantageous.

Such differences in the cotton product bring into question the creditability of analysis is built on the assumption of homogenous cotton. Using the Index A price to represent the value of homogenous cotton is not necessarily bad. As commented above the majority of cotton falls into the category of medium staple length, trade on the Index A. Therefore, the Index A price represents the majority of cotton value and a narrow staple length range. Any premium for better quality cotton or discount lower quality cotton requires a benchmark price as a reference for value of such grades of cotton. The most obvious benchmark is the Index A price. Changes in the Index A price are likely to be reflected in the price of other categories of cotton. On this basis the Index A market offers a reasonable model for cotton in general. While it is not perfect representation of the whole industry its size are centrality means it captures and reflects the changes within the industry. The nature of cotton traded in this market suggests that the assumption of homogeneity is too far fetched. A general comparison between Gillson's results of simulations where cotton is treated as an inhomogeneous product and the market is fragmented and the simulations where is treated as homogenous.

Gillson et al. perform four simulations and produce four estimates of the effect of the elimination of cotton subsidies. The first simulation assumes a uniform price elasticity of supply set at 0.5 exactly the same as Goreux (2004). It also assumes cotton homogeneity and therefore there is a single cotton market. Here the simulation estimates a price increase of 18 percent. In all the simulations the cotton production in the U.S., E.U. and China is estimated to decrease by 22, 33 and 14 percent respectively. Africa supply response in this simulation is estimating to increase cotton production in Africa by 9 percent. The assumption of uniform supply elasticity leads to a 9 percent increase in cotton production in every country, except the U.S., E.U. and China. Combining the supply response and the higher price is estimated to increase Africa total production earning by 28 percent (271 million U.S. dollars). No results are reported for Uganda, Kenya, Tanzania or any other Sub-Saharan country. The individual country results for Africa only include Western and Central African nations.

The second simulation continues to the assumption of uniform elasticity, but relaxes the assumption of homogeneity. In this case rigidity exists in the cotton market leading to fragmentation with the market based on country of origin. Therefore supply changes less than the previous simulation. Cotton production in the U.S., E.U. and China decreases by 8, 20, and 3 percent respectively. The estimated production increase for the African group is 3 percent, with the individual increases ranging from 0 to 11 percent. The increase in production earnings in the African was also lower than the previous simulation at 10 percent (94 million U.S. dollars). In this simulation rigidity related to the country of origin leads to less supply response and a higher increase in the world price. Here the world price is estimated to increase by 20 percent.

The third simulation assumes cotton is homogenous. The assumption of uniform elasticity of supply is relaxed and replaced with country specific elasticities for 15 countries (Australia, Burkina Faso, Cote d'Ivoire, Mali, Tajikistan, Togo, Uganda, Zimbabwe, Brazil, Cameroon, Egypt, Sudan, Tanzania, Turkmenistan and Uzbekistan.) They ranged from zero to 0.6. Eight of the countries: Brazil, Burkina Faso, Cameroon, Cote d'Ivoire, Mali, Tanzania, Togo, Uganda Zimbabwe, and are assigned elasticities of 0.6, suggesting these countries are 20 percent more than modelled in the previous simulations. Australia is the only developed nation to be assigned a differentiated elasticity. Australia, Tajikistan, Turkmenistan and Uzbekistan are all assigned elasticities of zero. The reasons for this are related to land and resource shortages in these countries. Egypt and Sudan are assign elasticities of 0.35. The rest of the world was assigned 0.5 as before. In this simulation cotton production in the U.S. E.U. and China is estimated to decrease by 14, 25 and 5 percent. The African group is estimated to have the greatest increase in production and earnings in this simulation. The total estimated earnings increase for the African group is 37 percent or 360 million U.S. dollars. The estimated price increase is 22 percent.

The final simulation relaxes both assumptions modelling the market as fragmented and cotton as inhomogeneous. The estimated overall African group increase in production earnings 14 percent, but the results very widely from country to country. No change in production and earnings is estimated of Congo. Togo has the largest estimated increases in production (18 percent) and earnings (57 percent). Strangely, Gillson et al. offer explicit explanation or comment on these results and the lack full disclosure of the price elasticities of supply for most of the African countries makes it impossible to deduce some conclusions. This pattern of inconsistency continues to the involvement of

Uganda in the analysis. Uganda is assigned a differentiated elasticity of supply and is mentioned often in the discussion of cotton production in Africa, yet Uganda is not included in the African group. Togo in contrast is assigned the same elasticity as Uganda in the differentiated simulations and is included in the African group, but Togo is barely mentioned in the paper. In this simulation the estimated increase the world price of cotton is a huge 28 percent. Due to the lack of discussion and detail regarding this simulation this result will receive little comment here. Although it appears that the rigidity within market and pays off well for countries that are already favoured by textile manufacturers and are also able to deliver increased supply. But this is only conjecture.

2.3.3 Sumner (2003):

Sumner's estimate of the economic impact of the cotton subsidies has received significant attention at the international level and has been employed as evidence in trade disputes between the U.S. and other cotton producers. Sumner's analysis was presented at the WTO as part of Brazil's case against the U.S. cotton subsidy program. Brazil alleged U.S. subsidies were legal under WTO principles because they were trade distorting and injurious to cotton producers in Brazil. Sumner's results and conclusions deserve attention because they have received attention at a high level and contributed to international trade rulings.

The framework of the Sumner (2003) model was designed to estimate the effect of U.S. government support programs for upland cotton on U.S. planted acreage, U.S. production, U.S. mill use, U.S. exports and the international cotton price. Sumner estimated the elimination of all forms of support for U.S. would lead to a 27 percent decrease in U.S. cotton production, a 43 percent decrease in exports for the U.S. and an 11.6 percent increase in the world price of cotton.

The model structure is based on the economic principles of supply and demand, and is built on the pre-existing structure of the FAPRI trade model. U.S. production and the international market are assumed to be linked through a market clearing world price. The Index A cotton price is used as the benchmark world price. This is a universal practice throughout the cotton literature. The analysis estimates a range of simulations for the nine cotton seasons from 1998 to 2007. Actual prices and quantities are used for the seasons from 1998 to 2000 to calibrate the model. The season from 2001 to 2007 are based on projections from actual data from the previous three years.

The model includes a range of factors that influence supply and demand. "The baseline projections include variations in the costs of production across crops, exchange movements, demographic shifts, population and income growth, changes in the price of other crops, changes in the prices and technical constraints in the textile demand and normal climate trends, all of which influence supply and demand for cotton." (Sumner, 2003, p.4). The U.S. portion of the model contains equations that allow for competition for land between crop and livestock, and allowances for simulating how policy changes effect cotton production within the competitive constraints on land.

Sumner estimated the impacts of individually removing each of the main cotton subsidy programs and then removing them all at once. Six cotton subsidies investigated: the marketing loan scheme (MLB); the production flexibility contracts (PFC's) which were transformed into decoupled payments (DP) in 2002; the market loss assistance (MLA) and counter cyclical payments (CCP); the crop insurance subsidies (CIS); the Step-2 payments for domestic users and exporters; and the export credit guarantee subsidies.

On the supply side, the estimated impact of eliminating subsidies on planted acreage is simulated via the mechanism of the expected net return from an acre of cotton. Negative expectations about government subsidies and the market price have a negative effect on expectations about net return, which in turn have a negative impact on decisions about planting and input use. Sumner used the weighted average market price of the current crop season (August – July) to model growers' expectations about the price in the next season. The model assumes farmers have good information about future prices when the make production decisions about the next season because the decision is made in January of the current season, half way through the weighted period. The expected net revenue equation is as follows:

$$\text{Expected Net Revenue} = \text{Expected }[(\text{Price*Yield})] + (\text{MLB*Yield}) + (b_{pfc}PFC + b_{dp}DP) + (b_{mla}MLA + b_{ccp}CCP) + CIS - \text{cost per acre}].$$

Each of these four subsidies has effect on expected net revenue and influences planted area. The coefficients b_{pfc}, b_{dp}, b_{mla} and b_{ccp} are scaling factors modelling the effect of each subsidy on expected net return.

Marketing loans are the non-negative difference between the established loan rate and the loan repayment rate, which is the adjusted world price. The marketing loan payments increase as the adjusted world price falls, keeping the price farmers receive relatively stable and therefore insulating farmers from price fluctuations. The marketing loan payments allow and encourage farmers to maintain relatively high levels of production despite low prices.

The PFC's and direct payments are based on historical production. As a stable income stream these payments influence planting and investment into production equipment. Eligibility for these payments also restricts the type of crops that can be grown, encouraging further cotton production. Sumner set b_{pfc}=0.15 and b_{dp}=0.25.

The market loss assistance and counter cyclical payments were introduced to support cotton farmers when the world price rapidly declined. Once again these payments effectively insulated cotton growers from the impact of low market prices by replacing the lower market value and revenue with government support. According to Sumner (2003) their effect is similar to the marketing loans but not as large. Sumner set b_{mla}= 0.25. The counter cyclical payments were introduced in 2002. They were designed to form a revenue safety net whenever average U.S. market price fell below 65.73 cents per pound. The policy allows more frequent yield and area updates than the PFC's and DP's and therefore are closely tied to production. Sumner set b_{ccp}= 0.40, but comments that this may be quite a conservative estimate of their impact.

The crop insurance subsidies are not directly linked to production but they lower the cost of production, which impacts on the expected net return. Sumner provides a more detailed explanation of the avenues through which this subsidy can effect production. The impact of lower insurance premiums is generally greater risk taking. According to Sumner "The practical effect of the crop insurance subsidy is to encourage farmers to plant cotton in marginal producing areas (such as parts of the Southwest) where climate variability cause cotton yields to be extremely low in some years." (Sumner, 2003, p.23).

On the demand side there are three cotton subsidies: the domestic Step-2, export Step-2 and export credit guarantee payments. The domestic Step-2 payments directly subsidise the cost of domestic cotton when the world market is below the average domestic price, influencing the domestic mill use. These payments narrow the market share of imported cotton and distort trade away from cotton exporters around the world. The export Step-2 payments subsidise the price of domestic cotton for exporters. The U.S. is easily the world's largest cotton exporter. Eliminating the export Step-2 payment would reduce the supply of cotton in the world market and put upwards pressure on the world price. A decline in U.S. exports would present an opportunity for other cotton exporters. Who capture the gap market will depend on the exporters that have the necessary stocks and/or flexibility to respond to the market. The export credit guarantee program acts like insurance for exporters and therefore low the risk to exporters and encouraging a higher level of exportation than would occur without the payments.

The results from any partial equilibrium trade model like the one used here depend substantially on the elasticities used to simulate supply and demand responses. Sumner used a weighted average revenue elasticity of supply for domestic production. The weighted average was constructed from the elasticities for six cotton producing regions in the United States. The elasticities are drawn directly from the FAPRI model. A separate weighted average is calculated for each year in the analysis. Sumner does not specific all the elasticities used in the model. For 2000, 2003 and 2004 the weighted averages are 0.361, 0.466 and 0.424 respectively. These elasticities are the percentage change in planted area in response to a one percent change in expected net revenue per acre. They are not directly comparable to the price elasticities of supply used in the other models reviewed.

The U.S. price elasticity of demand used in this model implies there is little competition between cotton and synthetic fibres with the U.S. textile industry. The price elasticity of demand used for the U.S. in this model is –0.2. This is relatively inelastic and implies a lower degree of input substitution competition. This elasticity is twice the price elasticity of demand used by Goreux (2004), implying the U.S. mill use response in this model is twice as large as in the Goreux (2004). The difference is the elasticity used by Goreux was applied to all countries. Here, it is only applied to the U.S. economy. Sumner offers three explanations for the relatively inelastic mill response. Firstly he suggests that few good substitutes for cotton exist in most of it current users. This claim will be taken at face value, as it cannot be verified without extensive background research beyond the scope of this research project. Secondly, Sumner comments that textile producers used fixed combinations of fibres in their products. This explanation is more plausible, as supply contracts for textiles are set before production begins leading to a degree of rigidity within the demand for cotton at the mill level. Thirdly, it is suggested that the cost of cotton is not an important factor for end users because it is a fraction of the total production cost.

Sumner's simulation of removing all forms of government support estimated that U.S. production would fall by 27.4 percent on average over the period 1998 – 2007. The marketing loan payments contribute the biggest share of the production decline, with

11.7 percent of the average decline coming from their elimination. Elimination of the Step-2 payments contributes an average 5.6 percent to the production decrease. Domestic mill use was estimated to fall by an average of 5.8 percent. Elimination the marketing loan subsides contributed an average 3.4 percent, the loin's share of the decrease. The impacts on U.S. exports are of most interest for this research project, because they affect the poverty among African producers via the world price of cotton. Eliminating all forms of subsidies was estimated to decrease U.S. exports by and average of 43 percent over the nine years. Once again the marketing loans and Step-2 payment contribute the two biggest shares of this decrease, 17.3 and 10 percent respectively.

The focus of this research project is the impact of eliminating these subsidies on the world price. The overall impact of eliminating all forms of U.S. government support for upland cotton was estimated to cause an 11.6 percent average increase in the world price of cotton over nine years investigated. The estimated price increases from elimination all forms of subsidisation ranged from 7.7 to 17.7 over the nine seasons simulated in the model. The estimated world price increase was 10.9 and 14.0 percent in the 1999/2000 and 2000/2001 seasons respectively. The average result for these two seasons is 12.45 percent. The similarity of this result to Goreux (2004) adds weight to a possibility of the elimination of cotton subsidies causing a price increase of around 12 percent.

Sumner's discussion of the U.S. government support of cotton production highlights the extensive nature of U.S. cotton subsidies. His estimates indicate the subsidy programs have significant economic influence on production in the United States. The economic influence of such support extends to the world market because the U.S. is by far the world's largest cotton exporter and their trade distorting nature is therefore reflected in Sumner's estimates of the impact of cotton subsidies on the world price of cotton. The chief concern of this research project is the impact of that economic influence on poverty in Africa. Some African governments offered temporary emergency support to their cotton producers, but nothing compared the magnitude and duration of the U.S. programs. As previously said, the only comparative advantage the U.S. has in cotton production is their ability to pay large ongoing cotton subsidies. Sumner's estimated average price increase of 11.6 percent in response to the elimination to all forms of U.S. subsidisation adds weight to an argument for the world price of cotton being depressed by between 10 and 12 percent by subsidisation.

2.3.4 Pan, Mohanty, Ethridge and Fadiga (2006):

Pan, Mohanty, Ethridge and Fadiga, from the Department of Agricultural and Applied Economics Texas Tech University, published their results from a partial equilibrium econometric model of the world fibre market. The authors this paper out to estimate the impact of eliminating U.S. cotton subsidies on the world fibre market. Previous analysis did not attempt to directly model inter-substitution and competition between cotton and synthetic fibres in their models. Poonyth et al. (2004) offered competition and inter-substitution as justification for the higher price elasticity of demand for cotton used in their model. "Given the high degree of substitution between cotton and other fibres, demand elasticity must be larger." (Poonyth et al., 2004, p.9) But they failed to directly simulate competition in their model. Pan et al. (2006) presented a model that deals with the interaction explicitly. They comment: "Absence of proper linkage between cotton and man-made fibre would definitely overestimate or underestimate the policy effects." (Pan et al., 2006, p.181). Pan et al. (2006) and Poonyth et al. (2006) disagree with Sumner (2003) who argued: "... there are relatively few good substitutes for cotton in most current uses." (Sumner, 2003, p.10). This brief review will discuss the model in the context that including the interaction represents a unique extension compared with previous analysis, but it may not necessarily lead to more accurate estimates. This paper estimates U.S. cotton production would decline by 5.7 percent with the elimination of the U.S. cotton support programs. In contrast with Sumner (2003) estimated the elimination of cotton subsidies in the U.S. would lead to a 27 percent decline in cotton production in the United States. These studies are not directly comparable, because they model the cotton market different ways, but the gap between the results is significant.

The model employ here is based on the model of the world fibre market developed by Pan et al (2004). The structural of the model follows the typical pattern of partial equilibrium econometric models used for the simulating and estimating policy effects on regional economies and the global market. But the model used for this study has two attributes that distinguish it from previous models. Firstly, as discussed above, the investigation in this model is extended by the explicitly inclusion of the linkage between cotton and synthetic fibres. Inter-fibre substation at mill level is built-in and fibre prices are solved endogenously in the model.

Secondly, the model is designed to give results from several different regions worldwide to simulate individual impacts in separate regions; with the intention of allowing for different climatic conditions, supply responses and demand responses globally. The model features eleven regions: USA, Australia, Brazil, China, Africa, India, EU-15, Mexico, Pakistan, Argentina and the Former Soviet Union. China, USA and India are broken down further into districts. The U.S. has four districts in the model: delta, southeast, southwest irrigated and west. China has three districts: Yellow River, Yangtze River and southwest. India also has three districts: North, South and West. It is Unfortunate the Africa is aggregated to a single region. Changes in the world market have different effects on individuals and regions within the African continent, as Oxfam (2002) and others have clearly demonstrated. Benin, Burkina Faso, Chad and Mali are more dependent on the export earnings from cotton than Egypt, Uganda and other Sub-Saharan countries. It is unclear what kind of weighting or averaging was used to construct the aggregate.

This model had the potential to estimate the economic role of cotton substitutes on the cotton market's response to the elimination of cotton in the U.S.. The model estimated eliminating U.S. cotton subsidies would lead to a 5.7 percent decrease in U.S. cotton. The production decrease and a higher domestic lead to an 8.3 percent decrease in the U.S. cotton exports. The world price was estimated to increase by 2.2 percent.

Unfortunately Pan et al. neglected to conduct any comparative analysis. The estimated price is less the all of the models reviewed. No explicit explanation of the result relative to other model is offer. Readers are merely left with impression that the reason for the low result has something to with the inclusion of competition between fibre types in the model. But such conclusion is not explicitly supported by the analysis because there are no results for a model with the presence of fibre competition. Therefore, the analysis fails to any strong or unique conclusion about role of fibre competition. Pan et al.'s analysis is frustrating and disappointing. It adds nothing to the general economic understanding of the cotton market. Producing a control estimate of the response to the elimination of cotton subsidies would have exponentially improved the value of their analysis. A control in the form of a simulation without competition would have been a benchmark to estimate the economic impact of competition. Without the benchmark we have a result without a comparison to measure it against.

2.3.5 Tokarick (2003):

Stephen Tokarick (2003) analysed impacts of trade liberalisation in ten agricultural commodities on global welfare. Instead of favouring one type of equilibrium model over another he separately estimated the welfare in a partial equilibrium model and then a computable general equilibrium. The commodities investigated were beef and veal; wheat; milk; rice; maize; cotton; refined sugar; wool; sheep meat and soybeans. Tokarick estimated the effect of removing four types of agricultural support: input subsidies, producer subsidies, import tariffs and export subsidies. For the purpose of his study the results from the removal of import tariffs and export subsidies were combined and reported as estimates for the removal of "market price support." In the partial equilibrium analysis Tokarick conducted four simulations: the removal of market price support, removal of production subsidies, removal of input subsidies and the removal of all forms of support. Each of these simulations was performing on a multilateral basis assuming all countries would liberalise at the same time. The general equilibrium analysis was performed using the GTAP framework developed by Hertel (1997).

Tokarick's partial equilibrium model structure consisted of separate supply and demand functions for each commodity and country. These equations fed into a world import demand and export supply equations. The assumption market clearing was applied to these equations to arrive at a solution for the world price of each commodity. The law of one price is applied by assuming the commodities are homogenous regardless of their origin. The data agricultural support for all commodities except cotton was sourced from OECD PSE and CSE tables. The data for cotton came from the USDA. The necessary elasticities were taken from Gardiner et al. (1989) and checked against OECD (2001) for consistency. Tokarick comments that best guess estimates were made for import demand and export supply elasticities. He reports the range of export supply elasticities to be from 1.5 to10 depending on the commodity. He also sites an import demand elasticity of -0.75 as being most common, but does not specifically the elasticities used for the cotton market. Therefore comparing the results for cotton to other studies is problematic. But if it is assumed the price elasticity of supply is 1.5 and the price elasticity of demand is -0.75, we can say that the supply and demand elasticities are 3 and 7.5 times those use by Goreux (2004). This would mean Tokarick's model much more sensitive than Goreux (2004) or other models reviewed, especially in the way demand response is model. The potential, but unconfirmed, differences in these elasticities could explain why the Tokarick estimate of price change is so much lower than Goreux (2004).

Before I discuss the results from this paper is important to comment on the data used in the cotton model. Tokarick's model treats the United States as the only country to subsidise cotton in the OCED. In this model the E.U. is assumed to not pay cotton subsidies. China is not in included because it is not in the OECD. The exclusion of these two cotton producers limits the results of the model. This model simply estimates the impact of U.S. removing its cotton supports on the world market, rather than the results reflecting multilateral liberalisation of the cotton industry. This restriction may partially explain why the result is lower other studies.

In this model all support measures at reflect in ad valorem terms. Producer subsidies are calculated to be 22 percent relative to the world price in this model. This seems to be not unreasonable compared to the figures published by Baffes (2005) which were based USDA figures, but it is possibly a little on the low side. Tokarick models export subsides with a 5 percent different between the domestic and world price. Input subsidies are assumed to be zero in the U.S.

Tokarick estimated that the removal of all forms of agricultural support for cotton would increase the world cotton price by 2.8 percent. It was estimated the removal of production subsidies alone would increase the world price by 2 percent and the rest of the price increase was contributed by the removal of market price supports. Liberalisation was estimated to have the largest effect on the world price of milk – 23.6 percent increase. This was closely following by the price increase for sheep meat, which was estimated to increase by 22.2 percent. Wool had the lowest estimate of a price increase with 0.1.

The partial equilibrium analysis also includes the estimation of changes in welfare. The welfare framework follows the typical investigation of changes in consumer and producer surplus. Overall the U.S. experienced a welfare gain due the liberalisation of the cotton industry. The following figures are in 2000 U.S. dollars and are based on support figures from 2000. American cotton experience a producer surplus loss of 964.5 million U.S. dollars with the complete liberalisation on the U.S. industry, the removal of producer subsidies account for 83 percent of this welfare loss. Consumers in the U.S. gain 43.1 million U.S. dollars through an increase in the consumer surplus. But as taxpayers, American consumers vicariously gain 1016.2 million U.S. dollars as a net change in government revenue. The terms of trade effect accounts for 52.5 mil U.S. dollars of the net change in government revenue. Therefore, the United States experiences a net gain in welfare of 94.9 million U.S. due the liberalisation of its cotton industry. Such decline in producer welfare from cotton is likely to lead to a shift in resource allocation away from cotton production.

Net exporters experience welfare gains from liberalisation. These welfare gains come from terms of trade improvements and efficiency gains. Net importers suffer terms of trade loses as the relative price of imported agricultural commodities increases. But net importers also benefit from efficiency improvements once the incentives for inefficient resource allocation are removed.

It is well documented that developing countries are typically net food importers. Eight out of the ten agricultural commodities studied by Tokarick are food. The price of these edible commodities will rise with the removal of agricultural support and this could have an impact of poverty. Tokarick's welfare estimates show the increase in export earnings (represented by a negative increase in import cost) from cotton and other exported commodities can outweigh the higher cost of imported food. The increase in cotton export earnings, as a direct result of the estimated increase in the world price of cotton, are higher than the increased cost of imported food in Benin, Burkina Faso, Central African Republic, Chad, Mali, Uganda and Uzbekistan. Uganda was estimated to gain 1.61 million U.S. dollars from and increase in cotton export earnings and lose

0.59 million U.S. dollars from imported wheat, maize, rice and refined sugar. In total Uganda was estimated to gain 1.02 U.S. dollars per year if liberalisation took place. This has the potential to lift 2795 Ugandans out of poverty based on a 1 U.S. dollar poverty line and a 365-day year. Tokarick's estimates say nothing about the distribution of changes in welfare within a country as a result of liberalisation. So estimates of changes in poverty can only be realised if all the gains went to cotton farmers in poverty and those who are face with increasing food costs are not forced into poverty by those costs.

In Tokarick's general equilibrium model liberalisation is simultaneous for all the commodities studied and includes the removal of all four forms of agricultural support. The general equilibrium model does not investigate cotton separately. The model estimated multilateral liberalisation in all the examined commodities would increase real income by 128 billion U.S. dollars (summing the change in income for countries in the model.) The countries that used the most distorting policies had the most to gain. Developed countries gained 75 percent of the total gain. The gains come from increased efficiency in the allocation of resources and the lower cost to consumers.

Tokarick suggests three ways the developing countries in Sub-Saharan will gain. Firstly, liberalisation in developed countries would increase their domestic real incomes thus increasing demand for the export commodities of Sub-Saharan Africa, such as: coffee, tea and coco. The products have already been liberalised, so their prices will actually become relatively cheaper under the liberalisation scenario examined here. The path for cotton demand is more complicated as export commodity of Africa. Coffee, tea, and cocoa are primary products that tend to be branded more in favour of Africa (Kenyan coffee, for example, features at the core of many sales strategies.) Cotton has not enjoyed such wide-ranging attention. Therefore, Tokarick's logic may not apply to cotton. An increase in real incomes in developed countries may lead to increased spending on cotton.

Secondly, the global shift in resource allocation away from agriculture and towards manufacturing would lower the price of manufactured goods, benefiting developing countries because they tend to be net importers of these goods. The lest developed countries in Sub Saharan Africa would especially benefit from less expensive manufactured goods such as farming equipment and machinery that will increase productivity.

Thirdly, an increase in the price of the agricultural commodities will increase tax revenue in developing and therefore increase the welfare of developing countries. An increase in government revenue in developing countries creates an opportunity for increase spending on potentially poverty reducing education and health plans.

In summary, Tokarick's partial equilibrium model estimated a 2.8 percent increase in the world price of cotton with elimination of production subsidies, export subsidies and import tariffs in the U.S. This analysis was done before the 2002-2004 when U.S. cotton support reached new highs. The general equilibrium analysis showed the liberalisation of cotton would benefit the cotton producers in Africa by increasing export earnings and relieving the downward pressure on the price of cotton from subsidisation and oversupply. Investigation into to the changes in the cost food imports for Africa revealed the increased export earnings for cotton were higher than the costs imported food. Therefore as an export cash crop, cotton has pivotal role to play in the cotton producing countries in Africa. Cotton trade and production should be liberalised as soon as possible, based on Tokarick's results, to capture the potential welfare improvements and efficiency gains for all countries.

2.4 Minot and Daniels (2005):

Minot and Daniels (2005) published an insightful empirical investigation into the impact of changes in the market price of cotton on income and poverty levels amongst cotton farmers in Benin. The purpose of the study is to estimate the impact of the 40 percent decline in the world price of cotton over the 2001-2002 period on poverty. The study uses household level survey information making it reasonably unique. Household level data for crops and expenditure is rare in Africa, due to lack of organization and funding. Lack of funding was cited by the Ugandan Bureau Statistics (UBOS) as the main reason why it had not conduct a crop survey component in all of its household level statistical surveys. Despite its scarcity, using household level data is very relevant for research about Africa. Many people in rural Africa do unpaid work on household land in return for a share in the household basics like food and shelter. Children also contribute their effect to the household and generally work much harder than would be considered to socially acceptable in a western country. Minot and Daniels use household expenditure, as a proxy for income to measure poverty. This is also very relevant to the African situation. Estimating individual incomes for those who do unpaid labour for their household would be difficult and very open to error.

Minot and Daniels' investigation is broken down into four stages: applying a poverty line, estimating the direct effect of the price decrease, estimating the indirect effect of the price decrease and estimating the flow on effects via an agriculture multiplier. The first stage of Minot and Daniels' investigation is to establish a poverty line that will be used as a reference point throughout their research. Instead of using the commonly employed poverty line of $1 US/person/day, they favour use the 40^{th} percentile of cumulative household income as their poverty line for rural Benin. When they used the one-dollar per person per day poverty line they estimated 95 percent of Benin's rural population were in poverty. Minot and Daniels do not offer any economic, sociological or anthropologic justification using their poverty line. In the absence of any justification such a poverty line is an arbitrary reference line that has value outside their study. The weaknesses of the one-dollar per person per day poverty are well established. It is strictly black and white in the sense that a household with an income of 99 U.S. cents per person per day is deemed to be in poverty regardless of how close it is to the poverty line. Such a poverty line assumes that the purchasing power is comparable across borders, clearly this quite a strong assumption. But there ways allow for differences in purchasing power. One way is to calculate the monetary value of a basket of goods that represent a local poverty line.

Throughout their research Minot and Daniels use expenditure as a proxy for income. Where expenditure is the total of expenditure on consumption goods, the valued of food produced and then consumed by a household and the rental equivalent for owner-occupied housing. Expenditure is then used as a measure of economic welfare.

The second stage of Minot and Daniel's investigation is the estimation of the direct effects of a drop in price. A change in price directly affects the cotton growers' return. Cotton farmers cannot change their production mix instantly to respond to the market shock. The nature of agriculture means there is a time lag between shocks and the production decisions that reflect the long-term market changes. Minot and Daniel's estimated that a 40% fall in farm-gate price leads to 7% fall in household income in the short term. The short-term change in expenditure, measured by the change in revenue (assuming savings is close zero), is estimated by equation 1:

$$y_{1i} - y_{0i} = \frac{1}{H_i}(Q_{ci}\Delta P_c) \tag{1}$$

y_{1i} is per capita expenditure of household i after the change in price

y_{0i} is the initial level of household expenditure

ΔP_c is the change in price level

Q_{ci} is the quantity of cotton grown by the household

H_i is the number of individuals in the household

To add to the estimate of the impact of a change in the price of cotton Minot and Daniels also estimate the shift in poverty levels resulting form a fall in income. They apply the Foster-Greer-Thorbecke (FGT) measure of poverty as defined by equation 2:

$$P_\alpha = \frac{1}{N}\sum_i \left[\frac{\mu - y_i}{\mu}\right]^\alpha \tag{2}$$

P_α is the poverty measure

N is the number of households

μ is the poverty line

y_i is the expenditure of household i

The FGT measure of poverty offers a powerful three-tied picture of the estimated changes in the poverty statistics. The key to the FGT measure is the interaction of the terms within the brackets. The expression generates a comparison between the expenditure level and the poverty line. Mathematically it calculates the percentage difference in income compared to the poverty line. When $y_i > \mu$ household income is above the poverty line. When $y_i < \mu$ household income is below the poverty line. How the poverty line is defined is important at this point. Any comparison of the measures of poverty between economies must consider the comparability of the poverty line. So the process of choosing a poverty line must be considered carefully. Shifting the poverty line changes the results of the study. Using a recognised poverty line, such as 1 US$/person/day has the advantage of comparability in relation to other studies.

We can measure different aspects of poverty with the FGT measure. by limiting the summation of household income to only those homes that are in poverty. When $\alpha = 0$ the expression in the brackets becomes 1 and P_0 is simply 1/N - the proportion of households in poverty. When $\alpha = 1$, P_1 measures the depth of poverty by considering the proportion of households in poverty and the aggregate gap from the poverty line. When $\alpha = 2$, more weight is given to the poorest of the poor. Effectively this equation measures the general variation from the poverty line and captures information about the distribution of incomes and creates a snapshot of inequality amongst the poor.

Following the literature involving the FGT measure, P_2 will be referred to as the severity of poverty.

Minot and Daniels estimated that 40% decline in the cotton price would increase P_0, the number of households below the poverty line from 40% to 48% over the whole economy. This is equivalent to 334,000 more people below the poverty line. The average change in per capita expenditure is 7% decrease. The effect is much greater on cotton growing households who are estimated to experience a 21% fall in income in the short term. The poverty gap, P_1, widens by 38% from 0.1 to 0.138 and the severity of poverty is estimated to increase by 62%.

To estimate the long-term change in welfare Minot and Daniels use a more complex equation:

$$y_{1i} - y_{0i} = \frac{1}{H_i}\left[(Q_{ci}\Delta P_c) + \left(\frac{1}{2}(\Delta P_c)^2 \varepsilon_c \frac{Q_{ci}}{P_c}\right)\right] \tag{3}$$

The second expression captures the farmer's ability to adjust their production decision in response to new market conditions. The expression is always positive indicating that the long term change in income will always be more positive than the short term impact. In the case of a 40% reduction in price the long term effects are less damaging than the short term effects. Although it is important to recognise that while the short term loss in income is higher than the long term one, the long term change has a more lasting effect.

The elasticity of supply for cotton (ε_c) in Benin was not available. Delgado and Minot (2000) estimated Tanzania's elasticity of supply for cotton to be 1.0. Minot and Daniels use a range of elasticities: 0.5, 1.0 and 1.5. Their results about the long term effect changes slightly depending on which elasticity is used. A 40% fall in the cotton price is estimated to lead to a 5-6% fall in income long term. The incidence of poverty, P_0, increases from 40% to 46-48%. The change in the poverty gap, P_1, shifts from 0.100 to 0.123-0.138. The increase in the severity of poverty, P_2, varies from 24% to 61%. The ability to respond to market shocks, as measure the elasticity of supply of cotton, will determine the long-term impact of a fall in the price of cotton. The ability to respond is limited by the range of existing alternatives. In some Sahelian economies cotton is a major cash crop and there are few alternatives.

The fourth stage of Minot and Daniels' investigation involves the estimation of the indirect effects of a fall in the price of cotton on the rest of the economy. Cotton is a primary product. A shock to cotton will have flow on effects to other related sectors. The adjustment away from cotton will affect spending on fertiliser use, demand for labour, land use, the supply of substitute crops, demand for cotton processing and the supply of processed cotton for the textile industry.

Minot and Daniels explore two areas that are indirectly affected by a fall in cotton prices, the labour market and household consumption. As the price of cotton falls farmers will have to reconsider the use of paid labour as opposed to household or family labour, which is generally unpaid. A decline in the expenditure of cotton producing households will cause a structural shift in the labour market. Magnitude of the shift will depend of the flexibility of the labour market. One of the weaknesses of analysis in this area is the assumption of a perfect elastic supply of non-tradables. This assumption would cause the overestimation of the structural shift in the labour market. In reality no labour markets are perfectly flexible.

To estimate the indirect impact on labour demand Minot and Daniels calculate the relative level of labour intensity of cotton farming compared to other crops and other activities. They found: "Cotton is 15% more labor-intensive than the area-weighted average of other crops. Overall, cotton accounts for 21% of the demand for hired labor. Thus, a 10% reduction in cotton production might lead to a 2% reduction in the national demand for labor, but this would be partly offset by the demand for labor on the crops that replace cotton." (Minot et al., 2005, p.463). Their analysis later shows that cotton production has a statistically insignificant effect on demand for hired labour.

The second type of indirect effect Minot and Daniels examined was a multiplier effect. A multiplier effect estimates how a reduction in the household expenditure of cotton grows effects the household welfare in the overall economy. Minot and Daniels use a semi-input-output multiplier developed by Bell and Hazell (1980) that was further simplified by Hazell (1984). Minot and Daniels estimated the multiplier value to be 2.96. This implies that for every 1 US dollar fall income for cotton farmers leads to overall income decline of $2.96 US. The multiplier is specified as follows:

$$M = \frac{1}{\left(1 - \alpha_n - \beta_n v(1-s)\right)} \tag{4}$$

α_n = the ratio of non-tradable intermediate goods to total output

β_n = the marginal propensity of Benin cotton farmers to consume non-tradables

v = the share of value added goods is total output

s = the savings rate

Minot and Daniels' study provided significant motivation for the approach used in this research thesis in three ways. Firstly Minot and Daniels' research demonstrated how household level data could provide a more accurate picture of the effect of a market shift on farmers throughout a country. Therefore household level data for Uganda was sought for this research thesis. Obtaining household level data for cotton farmers in Uganda was difficult, but the Ugandan Bureau of Statistics made such data available. Secondly, Minot and Daniels (2005) approach offered an empirically driven study. Estimating a shift in poverty levels via an econometric model would not have spoken as loudly as their empirical analysis. The simplicity of the analysis, in conjunction with the richness of the data, presents a solid picture of the relationship the world price of cotton and poverty amongst cotton producers in Africa. Thirdly, their study suggests a different approach to establishing a poverty line amongst cotton farmers in Benin. Such an approach adds to the shortlist of options for establishing a poverty line amongst Ugandan cotton farmers.

Chapter 3: Methodology:

3.1 A Poverty Line for Cotton Producers in Rural Uganda:

Establishing a poverty line is the first step in any research aiming to measure changes in poverty. Poverty is a relative concept and has no absolute definition. Poverty lines tend to measure a relative standard of living within a society. The chosen definition of a particular poverty line acts as a reference point or benchmark in the analysis of changes in the extent of poverty in a community. How the chosen definition of poverty is translated in to a quantitative poverty line will influence the description of poverty throughout the analysis. Daily income, food expenditure and calorie intake are some common ways to define poverty. Comparability, accurate representation and the robustness of any poverty line dwell at the heart of debate about poverty lines. But theoretical and empirical issues must be balanced against the practical issues of the cost of measurement, ease of use, and the typical lack of empirical data from the countries most in poverty. Being able to compare economic welfare and poverty in different countries is vital in the process of creating informed policies and strategies for reducing global poverty. The ability to compare poverty in a wide range of countries will reveal those areas where need and suffering is greatest and therefore direct policy makers to those most in poverty.

Arguably the definition of poverty varies across different countries and subgroups within each country. Each society has its own social norms and perceptions, which influence how a society defines poverty. Ravallion and Bidani (1994) describe the relative nature of the definition of poverty as specificity. Clearly the perceptions and social norms will vary between societies. The developing world has very different mean standard of livings than the developed world. Mean standards of living influence the definition of poverty, because they tend to shape perceptions about poverty within a community.

This research is focused on poverty Sub-Saharan Africa, an area where millions of people struggle to survive. Poverty in this region is severe. The mean life expectancy for Uganda in 2000 was 45 years (World Bank Indicators 2000). This is just one of a series of sobering indicators of poverty in Uganda. Households throughout Sub-Saharan Africa struggle to meet the basic needs of life and survival. Households in rural locations continue depend on subsistence agriculture to meet their basic needs. For the purpose of this research, poverty will be conceptually defined as the inability or incapability to meet the basic needs.

Policy makers ideally require consistency when measuring poverty across international borders. Ravallion and Bidani (1994) defined consistency by the following example: "For example, suppose we are comparing two households deemed to have exactly the same standard of living in all relevant respects but located in different regions; the poverty profile would be inconsistent if it classified one of these households as poor and the other as not." (Ravallion and Bidani, 1994, p.76). Informed policy decisions ideally require comparability between countries and consistency is fundamental to comparability. The previously discussed concept of specificity is in conflict with consistency. But in reality some degree of specificity will be present in every poverty line. As poverty lines are typically estimated from local factors such as prices, local diets and mean consumption expenditure. These factors all add elements of specificity to poverty lines. Clearly consistency is important when comparing poverty in different countries. But specificity is unavoidable and therefore, inconsistency is inevitable. Consistency is merely an ideal standard that should be considered in the design of any poverty line.

There are two setting a poverty line; both of these measures become monetary measures regardless of their starting point. They are simply different approaches to obtaining a monetary reference line of the state of beginning in poverty. The first approach is the cost of basic needs (CBN) method. A CBN poverty line is based on the estimated mean value of a basket of food and non-food goods. The basket of goods is constructed from local consumption and expenditure information. A model of mean or weighted average consumption pattern is created and the mean value of consumption expenditure is estimated from local prices those commodities. This approach can be highly specific to a country or community. The CBN method is quite detailed approach to defining poverty but it remains a relative approach.

The second approach is based the cost of the minimum food energy intake (FEI). For this approach the starting is a predetermined minimum energy intake. The mean cost of consuming the set level of calories is used to create the poverty line. Once again this poverty line is dependent on local prices and commodities. This approach can been used to estimated the cost of the food portion of a basket of consumption good is the CBN approach. One problem related with using this measure is variation of energy intake related to the age and gender of an individual. Children have lower requirements than adults. Attempting to allow for this can be very difficult and impractical. Another problem with the FEI intake is defining the cost of the minimum energy intake. There are often many ways to consume the minimum number of calories. So, once a decision must be made about a representative consumption. This decision creates an arbitrary poverty line containing some degree of specificity.

The practical definition of poverty will be set at one U.S. dollar per person per day for this research project. This poverty line is commonly used by international organizations as a reference line for poverty in developing countries. The use of this poverty is generally considered to be arbitrary in nature. Using this poverty line is justifiable for Uganda. The Ugandan Bureau of Statistics (2003) found that a bundle of goods designed to represent the poverty line in Uganda to cost 34 U.S. dollars per person per month.

A poverty line of one U.S. per person per day has the advantage related to its ease of use. The process of converting the local currency value of income or expenditure is simple once credible foreign exchange value has been established. The weaknesses of this poverty line stem from its somewhat arbitrary nature. The first weakness is the intrinsic assumption about comparability of purchasing power. Purchasing power at the poverty line varies between economies due to differences in the foreign exchange value of a U.S. dollar.

The second weakness of the one U.S. dollar approach is derived from its strict nature. A household is either in or out of poverty. One U.S. dollar per day is an exact reference line. A household is assumed to be in poverty when the total household income per person day was less than 1 US dollar by any fraction of a decimal point. Implying that a household with a per person per day income of 0.99 US dollars is assumed to be in poverty despite the fact that there is only a one cent difference between being in poverty and out of poverty.

The universal treatment of all individuals is the third weakness of this poverty line. The needs of a child may not be as taxing on household as those of adult, for example a child typically eats less food than an adult. The one US dollar poverty line ignores all such differences amongst household members and treats them all as equivalent generic individuals. This treatment is another recognised weakness of the poverty line. The use of a weighting based on age could be applied to improve the measure, but of course this would require a lot more detailed data, increase the cost of household surveys and complicate the poverty line.

The number of people in each household is significant when using such a measure. Although Ugandan children generally perform some kind labour that contributes to household income and/or welfare, their effort is not equivalent to an adult's contribution. The UBOS crop survey report confirms that children contribution substantially to household labour in Uganda. "The total number of persons that were engaged in crop farming activities at the beginning of the first season of the 1999/2000 agricultural year was estimated to be about 11,000,000 persons. Of the estimated number of persons engaged, 32% were male, 39% were female while 29% were children. Unpaid household members constituted the majority of persons engaged in crop farming of which 52% were children. This implies that child labour was still a major contributor to crop farming labour." (UBOS, 2000, p.vii)

In their study of poverty in Benin, Minot and Daniels (2005) reject the use of the one U.S. dollar per person per day seemingly because it measures that 95 percent of rural households in Benin are in poverty. (Minot, 2005, p.457). Instead they set their poverty line at the 40th percentile of per capita consumption expenditure. The absence of any economic or anthropologic justification implies this poverty line is completely arbitrary. Based on face value they appear to sacrifice the comparability of the one-dollar per person per in favour of a lower poverty statistic. This choice is a weakness within their study. At very least an economic justification should be provided for its use. Repeating their study with the one-dollar poverty line would offer an interesting alternative study.

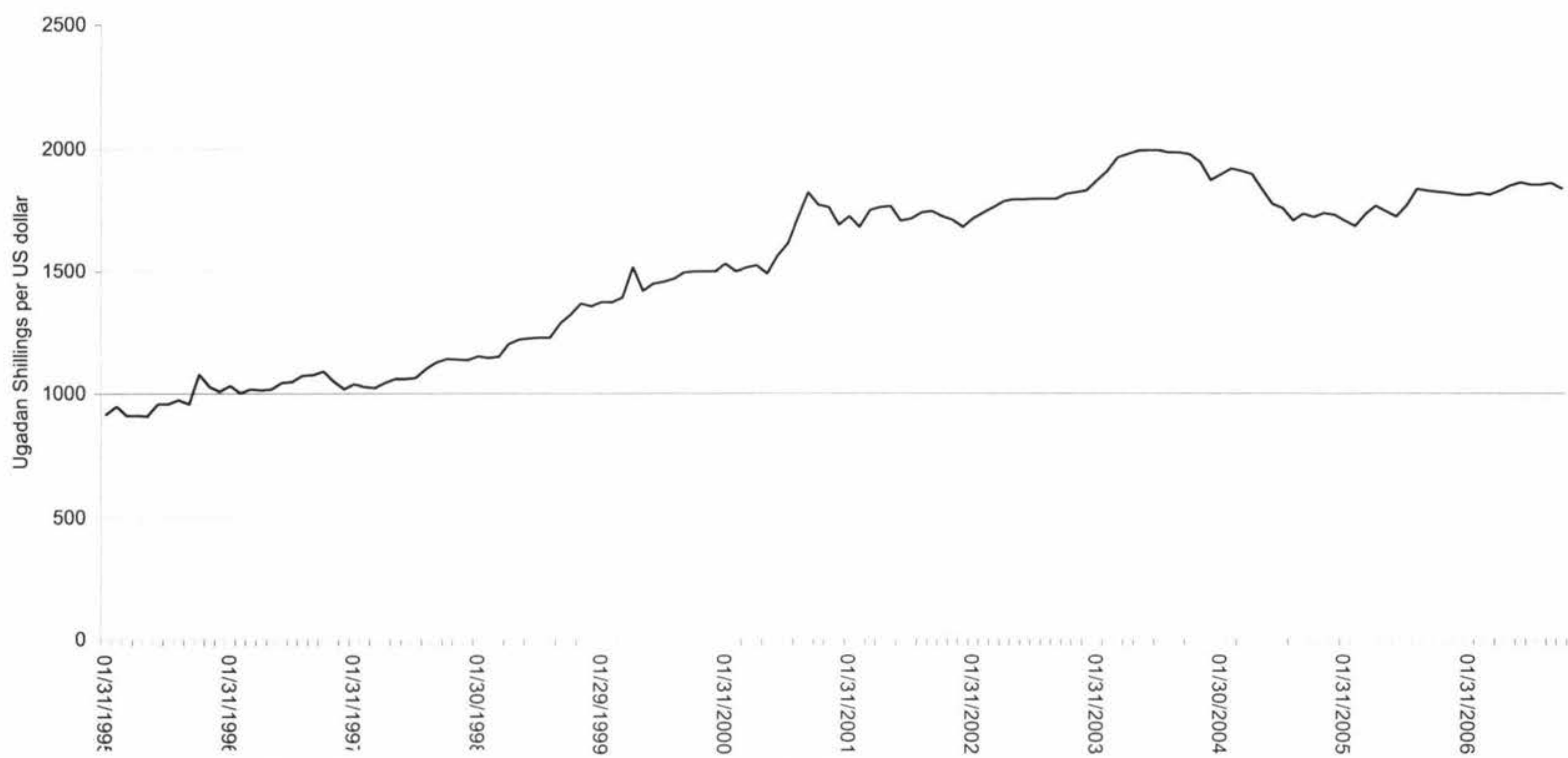
UBOS (2003) established a poverty line of 34 U.S. dollars per person per month. UBOS arrived at this poverty line by considering the cost of a basket of food and non-food goods across the four regions of Uganda. The food expenditure portion of the basket was based on the cost of 3000 calories per adult equivalent per day for the poorest 50 percent of the population. The WHO (1985) principles state that an adult male working in subsistence agriculture requires 3000 calories per day. The cost of this calorie intake was based on the mean quantities of different food items consumed by the poorest 50 percent of the population. To capture regional differences in regional costs the non-food expenditure portion of the basket was allowed to vary across the four regions of Uganda. A mean non-food expenditure value was calculated from the regional information. The mean exchange value for the May 2002 to April 2003 period covered by the UNHS 2002/03 survey was one U.S. dollar equalled 1,846.75 UGX. Therefore 34 U.S. dollars per person per month is equal to 62,789.50 or 2093 per day, based on a 30-day month.

A degree of arbitrariness and specificity is inescapable in any definition of poverty and the subsequent poverty lines constructed it. It may be impossible to construct a poverty line that is perfectly consistent for two countries. Therefore policy makers and analysts should be aware of the nature and basis for the poverty lines they compare. Ravallion writes: "... recognizing that a certain amount of arbitrariness is unavoidable in defining any poverty line in practice, one should be particularly careful about how the choices made affect the poverty comparisons, for these are generally what matter most to the policy implications." (Ravallion, 1992, p.29) The application of the one U.S. dollar poverty line is arbitrary and contains specificity, but based on the findings of UBOS (2003) is justifiable and appropriate for this research project.

3.2 The Applied Exchange Rate:

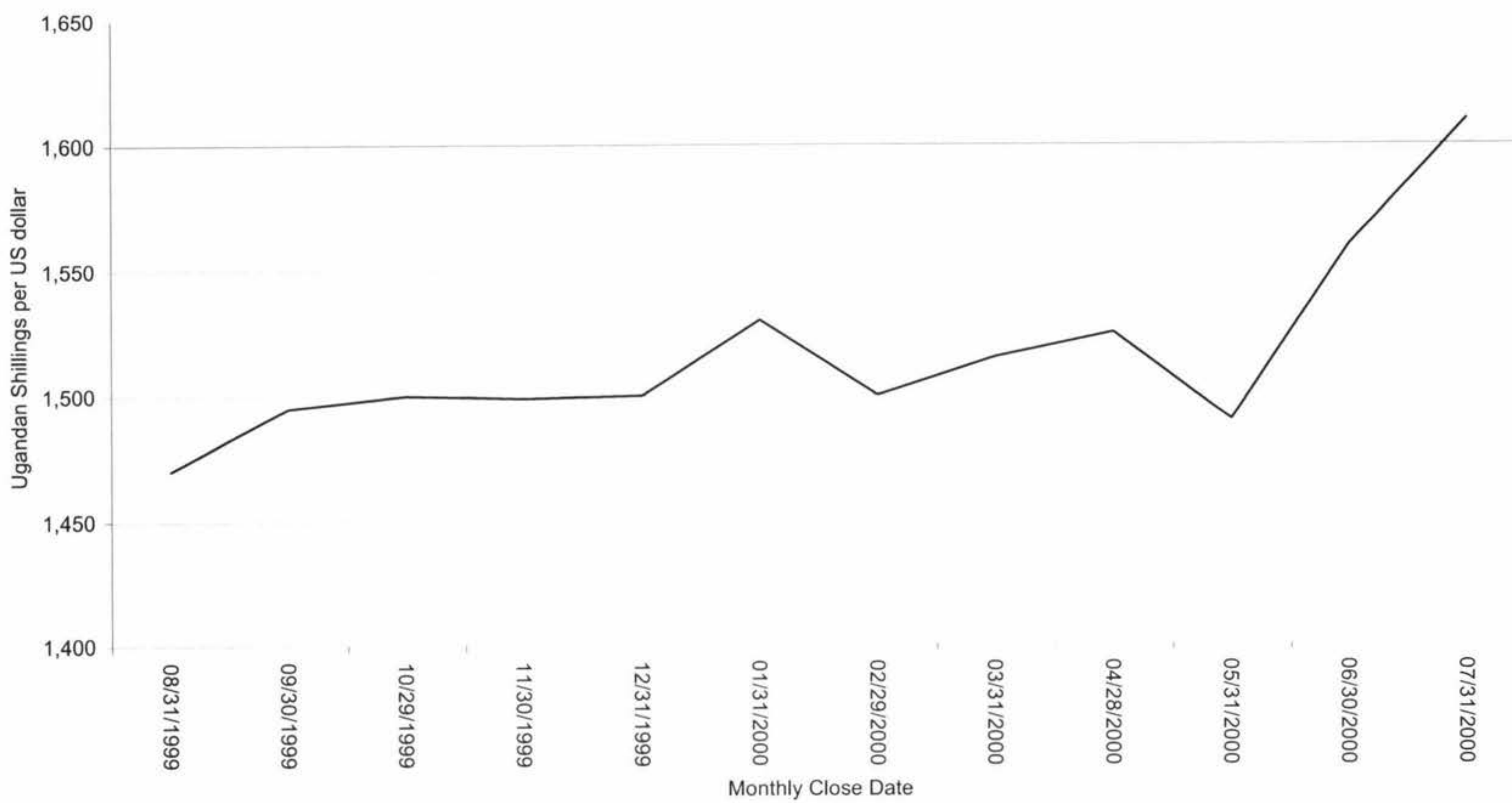
The use of the one US dollar poverty line and the Index A spot cotton price required the conversion of Ugandan shillings (UGX) to US dollars. The closing exchange rate values for the period from January 1995 to September 2006 were sourced from ww.globalfinancialdata.com. Figure 5 shows the UGX depreciating against the US dollar of the period. The period from August 1999 to July 2000 is most relevant for this study. All conversions in this study used the average closing value average over the twelve-month period of 1 US dollar equal to 1516 Ugandan shillings. Figure 6 show the monthly closing values over this period.

Figure 4: Ugandan Shilling vs. USD January 1995 - September 2006



Source: www.globalfinancialdata.com

Figure 5: Ugandan Shilling (UGX) vs. USD August 1999 - July 2000



Source: www.globalfinancialdata.com

3.3 Estimating Total Household Income:

Total household income for cotton growing households was calculated based on a number of income sources. First, the total income from crops sold (excluding cotton) was calculated from the crop sales data in the crop survey data set. The crop survey included a question about total crop income for each household, but often these figures were well below the total crop income when the sales data was added up. Therefore the figures for the total income in the crop survey were discarded in favour of the summation, which appear to be more precise. As with cotton, the individual crop sales figures were calculated based on the quantity sold multiplied by the recorded producer price. The crop survey included sales income figures but the recorded total did not always match the price multiplied by the quantity sold. Responses to the survey questions appeared to have been rough estimates.

The next stage in estimating the total household income was to add income from all other sources that did not fall in to the categories other crop or employment. The socio-economic survey contained the relevant information necessary for an estimate of income from other sources. These other sources included income from: livestock, cottage industries, rent on land, rent of buildings, interest on investments and savings, dividends, inheritances and government funding or social welfare programs.

The last stage in estimating total income (excluding income from cotton) was to include income from employment. In each one of these sources the value of payment in 'kind' (produce offered a payment instead of currency) was ignored. Such values were included in the data sets but they were considered too subjective to be included.

$$Y = Q_c P_c + Y_{crop} + Y_{hld} + Y_{emp}$$

$$\Delta Y = Q_c \Delta P_c + Y_{crop} + Y_{hld} + Y_{emp}$$

Y: Household income

Q_c: Quantity of cotton sold in one-kilogram units

P_c: Producer price of cotton sold

Y_{crop}: Household income from all crops except cotton

Y_{hld}: Household income from household activities excluding agriculture and employment

Y_{emp}: Household income from paid employment

3.4 The Baseline Case:

The baseline case was created as a reference case for all subsequent cases. The baseline is simply the total income where the cotton farmers receive the survey producer price. The Foster-Greer-Thorbecke (FGT) measure of poverty is applied here to identify the number of households initially in a state poverty. P_0 is the count of those households in poverty divided by the total number of cotton producing household in the sample. Once problem households were removed from the sample 428 households were investigated. P_1 is the gap between household income and the poverty line. Minot and Daniels referred to it as a measure of the depth of poverty. The aggregate of all individual P_1's represents a measure of the average gap between the poverty line and the household income (per person per day) and the poverty line for those households in poverty. P_2 is the poverty gap P_1 squared and is designed to reflect variation amongst households in poverty. The reported aggregate P_2 result is the sum of all the households divided by the number of households below the poverty line, based on the result of the P_0 calculation.

3.5 Sensitivity Analysis of Poverty the Producer Price after the Elimination of Cotton Subsidies:

After the baseline case was established the actual producer price of cotton was increased systematically by between 2.5 and 15.0 percent. At each stage the original price was increased by and additional 2.5 percent. The range of price increase reflects the result of the studies by Goreux (2004), Gilson et al (2004), Sumner (2003), Tokarick (2003) and Pan et al (2006). In these studies the elimination of cotton subsidies was estimated to increase the Index A price of cotton by 2.2 to 28 percent. The total income each household was recalculated at each stage and this total income divided to represent the household income per person per day in U.S. dollars. This value was then compared to the poverty line. Each of the three FGT measures of poverty were calculated from the per person per day value. P_0 is simply the percentage of households below the poverty line. The equations for P_1 and P_2 are reported below:

$$P_1 = \frac{1}{N}\sum_i \left[\frac{\mu - y_i}{\mu}\right]$$

$$P_2 = \frac{1}{N}\sum_i \left[\frac{\mu - y_i}{\mu}\right]^2$$

P_1 measures the depth of poverty – the average monetary gap between the poverty line and the income of households below the poverty line.

P_2 measures the severity of poverty – the average monetary gap between the poverty line and the income of households below the poverty line squared.

N is the number of households

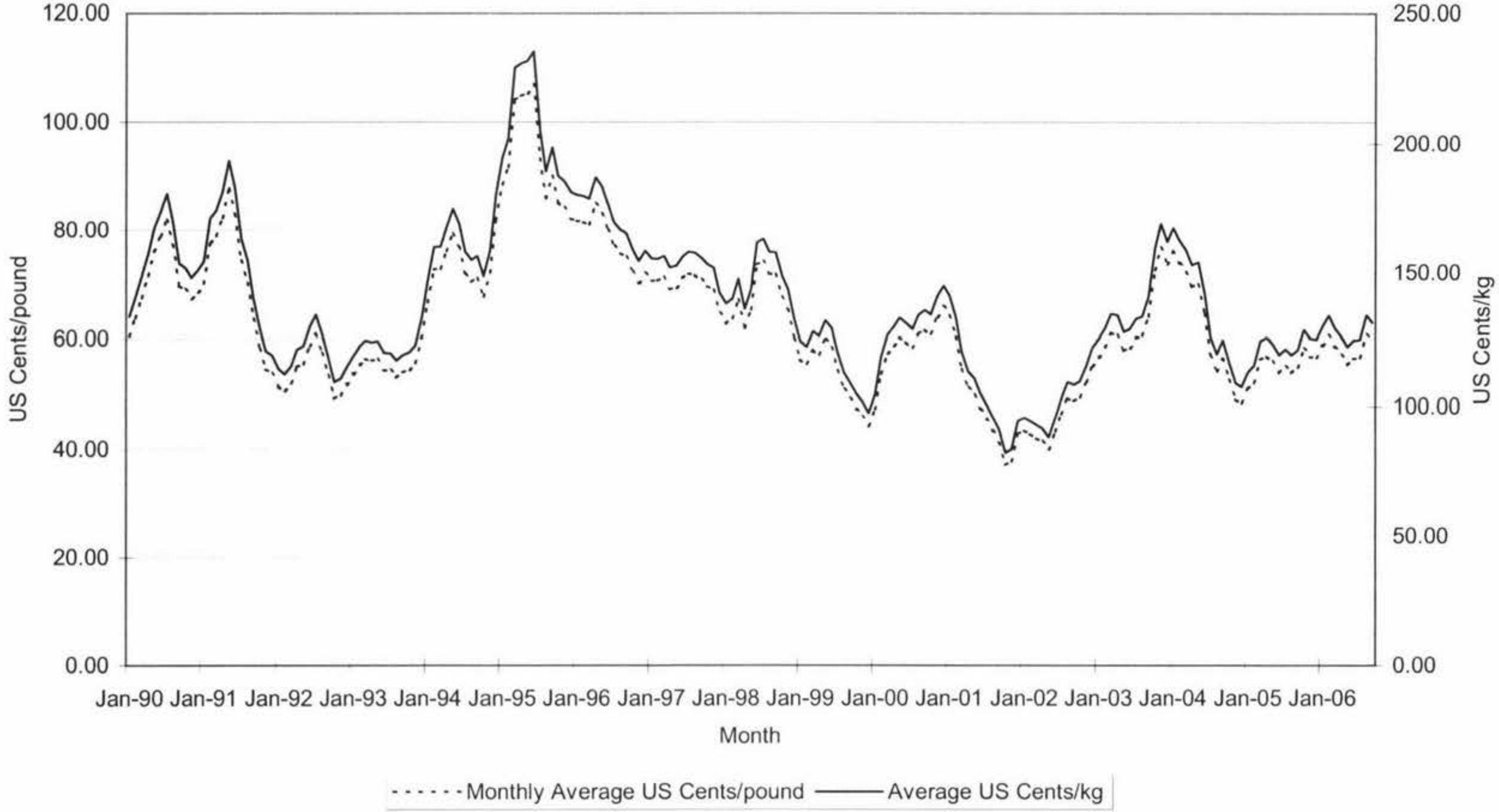
μ is the poverty line

y_i is the income of household i in per person per day terms

An examination of the producer price of cotton in Uganda revealed that Ugandan farmers received a price well below the world price as reflected the Index A spot price of cotton. The average producer price reported in the crop survey sample of cotton producer was 376 UGX per kilogram. For the survey period the average Index A price was equivalent to 1784.71 UGX. The gap between these to prices was striking. It implies Ugandan cotton producers sold their cotton at 21 percent of the world price. Figure 7 shows the Index A monthly average cotton price for the period from January 1990 to September 2006. Figure 8 is the Index A monthly average price for the period August 1999 to July 2000. In the next stage of the analysis the base producer was shifted to 1784.71 UGX per kilogram. Following the previous sensitive analysis this producer was incrementally increased by 2.5 percent up to 15 percent. These increases are intended to simulate the impact of the elimination of cotton subsidies and changes in income and poverty a recalculated for each increase.

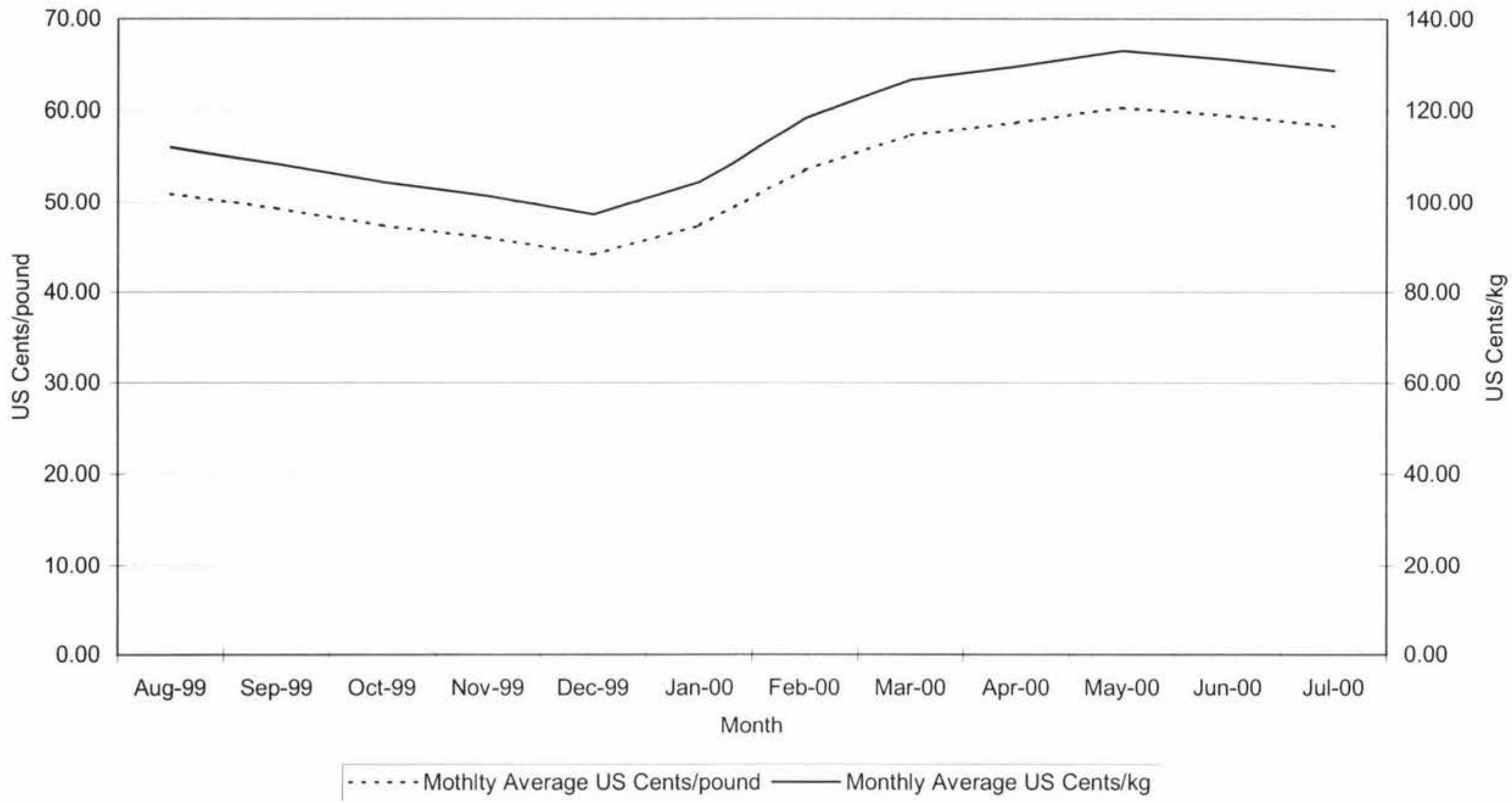
The analysis was applied to the total sample first representing the whole country, then the overall sample was divided into four regional data groups based on the four administrative regions of Uganda – Northern, Western, Eastern and Central. Figure 9 is a map of the administrative districts and table 3 contains the name of each district. The regional analysis allows more specific insight into poverty. The production of cotton in Uganda is concentrated in the Northern and Eastern Regions. The discussion of the results will further discuss regional differences.

Figure 6: Index A World Cotton Price: Monthly Average January 1990 - September 2006



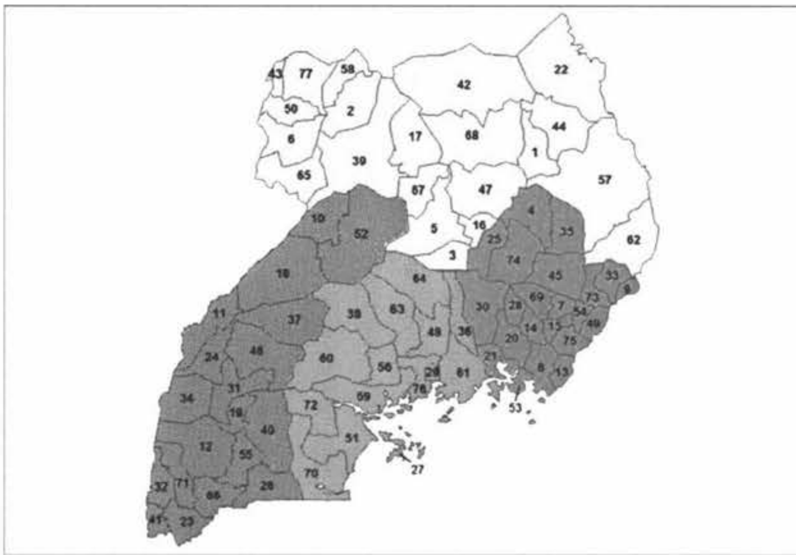
Source: www.globalfinancialdata.com

Figure 7: Index A World Cotton Price Monthly Average August 1999 - July 2000



Source: www.globalfinancialdata.com

Figure 8: Map the of Administrative Districts of Uganda



Source: http://upload.wikimedia.org/wikipedia/en/8/84/Uganda_Districts.png

Table 3: Administrative Districts of Uganda

Central Region (red)		Eastern Region (green)		Northern Region (yellow)		Western Region (blue)	
Map	District	Map	District	Map	District	Map	District
27	Kalangala	4	Amuria	1	Abim	10	Bulisa
29	Kampala	7	Budaka	2	Adjumani	11	Bundibugyo
36	Kayunga		Bududa	3	Amolatar	12	Bushenyi
38	Kiboga	8	Bugiri	39	Amuru	18	Hoima
48	Luwero		Bukedea	5	Apac	19	Ibanda
	Lyantonde	9	Bukwa	6	Arua	26	Isingiro
51	Masaka	13	Busia	16	Dokolo	23	Kabale
56	Mityana	14	Namutumba	17	Gulu	24	Kabarole
59	Mpigi	15	Butaleja	22	Kaabong	31	Kamwenge
60	Mubende	20	Iganga	42	Kitgum	32	Kanungu
61	Mukono	21	Jinja	43	Koboko	34	Kasese
63	Nakaseke	25	Kaberamaido	44	Kotido	37	Kibale
64	Nakasongola	28	Kaliro	47	Lira	40	Kiruhura
70	Rakai	30	Kamuli	50	Maracha-Terego	41	Kisoro
72	Sembabule	33	Kapchorwa	57	Moroto	46	Kyenjojo
76	Wakiso	35	Katakwi	58	Moyo	52	Masindi
		45	Kumi	62	Nakapiripirit	55	Mbarara
		49	Manafwa	65	Nebbi	66	Ntungamo
		53	Mayuge	67	Oyam	71	Rukungiri
		54	Mbale	68	Pader		
		69	Pallisa	77	Yumbe		
		73	Sironko				
		74	Soroti				
		75	Tororo				

Source:http://en.wikipedia.org/wiki/Districts_of_Uganda

3.6 Equivalent Households on a National and Regional Basis:

The sample data set included 428 households. From this sample we can estimate the impact of changes in price on an entire region. The main focus of this research project was to estimate the impact of the cotton price increases on cotton producing households in rural Uganda. The impact on the data set can be approximately applied to the average number of cotton producing households in each region. The estimation of the national and regional equivalents is only intended to be approximate guide for policy-makers. The equivalent households and equivalent population lifted above the poverty are best estimates built on the available data. Their precision and accuracy could be improved further fieldwork. The following equations were used to produce the quantitative estimates:

$$P_\alpha = \frac{1}{N}\sum_i \left[\frac{\mu - y_i}{\mu}\right]^\alpha$$

P_0 ($\alpha = 0$) is the percentage of households below the poverty line.

P_1 ($\alpha = 1$) measures the depth of poverty – the average monetary gap between the poverty line and the income of households below the poverty line.

P_2 ($\alpha = 2$) measures the severity of poverty – the average monetary gap between the poverty line and the income of households below the poverty line squared.

N is the number of households

μ is the poverty line

y_i is the income of household i in per person per day terms in U.S. dollars

$$\Delta hh = \Delta P_0 \times \left(hh_R / hh_T \right) \times hh_E$$

$$\Delta popn = \Delta hh \times hh_S$$

Ä*hh*: Equivalent number of households lifted out of poverty

Ä*popn*: Equivalent number of people lifted out of poverty

hh_R: Number of households in the regional sample

hh_T: Total number of households in the national sample

hh_E: Estimated number of rural households in Uganda

hh_S: Mean number of people in a rural Uganda households

3.7 Lorenz Curve and Gini Coefficient Analysis:

Lorenz curves measure income inequality within a society. The cumulative percent of population is plotted on the horizontal axis and the cumulative percentage of total income is plotted on the vertical axis. A 45-degree line called the line of equality acts as a reference line and represents a social group with perfect income equality. Therefore, the deviation of the Lorenz curve from the line of equality graphically represents the nature of income inequality within the social group of interest. Any economic change that moves the Lorenz curve towards the line of equality indicates a decrease in income inequality, which is generally considered to be a welfare improvement.

The Gini coefficient is a numeric measure of inequality. The Gini coefficient is the area between the line of equality and the Lorenz curve divided by the total area below the line of equality. It is a percentage that indicates the level of inequality within the income distribution where a Gini coefficient of zero indicates perfect equality and a coefficient of one indicates total inequality. Thus in this analysis a decrease in a Gini coefficient for a group of households indicates a decline in inequality.

In this study Lorenz curves and Gini coefficients were constructed for the baseline simulations of the "all Uganda" data sets and each of the four regions. New Lorenz curves and Gini coefficient were found when a simulated increase in the price of cotton resulted in a decrease in P_0. Each of these new representations of inequality was compared to the relevant baseline Lorenz curve or Gini coefficient.

Chapter 4: Data & Data Issues:

4.1 Introduction:

The Ugandan Bureau of Statistics (UBOS) generously provided the data sources for this research. UBOS conducts a household level survey roughly every three years, as funding allows. The household level survey is called the Ugandan National Household Survey (UNHS). These surveys began in 1989 and offer some of the most comprehensive household level data available for least-developed in Africa. Each UNHS is comprised of a number of independent interconnected surveys on a range of topics such as agriculture production, household demographics and community structures.

Three UNHS data sets were made available for this research project: UNHS 1992-1993, UNHS 1999-2000 and UNHS 2002-2003. The UNHS 1999-2000 data set was the most useful for this research project, because it included a unique household level crop survey for the period from August 1999 to July 2000. It gathered detailed crop production information about 33 specific crops, including cotton. This crop survey was an important resource for this research project as it enabled the investigation of the impact of cotton subsidies at household level. The UNHS 1999-2000 data set and subsequent report also included the community survey and socio-economic survey. Each of the three components collected information on separate area of the Ugandan economy. The community survey focused governance structures, markets, access to credit, and type land tenure within a community. The socio-economic survey focused on housing, education, health care, age, gender and income/expenditure/consumption.

Five administrative districts were excluded from the UNHS 1999/2000 due to insecurity and on going conflicts that would endanger the welfare of UBOS staff. Gulu, Kitgum and Pader were excluded from the northern region and Bundibugyo and Kasese were excluded from the western region.

4.2 Description of Ugandan Households by Age, Gender, Education and Size:

The total population of Ugandan was estimated to 21.4 million people based on the results of the socio-economic survey (UBOSb, 2000, p.x). The total number of households in Uganda, in the period 1999-2000, was estimated to be 4.2 million, with 3.5 million of these households located in rural Uganda. The average household size was 5.2 people. (UBOSb, 2000, p.10) The average household size in rural areas was 5.4 people compared to the urban average of 4.4. (UBOSb, 2000, p.13) The total number of land holdings in Uganda was estimated 3.3 million (UBOSa, 2000, p.viii). Fifty three percent of the rural population was under 15 years of ages. (UBOSb, 2000, p.10) Fourteen percent of children younger than 15 years of age had lost at least one parent and 3 percent had lost both. (UBOSb, 2000, p.14)

Literacy of people aged 10 years old or more varied between genders and location. Literacy was measured by the completion of at least 3 years of primary education. Overall literacy in Uganda was estimated at 65 percent. In rural areas literacy was 72 percent for males and 54 percent for females. In urban area literacy was 92 percent in males and 82 percent in females (UBOSb, 2000, p.16). Clearly there was a literacy gap between males and females, which is typical of many developing countries. By 2002-2003 the literacy gap had closed. Overall literacy in Uganda in 2002-2003 was estimated to be 70 percent. (UBOS, 2003, p.13) In rural areas literacy was 74 percent for males and 60 percent for females. In urban area literacy was 90 percent in males and 84 percent in females. The Government of Uganda is dedicated to education as a poverty reduction strategy. Orphanages in rural area often operate schools that are open to other children in the local community at low cost. Child sponsorship funds are an important source for rural schools and the sponsorship of one child is sometimes managed in way to provide education for other orphans in the community. I have spent a week at a rural orphanage in Ugandan district of Masaka, where an orphanage with 150 children was able to provide education for up to 600 pupils during the school year

4.3 Households in the Crop Survey 1999-2000:

The total number of individual households surveyed in section 5 of the UBOS Crop Survey 1999-2000 was 8256. Each household was identified by a unique household code. Section 5 of the crop survey contained questions on crop type, beginning stocks, output, output sold, sales value, output consumed by producer's household, output convert to seed, output paid as wages, output used for other purposes, wasted output end stocks and producer price. The information was gathered over two visits to each household within in the 12-month duration of the crop survey. Cyclical variations in the agricultural industry are potentially better captured with more frequent visits to a surveyed farm during the year of interest. Therefore, section 5 was divided into two parts related to these two visits. Section 5A covered March 1999 to August 1999. Section 5B covered September 1999 to February 2000. Cotton is generally harvested once each year, but in cases it was harvested twice. From the whole sample 493 households reported cotton production, representing 6% of the sample.

4.4 Crop categories for the purpose of research:

The crop report includes 36 crop categories: Matooke (food type – Matooke is Ugandan for plantain), matooke (beer type), matooke (sweet type), maize, finger millet, sorghum, rice, beans, field peas, cow peas, pigeon peas, ground nuts, soya beans, sim-sim (sesame), cotton, Irish potatoes (the Ugandan name for common garden potatoes), sweet potatoes, cassava, coffee, tea, tobacco, trees (timber), flowers (for export), oranges, passion fruit, pineapple, mango, pawpaws, other fruits, onions, cabbages, dodo (a type of herb), tomatoes, carrots, other vegetables and other crops. From the preceding list the following were classified as food crops for the purpose of this research: Matooke (food type), matooke (beer type), matooke (sweet type), maize, finger millet, sorghum, rice, beans, field peas, cow peas, pigeon peas, ground nuts, soya beans, sim-sim, irish potatoes, sweet potatoes, cassava, oranges, passion fruit, pineapple, mango, pawpaws, other fruits, onions, cabbages, dodo, tomatoes, carrots, and other vegetables. Coffee, tea cotton, tobacco, flowers and trees are treated as non-food income generating cash crops.

4.5 Data Issues with the Cotton Producing Household in the Crop Survey Sample:

4.5.1 Sales value, output sold and producer price:

The quantity of cotton sold and the producer price are the two key factors for this research project. The sales revenue can be calculated from these factors and serve as an estimate for all cotton producers in Uganda. Section 5 actually included a question on total revenue from the sale of produce. The reported sales revenue should be precisely equal to the quantity sold multiplied by the producer price, or at least very near to it. But, some inconsistencies were present in the sales revenue data. There were cases where the sales income was not equal to producer price multiplied by the quantity sold and not even close to it. Due to these inconsistencies within the sales revenue data it was not used for this project. A new data set was calculated for the sales revenue from the information about quantity sold and producer price. Using the inconsistent data would have undermined the final results. This "adjustment" improved the reliability of the results. Due to inconsistencies in the sales income for cotton when it was compared to the product price and quantity sold, it was important to obtain the highest possible degree of precision allowed by the core data.

4.5.2 Producer Price Data Issues:

An examination of the producer price data revealed several rogue or outlying prices in the data set. They were obvious because they were between ten and one hundred times larger than the majority of the price data. Such rogue prices usually were accompanied by rogue figures for sales income. Once these rogues were identified they were removed from the sample of cotton producing households. There were also 15 households with no reported producer price. These households tended to report very little information for other survey and were therefore removed as incomplete data entries. After removing all problem households from the data set there were 476 cotton-producing households in the crop survey. It was decided to maintain the percentage of cotton producing households at 6 percent of all crop-producing households when calculating the national equivalents.

One of the primary values of the UBOS Crop Survey data set is it contains survey data on producer prices. The implication of having producer prices for each household surveyed is it generates a sample of farm-gate level prices for each of the commodities surveyed. Therefore, we can see how a simulated increase in the world price of cotton (assuming complete price transmission) could potentially affect farm income and poverty levels.

4.5.3 Inconsistencies in the Total Income from Crop Sales:

The FGT measure of poverty required some knowledge about total household income. Selling crop is one of the core sources of income in rural Uganda. Section 9a of this socio-economic survey component of the UNHS 1999/2000 collected estimates of the total income from crop sales over the previous 365 days. Comparing total income responses to the income from cotton sales revealed that in some cases the reported total income from all crops was significantly less than the income from cotton saes. This inconsistency calls into question the reliability of the data on overall crop income. But there are also some possible explanations differences between cotton income and overall income. If the socio-economic survey information was collected before the total crop information the cotton sales income would not be included in the cotton farmers reported estimate of crop income from the last 365 days. This seems a highly plausible explanation considering the crop survey data was collected in two separate visits over a 12-month period, while the socio-economic survey data only required one visit to collect. Regardless of the reason for such inconsistencies, they are a serious data issue for this research thesis. Therefore, to circumvent these inconsistencies in overall crop income the total crop income for each household was calculated from the quantity sales and producer price data for each crop in the same way the actual cotton income was recalculated.

4.5.4 Modelling Household Income:

Household expenditure is frequently used as a proxy for income in poverty studies. The availability of household income data for Uganda and the importance of crop income in this project meant that expenditure data was not applied here. Total household income was calculated based on the combination of data of a number of income sources. As mentioned above the crop survey provided the necessary information to calculate the total income from all crop sales. The socio-economic included responses about income from, employment, livestock, cottage industry, and other sources. Despite the potential mismatch between the socio-economic survey and the crop survey, the socio-economic provides the best estimates of these other sources of income.

Chapter 5.0: Results

Tables 4 to 8 contain the results of the quantitative analysis. The formulae for the analysis can be found Appendix A.

Table 4: Results for All Regions Analysis (428 households)

Simulation	P0	P1	P2	Δ P0	Δ P1	Δ P2	Δ hh	Δ popn	Δ gini
Baseline case	0.9416	-0.8010	0.6877						0.533755
Producer price + 2.5%	0.9416	-0.8006	0.6872	0.00000	0.0004	-0.0006	-	-	
Producer price + 5.0%	0.9393	-0.8021	0.6883	-0.00234	-0.0012	0.0006	491	2,650	0.000717
Producer price + 7.5%	0.9393	-0.8017	0.6878	-0.00234	-0.0008	0.0000	491	2,650	
Producer price + 10.0%	0.9393	-0.8013	0.6872	-0.00234	-0.0004	-0.0005	491	2,650	
Producer price + 12.5%	0.9393	-0.8009	0.6866	-0.00234	0.0000	-0.0011	491	2,650	
Producer price + 15.0%	0.9393	-0.8005	0.6861	-0.00234	0.0004	-0.0017	491	2,650	
Shift to Index A price	0.8949	-0.7488	0.6081	-0.04673	0.0521	-0.0797	9,813	52,991	0.055977
Shift to Index A price +2.5%	0.8949	-0.7465	0.6053	-0.04673	0.0545	-0.0824	9,813	52,991	
Shift to Index A price +5.0%	0.8949	-0.7441	0.6026	-0.04673	0.0568	-0.0851	9,813	52,991	
Shift to Index A price +7.5%	0.8949	-0.7418	0.6000	-0.04673	0.0592	-0.0878	9,813	52,991	
Shift to Index A price +10.0%	0.8925	-0.7414	0.5989	-0.04907	0.0596	-0.0888	10,304	55,640	0.058712
Shift to Index A price +12.5%	0.8879	-0.7430	0.5994	-0.05374	0.0580	-0.0883	11,285	60,939	0.059099
Shift to Index A price +15.0%	0.8855	-0.7426	0.5984	-0.05607	0.0583	-0.0894	11,776	63,589	0.059734

Table 5: Results for the Northern Region Analysis (141 households)

Simulation	P0	P1	P2	Δ P0	Δ P1	Δ P2	Δ hh	Δ popn	Δ gini
Baseline case	0.9929	-0.8290	0.7303						0.461945
Producer price + 2.5%	0.9929	-0.8287	0.7298	0.00000	0.0004	-0.0005	-	-	
Producer price + 5.0%	0.9929	-0.8283	0.7292	0.00000	0.0008	-0.0011	-	-	
Producer price + 7.5%	0.9929	-0.8279	0.7287	0.00000	0.0011	-0.0016	-	-	
Producer price + 10.0%	0.9929	-0.8275	0.7281	0.00000	0.0015	-0.0022	-	-	
Producer price + 12.5%	0.9929	-0.8271	0.7276	0.00000	0.0019	-0.0027	-	-	
Producer price + 15.0%	0.9433	-0.7733	0.6410	-0.04965	0.0557	-0.0893	3,435	18,547	0.0029
Shift to Index A price	0.9433	-0.7707	0.6379	-0.04965	0.0583	-0.0924	3,435	18,547	
Shift to Index A price +2.5%	0.9433	-0.7707	0.6379	-0.04965	0.0583	-0.0924	3,435	18,547	
Shift to Index A price +5.0%	0.9433	-0.7682	0.6349	-0.04965	0.0609	-0.0954	3,435	18,547	
Shift to Index A price +7.5%	0.9433	-0.7656	0.6320	-0.04965	0.0634	-0.0983	3,435	18,547	
Shift to Index A price +10.0%	0.9362	-0.7688	0.6338	-0.05674	0.0602	-0.0965	3,925	21,196	0.040659
Shift to Index A price +12.5%	0.9362	-0.7663	0.6308	-0.05674	0.0628	-0.0995	3,925	21,196	
Shift to Index A price +15.0%	0.9291	-0.7696	0.6327	-0.06383	0.0594	-0.0976	4,416	23,846	0.041108

Table 6: Results for the Eastern Region Analysis (275 households)

Simulation	P0	P1	P2	Δ P0	Δ P1	Δ P2	Δ hh	Δ popn	Δ gini
Baseline case	0.9127	-0.7858	0.6638						0.525495
Producer price + 2.5%	0.9127	-0.7854	0.6632	0.00000	0.0004	-0.0005	-	-	
Producer price + 5.0%	0.9127	-0.7850	0.6627	0.00000	0.0008	-0.0011	-	-	
Producer price + 7.5%	0.9127	-0.7846	0.6621	0.00000	0.0012	-0.0016	-	-	
Producer price + 10.0%	0.9127	-0.7841	0.6616	0.00000	0.0016	-0.0022	-	-	
Producer price + 12.5%	0.9127	-0.7837	0.6611	0.00000	0.0020	-0.0027	-	-	
Producer price + 15.0%	0.9127	-0.7833	0.6605	0.00000	0.0025	-0.0033	-	-	
Shift to Index A price	0.8691	-0.7365	0.5914	-0.04364	0.0493	-0.0724	5,888	31,794	0.045107
Shift to Index A price +2.5%	0.8691	-0.7343	0.5890	-0.04364	0.0514	-0.0748	5,888	31,794	
Shift to Index A price +5.0%	0.8691	-0.7322	0.5865	-0.04364	0.0536	-0.0773	5,888	31,794	
Shift to Index A price +7.5%	0.8691	-0.7301	0.5841	-0.04364	0.0557	-0.0797	5,888	31,794	
Shift to Index A price +10.0%	0.8691	-0.7279	0.5816	-0.04364	0.0579	-0.0822	5,888	31,794	
Shift to Index A price +12.5%	0.8618	-0.7320	0.5841	-0.05091	0.0538	-0.0797	6,869	37,093	0.047699
Shift to Index A price +15.0%	0.8618	-0.7299	0.5817	-0.05091	0.0559	-0.0821	6,869	37,093	

Table 7: Results for the Western Region Analysis (8 households)

Simulation	P0	P1	P2	Δ P0	Δ P1	Δ P2	Δ hh	Δ popn	Δ gini
Baseline case	1.0000	-0.9125	0.8364						
Producer price + 2.5%	1.0000	-0.9122	0.8359	0.00000	0.0003	-0.0005	-	-	
Producer price + 5.0%	1.0000	-0.9119	0.8354	0.00000	0.0006	-0.0010	-	-	
Producer price + 7.5%	1.0000	-0.9116	0.8349	0.00000	0.0008	-0.0015	-	-	
Producer price + 10.0%	1.0000	-0.9114	0.8344	0.00000	0.0011	-0.0020	-	-	
Producer price + 12.5%	1.0000	-0.9111	0.8340	0.00000	0.0014	-0.0025	-	-	
Producer price + 15.0%	1.0000	-0.9108	0.8335	0.00000	0.0017	-0.0030	-	-	
Shift to Index A price	1.0000	-0.8383	0.7165	0.00000	0.0742	-0.1199	-	-	
Shift to Index A price +2.5%	1.0000	-0.8361	0.7133	0.00000	0.0764	-0.1231	-	-	
Shift to Index A price +5.0%	1.0000	-0.8340	0.7102	0.00000	0.0785	-0.1263	-	-	
Shift to Index A price +7.5%	1.0000	-0.8318	0.7070	0.00000	0.0806	-0.1294	-	-	
Shift to Index A price +10.0%	1.0000	-0.8297	0.7039	0.00000	0.0828	-0.1325	-	-	
Shift to Index A price +12.5%	1.0000	-0.8276	0.7007	0.00000	0.0849	-0.1357	-	-	
Shift to Index A price +15.0%	1.0000	-0.8254	0.6976	0.00000	0.0871	-0.1388	-	-	

Table 8: Results for the Central Region Analysis (4 households)									
Simulation	P0	P1	P2	Δ P0	Δ P1	Δ P2	Δ hh	Δ popn	Δ gini
Baseline case	1.0000	-0.5477	0.4025						
Producer price + 2.5%	1.0000	-0.5461	0.4003	0.00000	0.0016	-0.0022	-	-	
Producer price + 5.0%	0.7500	-0.7262	0.5309	-0.25000	0.1863	-0.3055	491	2,650	
Producer price + 7.5%	0.7500	-0.7242	0.5281	-0.25000	0.1883	-0.3084	491	2,650	
Producer price + 10.0%	0.7500	-0.7223	0.5252	-0.25000	0.1902	-0.3112	491	2,650	
Producer price + 12.5%	0.7500	-0.7203	0.5224	-0.25000	0.1921	-0.3140	491	2,650	
Producer price + 15.0%	0.7500	-0.7184	0.5195	-0.25000	0.1941	-0.3169	491	2,650	
Shift to Index A price	0.7500	-0.4094	0.1847	-0.25000	0.5030	-0.6518	491	2,650	
Shift to Index A price +2.5%	0.7500	-0.3995	0.1780	-0.25000	0.5130	-0.6584	491	2,650	
Shift to Index A price +5.0%	0.7500	-0.3895	0.1716	-0.25000	0.5230	-0.6648	491	2,650	
Shift to Index A price +7.5%	0.7500	-0.3796	0.1654	-0.25000	0.5329	-0.6710	491	2,650	
Shift to Index A price +10.0%	0.7500	-0.3596	0.1539	-0.25000	0.5528	-0.6826	491	2,650	
Shift to Index A price +12.5%	0.7500	-0.3596	0.1539	-0.25000	0.5528	-0.6826	491	2,650	
Shift to Index A price +15.0%	0.7500	-0.3497	0.1484	-0.25000	0.5628	-0.6880	491	2,650	

Figure 9: All Regions Lorenz Curve: Baseline vs. Ugandan Producer Price + 5.0%

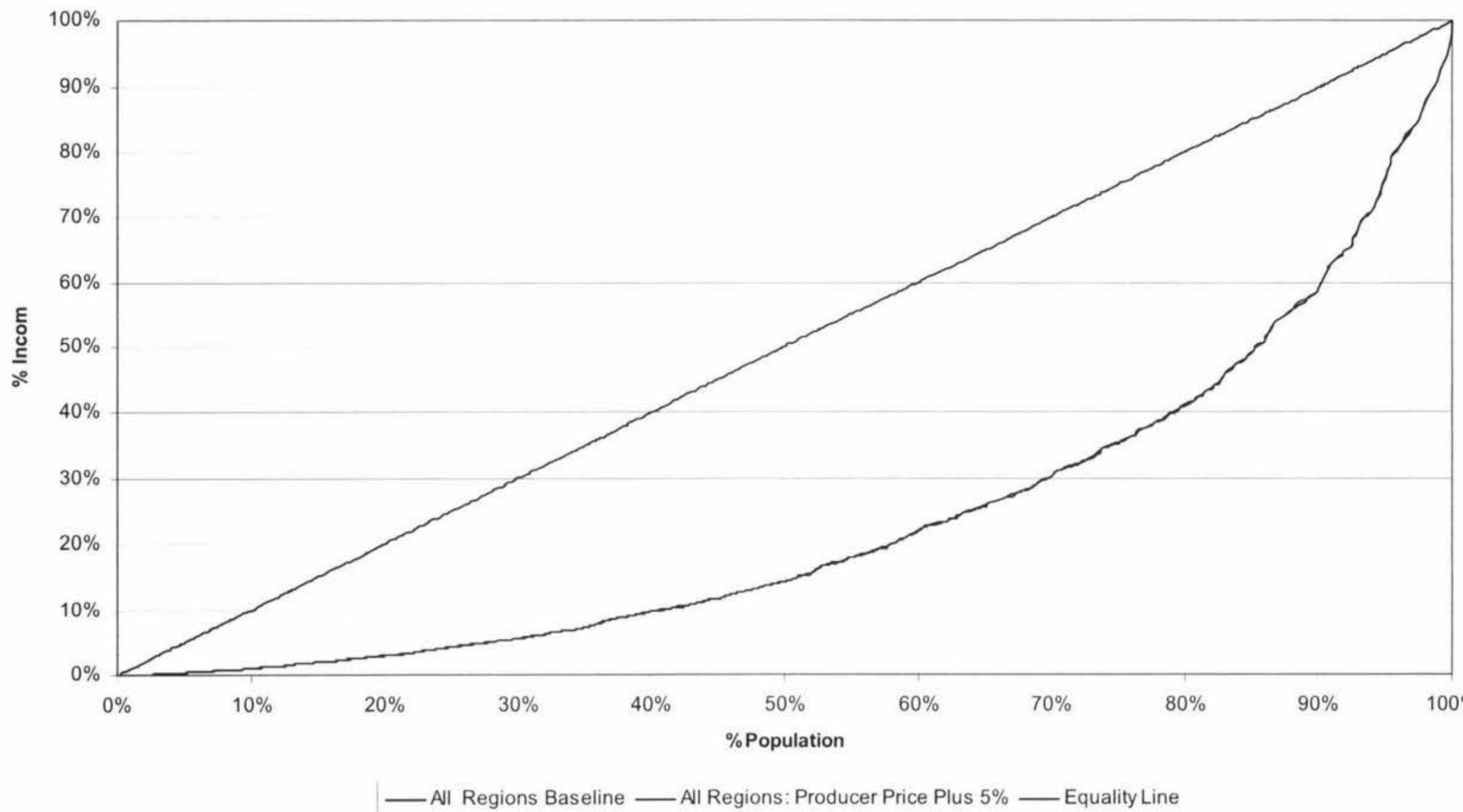


Figure 10: All Regions Lorenz Curve: Baseline vs. Index A Price

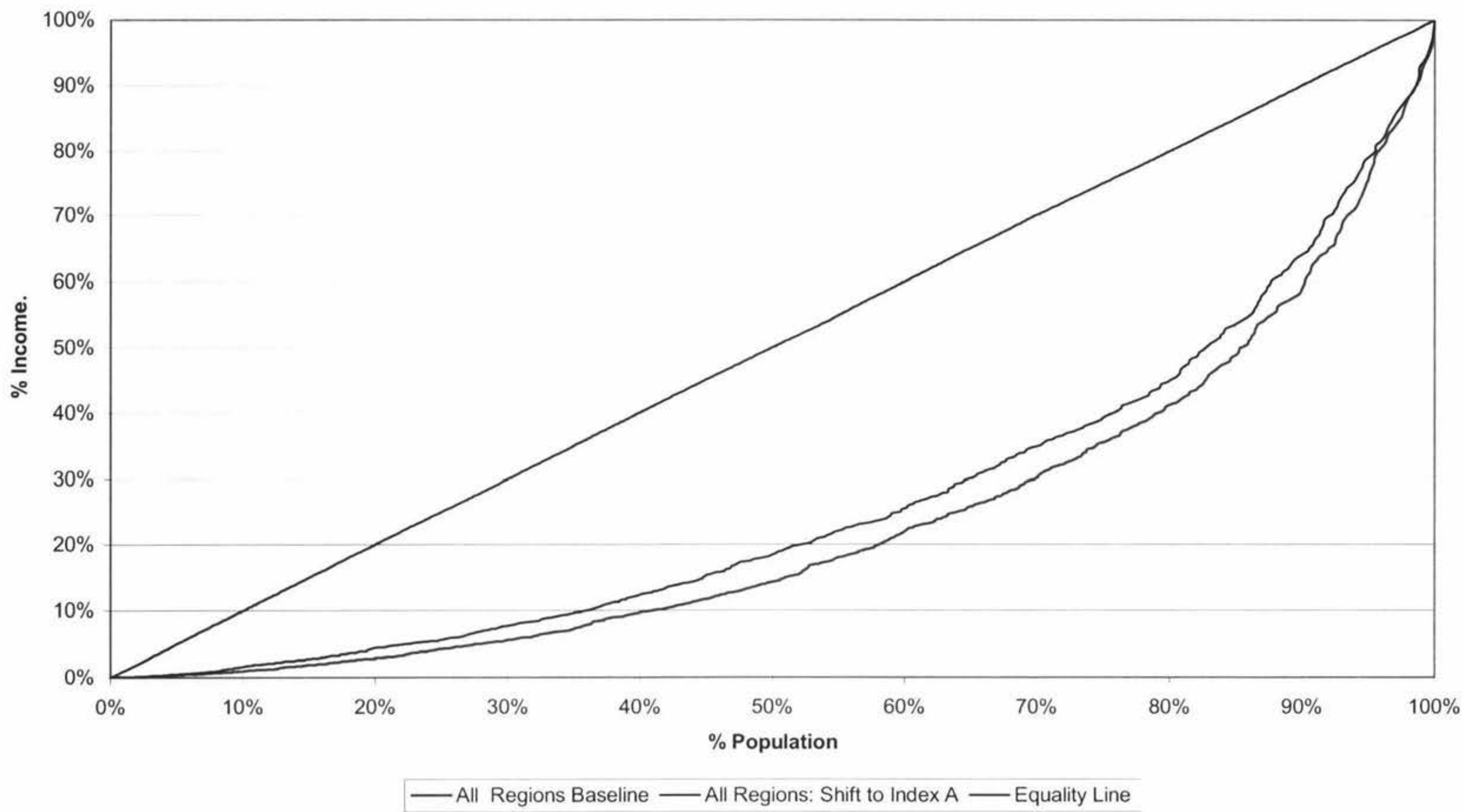


Figure 11: All Regions Lorenz Curve: Baseline vs. Index A Price +10%

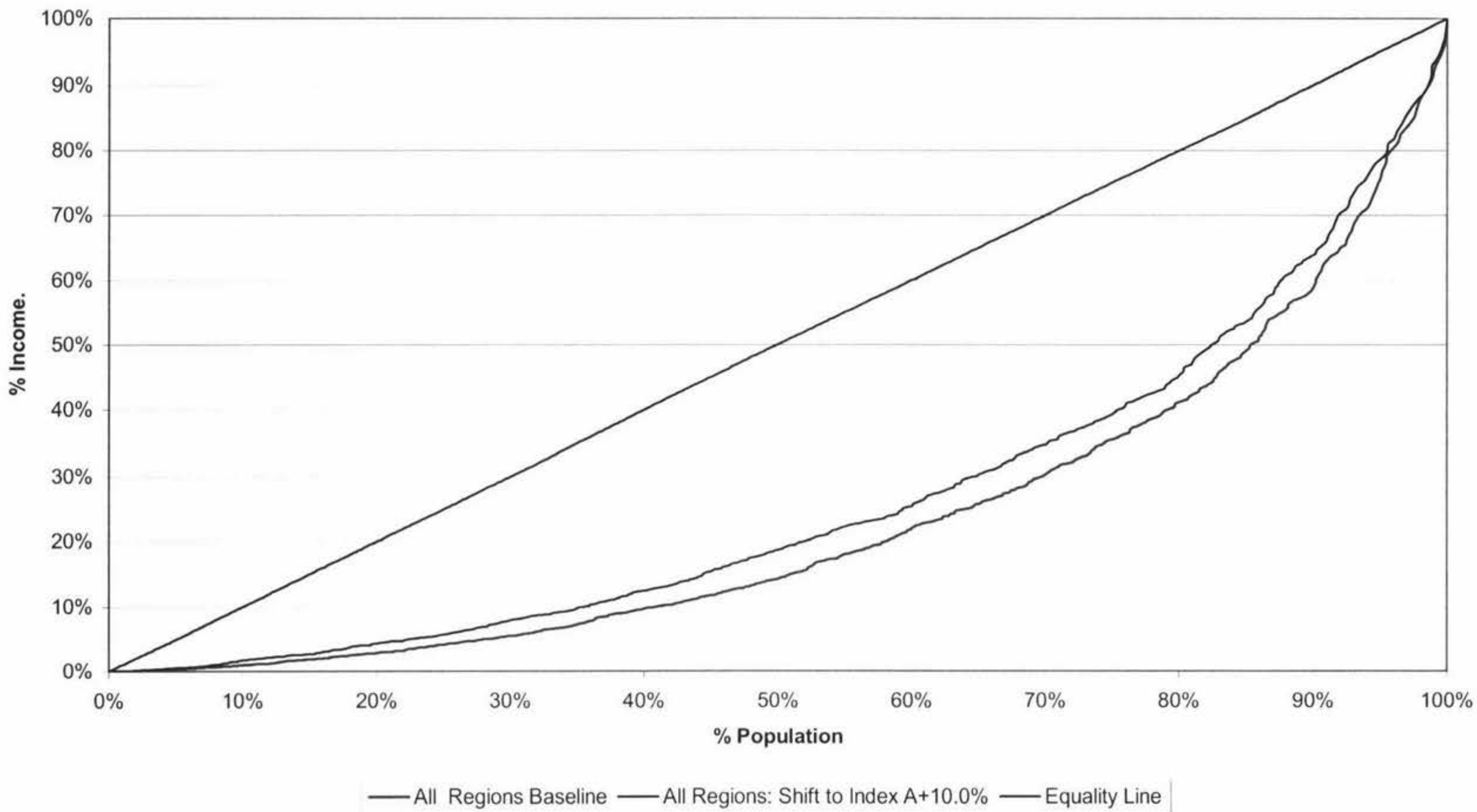


Figure 12: All Regions Lorenz Curve: Baseline vs. Index A Price +12.5%

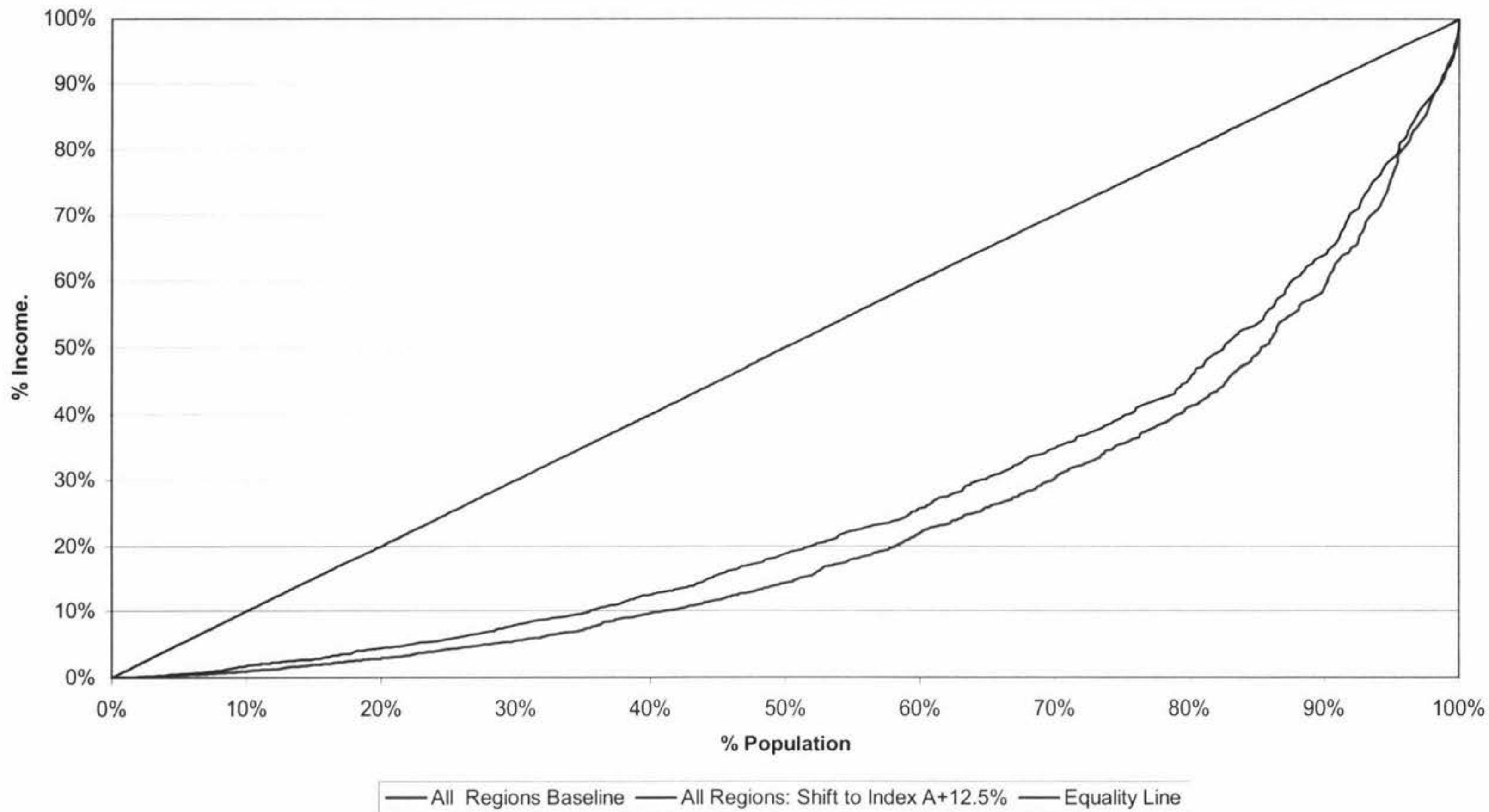


Figure 13: All Regions Lorenz Curve: Baseline vs. Index A Price+15.0%

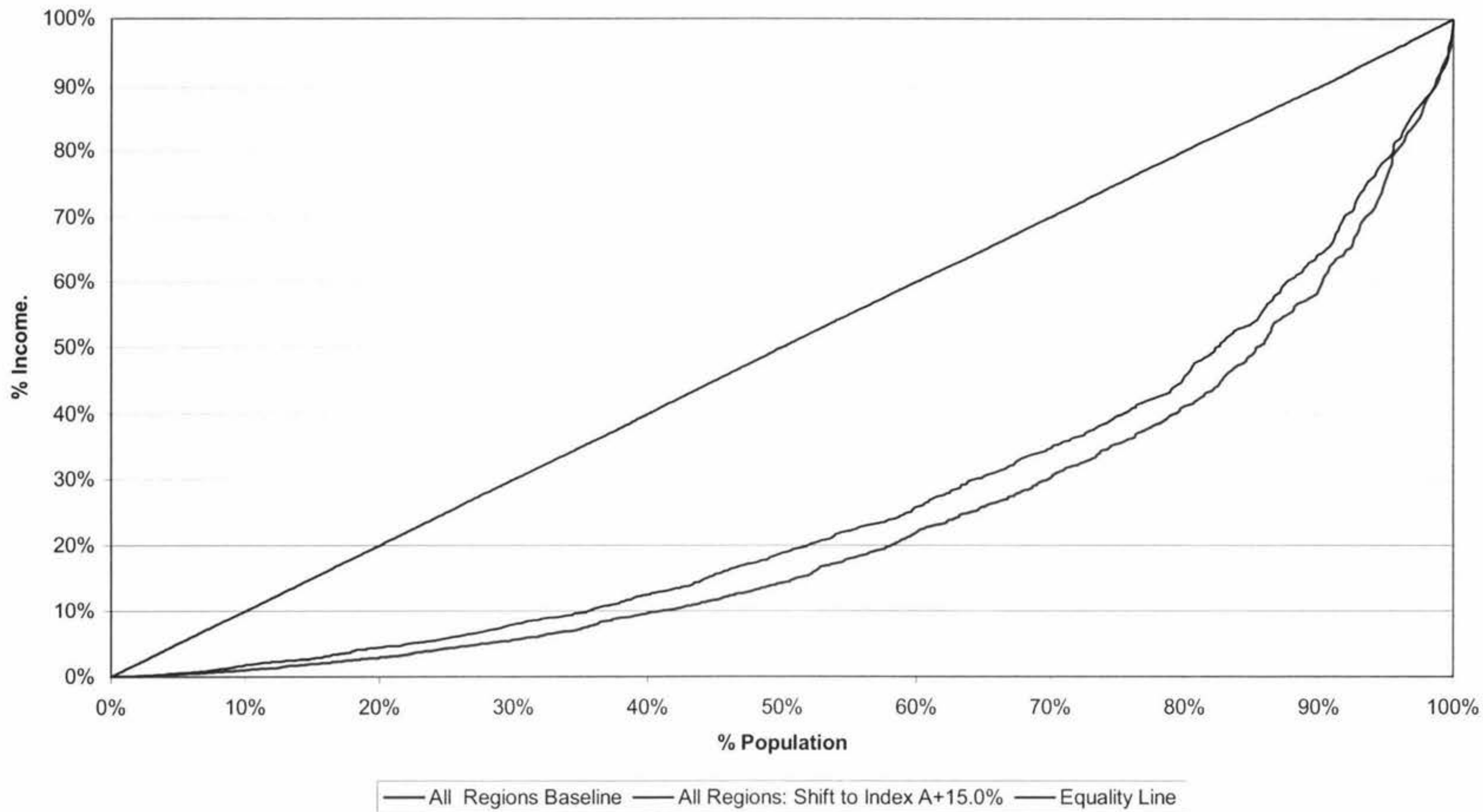


Figure 14: Eastern Region Lorenz Curve: Baseline vs. Index A Price

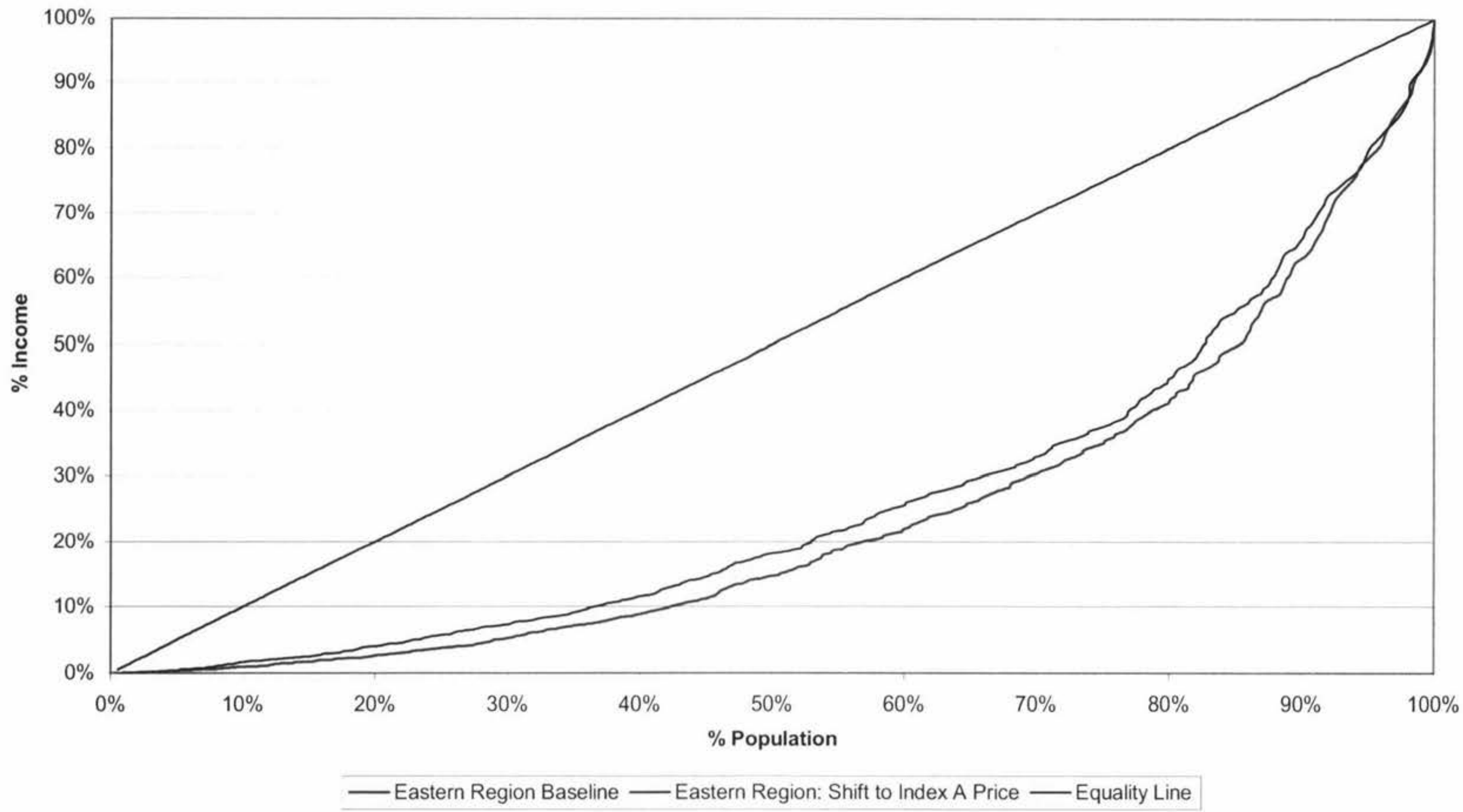


Figure 15: Eastern Region Lorenz Curve: Baseline vs. Index A Price + 12.5%

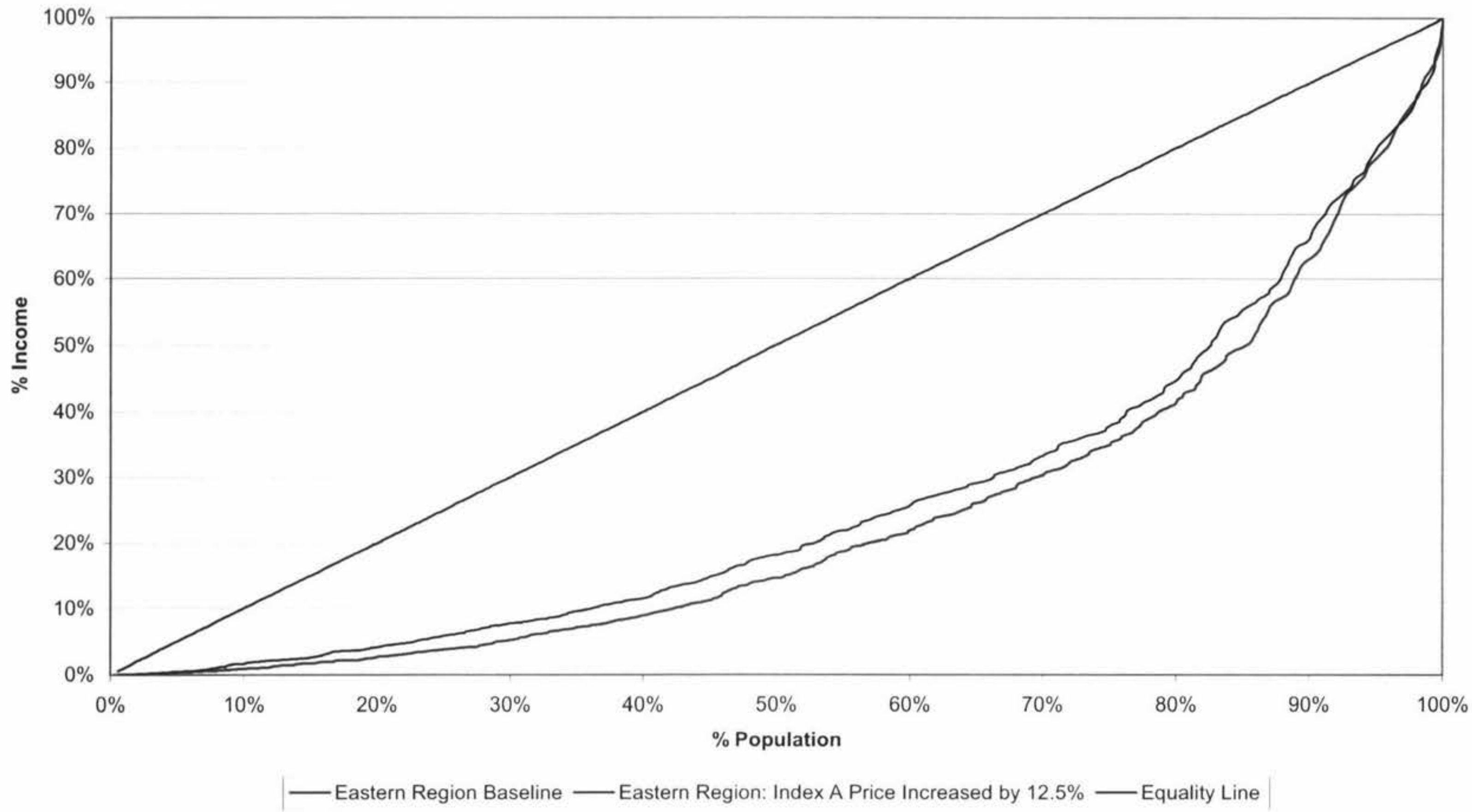


Figure 16: Northern Region Lorenz Curves: Baseline vs. Ugandan Producer Price + 15.0%

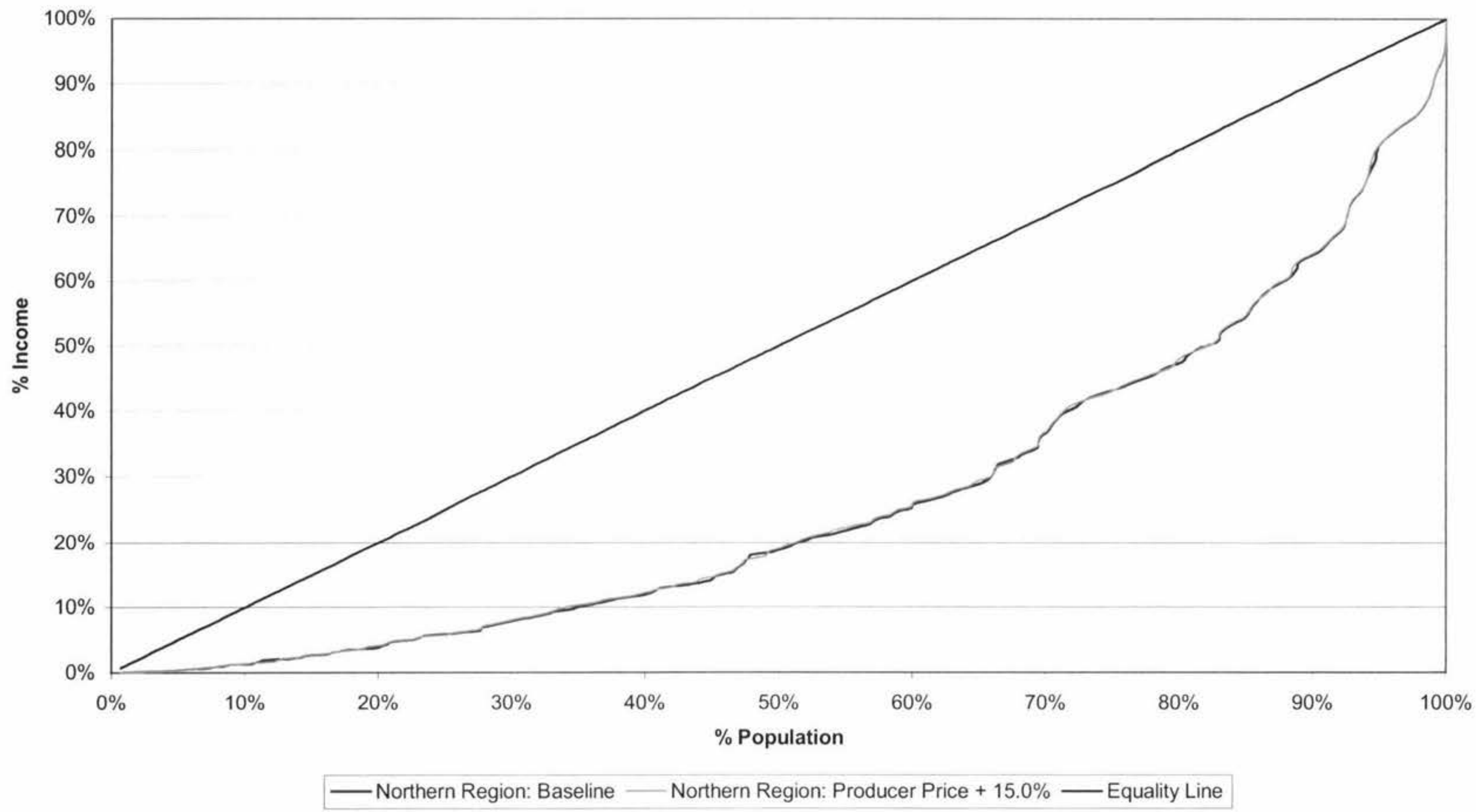


Figure 17: Northern Region Lorenz Curves: Baseline vs. Index A Price + 10.0%

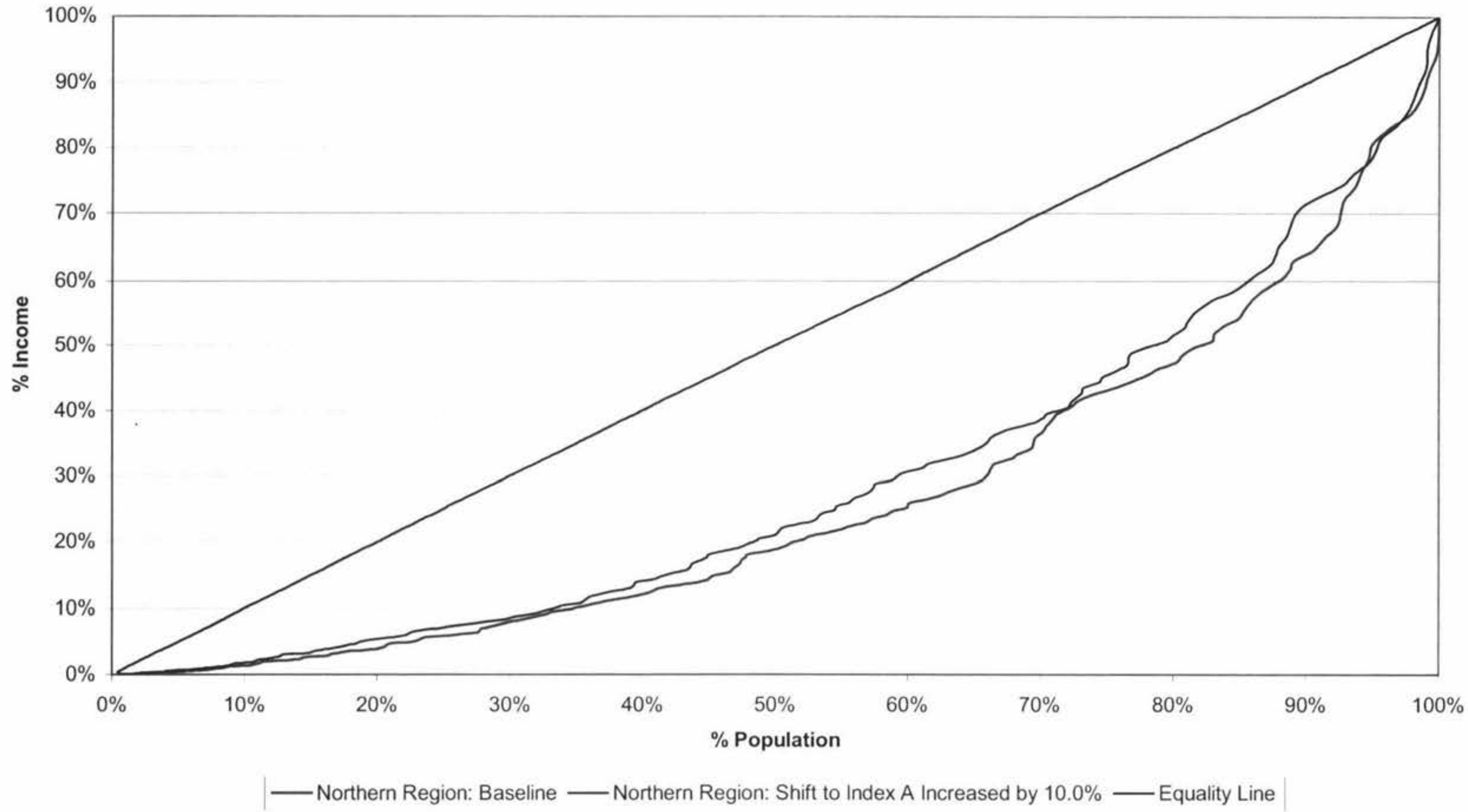
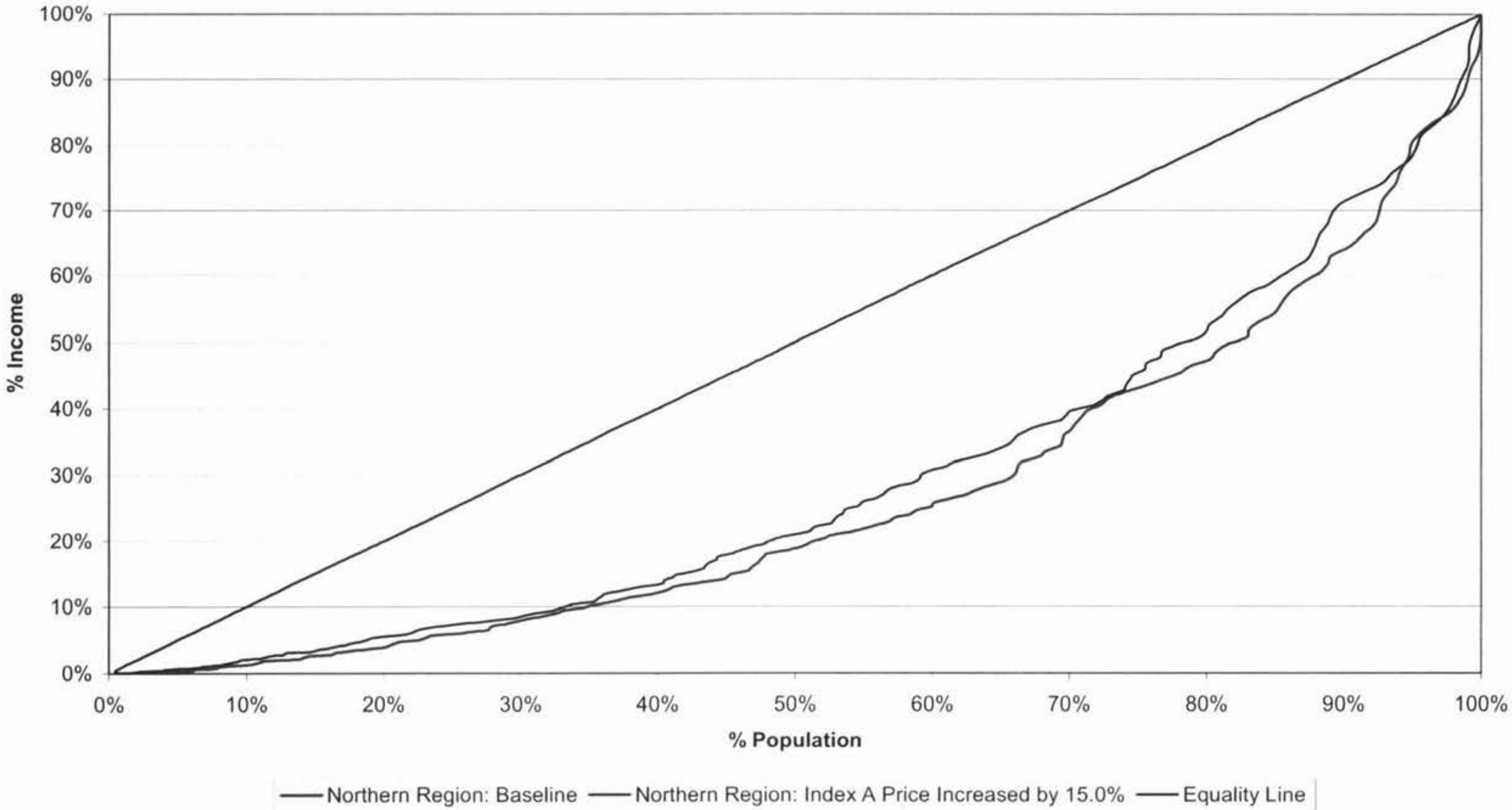


Figure 18: Northern Region Lorenz Curves: Baseline vs. Index A Price + 15.0%



Chapter 6: Discussion of Results

6.1 All Regions

The analysis of poverty among the rural cotton-growing households in the sample indicates 94.16 percent of households are in an initial state of poverty. This result indicates there is a high level of poverty within the cotton-producing households in rural Uganda although this level of poverty is not isolated to cotton farmers. Minot and Daniels (2005) estimated 95 percent of household were in poverty in Benin when the also used a one U.S. dollar per person per day poverty line. The analysis of income equality generated a gini coefficient of 0.5338.

As stated in the literature review of this research, the elimination of cotton subsidies were estimated to increase cotton price between 2.5 and 12.5 percent. In this study an estimated 5 percent increase in the mean producer price would reduce poverty by 23 percentage points. The next reduction in poverty across the overall Ugandan sample occurs in the case where the producer price is shifted to the mean Index A price. As a result the percentage of households in poverty is reduced by 4.67 percent. This reduction in the poverty is accompanied by reductions in the depth and severity of poverty of 5.21 and 7.97 percent respectively. When the estimates from the sample are converted are to national equivalents, the analysis estimated a nationwide shift to the Index A cotton price could lift 52,991 people above the poverty line. The shift to the Index A cotton price would also reduce the gini coefficient by 5.60 percent. This reduction in income inequality is reflected in the Lorenz curve in figure 10.

Price reform in Uganda is simulated by the increasing the price of cotton to the Index A mean price. The next poverty reduction occurs in the group of simulations involving all the regions of Uganda when the shift to the Index A cotton price is accompanied by a 10 percent price increase. Such a price increase is within the range of estimates of the impact of the elimination of cotton subsidies. In this case the percentage of households in poverty, the depth of poverty and the severity of poverty are reduced by 4.91, 5.96 and 8.88 percent respectively. This result is equivalent to lifting 55,640 people above the poverty line nationally. The increased income from cotton also reduced income inequality amongst rural cotton producers by 5.87 percent (see figure 11.)

Goreux (2004) estimated the elimination of cotton subsidies would increase the Index A price by 12.5 percent. When this increase in the cotton price is applied to this analysis of poverty in Uganda, the percentage of households of poverty, the depth of poverty and the severity of poverty reduced by 5.37, 5.80 and 8.83 percent respectively. On a national level this would be equivalent to lifting 60,939 people out of poverty. Such reductions in the state poverty and nature of poverty are significant and will improve the living standards in rural communities throughout rural Uganda. An increase in the incomes of cotton growing household will have flow on benefits for the economy and welfare of the rural communities. The 12.5 percent increase in the Index A price reduces income inequality by 5.91 percent amongst the rural cotton producing community.

The last estimate for the four regions combined analysed the impact on poverty of a 15.0 percent increase in the Index A price once the producer was shifted the world price level. This increase is 2.5 percent above the range of estimates produced by existing research. The analysis of this price increase forms part of the sensitivity analysis of price change. The further 2.5 percent increase in the cotton price leads to a 3 percentage point reduction in the percentage of households in poverty.

6.2 Northern Region

The sample of the Northern region consisted of 141 households out the total sample of 428 households. Three administrative districts were excluded from the UNHS for 1999/2000 due to conflict and insecurity. The districts of Pader, Kitgum and Gulu are the main areas affected by the on-going guerrilla war between the Ugandan government and the "Lord's Resistance Army" (LRA). These districts could contribute to economic growth and poverty reduction if security is restored. You and Chamberlin (2004) found that, in agroclimatic terms, the northern districts of Gulu, Kitgum and Lira were among the most suited Ugandan districts for cotton production. (You & Chamberlin, 2004, p.19)

The baseline analysis of poverty among cotton growing households demonstrates the severity of poverty in the northern region. The initial percentage of households in poverty, the depth of poverty and severity of poverty are estimated to be 99.29, 89.20 and 73.03 percent respectively. In this region, the first reduction in poverty occurs when the producer price is increased by 15.0%. This result indicates poverty in the northern region will not be significantly reduced without a shift to producer prices that reflect the world price. Shifting the producer towards the Index A price is the responsibility of the Ugandan Government. The percentage of households in poverty is reduced again if the elimination of subsidies causes a 10 percent increase in the

Index A price. In this case, the percentage of households in poverty, the depth of poverty and the severity of poverty are reduced by 5.67, 6.02 and 9.65 percent respectively. These reductions are significant, but the percentage of households is only 3 percentage points more than the result for the 15.0% increase in the producer price. Therefore most of the reduction in poverty in the northern could be achieved by the Government of Uganda acting to shift the producer price to the Index A price. This conclusion is reflected in the national equivalent numbers. The 15.0 percent increase in the producer was estimated to lift 18,547 people out of poverty. The result for increasing the price to the Index A price increased by 10 percent was 21,167 people. Therefore the majority of the reduction in poverty in the northern region could be achieved through market liberalisation inside Uganda. The process of market liberalisation would involve aligning the current cotton producer price with the Index A price.

The next poverty reduction in the northern region occurs when the index A price is increased by 15.0%. Such an increase seems unlikely based on the estimates of price change upon the elimination of cotton subsidies. But the simulation further indicates market liberalisation is the key to poverty reduction among the cotton community of the northern region.

Trade liberalisation and market reform are estimated to reduce income inequality in the northern region. As with the all region analysis, the analysis of changes in income inequality in the northern region will focus on the simulations where the percentage of households in poverty is reduced. As discussed above the first reduction occurs in the simulation of a 15.0 percent increase in the producer price.

This increase only reduces the gini coefficient by 0.0029. Therefore income inequality is almost unaffected by the price increase despite its significant impact on poverty. The absence of a gap between the Lorenz curves in figure 16 graphically reflects the absence of change in income inequality. But next two poverty-reducing simulations for the northern region forecast reductions in income inequality. These reductions are in the summary of results in table 5 and are graphically reflected in figures 17 and 18. The simulations indicate that the combination market reform (through a shift towards producer prices matching the Index A market price,) and trade liberalisation (through the elimination of cotton subsidies) will reduce income inequality. A 10 percent increase in the Index A price is estimated to reduce the gini coefficient, as a measure of income inequality, by 4 percent.

6.3 Eastern Region:

Simulations for the eastern region estimated this region could benefit most from the increase in the price of cotton as result of the market reform within Uganda and the elimination of cotton subsidies in developed countries. The baseline simulation estimated the initial state of poverty the eastern region. The percentage of cotton producing households in poverty, the depth of poverty and the severity of poverty were estimated to be 91.27, 78.58 and 66.38 percent respectively. These estimates of poverty are the lowest across all four regions in Uganda. The eastern region also has the largest number of cotton producing households compared to the other regions. Sixty-four percent of all the cotton-producing households in the sample are located in the eastern region, explaining why the region benefits the most.

The eastern region is estimated to benefit most from market reform simulated by the shift to the Index A mean price for the studied period. In this simulation the percentage of households in poverty is reduced by 4.36 percent. The depth and severity of poverty are also reduced by 4.93 and 7.24 percent respectively. These reductions in poverty are reflected in the estimates of national improvements. Market reform is estimated to lift 31,794 people or 5,888 cotton-producing households above the poverty line.

Poverty in the eastern region is also reduced by the simulation of a 12.5 percent increase in the Index A price. This simulation models the combined benefits of market reform and the elimination of cotton subsidies. The percentage of households in poverty, the depth of poverty and the severity of poverty are reduced by 5.09, 5.83 and 7.97 percent respectively compared to the baseline estimate. In this simulation 37,093 people are lifted above the poverty line.

The welfare improvements from price reform and the elimination of cotton subsidies are also reflected in the Lorenz curves for the eastern region. The gini coefficient is initially 0.5255. It is reduced by 0.0451 by the shift to the Index A price and reduced by 0.0477 in the simulation of a 12.5 percent increase in the Index A price. These reductions in income inequality a reflected in the Lorenz curves for the eastern region.

6.4 Central Region:

Only four households from the data set were located in the Central Region. Therefore this regional sample is too small to draw significant and credible conclusions about the impact of the elimination of subsidies on poverty. But the sample size indicates that cotton is not an important crop in the Central Region.

6.5 Western Region:

The Western Region data set only contained 8 households. Therefore the results for this region were treated like those of the Central Region. The sample size is too small to build credible conclusions upon. Two districts were excluded from this region due to insecurity near the border of Uganda. With the data available it was difficult to judge whether the exclusion of these districts lead to the low number of cotton producing households from the western region, but it seems unlikely that there would a higher concentration of cotton production in these districts than any other in the Western Region. The baseline simulation estimated that all western cotton-producing households in the sample are in poverty. None of the simulations lifted any households over the poverty line.

6.6 The Impact of the Elimination of Cotton Subsides on Uganda:

The simulations in this research projects are effectively divided into two groups. As described in chapter four, the first group of simulations apply increases to the current producer price for cotton in Uganda. This price was 21 percent of the Index A cotton price. The second group of simulations were intended to simulate the impact of cotton price reform in Uganda and the elimination of cotton subsidies. Price reform was simulated by shifting the producer price to the Index A market price of cotton. The elimination of cotton subsidies was then applied to the new base producer price of cotton. The section will focus on the first group where the base producer price was kept at the average Ugandan price in the studied period. The combination of price reform and the elimination of cotton subsidies will be discussed in the next section.

The elimination of cotton subsidies was estimated to have a positive effect on poverty in Uganda. In the all regions analysis the simulation of a 5 percent increase in the producer price of cotton reduced poverty by 0.234 percent, which is equivalent to lifting 2,560 people out of poverty. None of the other increases in the Uganda cotton price led to a decline in poverty. This implies eliminating cotton subsidies will benefit a relatively small number of households, but it is not enough to significantly improve the lives of majority of those who produce cotton in Uganda.

On a regional basis, benefits of the eliminating cotton subsidies were concentrated in the Northern where cotton farming is relatively popular. The absolute decreases in poverty, in terms of number of households in poverty, are not changed by the shift to a regional analysis. But the percentage decrease in poverty is larger in the regional analysis simply because the effect is focused on the regions where cotton production is concentrated. In the Northern Region, only the simulation of a 15 percent increase in the price of cotton leads to reduction in poverty. This simulation was estimated to reduce the percentage of households in poverty by 4.97 percent. This result again implies the eliminating cotton subsidies alone are not enough to positively impact the lives of the majority of cotton producing households.

6.7 The Combined Impact of Price Reform within Uganda and the Elimination of Cotton Subsidies in Developed Countries:

The results of this group of simulations show cotton price reform will lead to greater reductions in poverty than the elimination of cotton subsidies alone. The impact price reform is evident in the first simulation of this group for the all regions data set. Shifting the cotton to the Index A average price causes a 4.67 percent decrease in P_0. On a national equivalent level price reform was estimated to lift 52,000 people above the poverty line. In terms of the number of people this result is 19.6 times higher than the estimated number of people lifted above the poverty line by the elimination of cotton subsidies at the Uganda price level.

Poverty is further reduced in the all regions data set when price increases were applied to the Index A price to simulate the elimination of cotton subsidies. The poverty reduction occurs when the price increased by 10, 12.5 and 15 percent. The result for the 12.5 percent increase is of most interest because Goreux (2004) estimated the elimination of cotton subsidies would increase the Index A price by 12.5 percent. A full review of Goreux's analysis can be found in the literature review. The simulation of a 12.5 percent increase in the Index A price estimated that poverty in the all region data set would be reduced by almost 6 percent (5.994.). The national equivalent estimate for this simulate was 60,000 people. This simulation also results a 5.91 percent decrease in the Gini coefficient. Implying a significant decrease in income inequality amongst the cotton-producing households of Uganda.

The regional analysis shows that the benefits of price reform and the elimination of cotton subsidies are clearly concentrated in the Northern and Eastern Regions. In the

Northern Region poverty is reduced by a 10 and 15 percent increase in the Index A price. The 10 and 15 percent increases in the Index A price were estimated to reduce the measure of income inequality by 4.07 and 4.11 percent respectively. The shift to the Index A price is not as significant in the Northern region as in the Eastern Region. As stated above the 15 percent in the Uganda price reduce poverty by 4.97 percent. The 10 and 15 percent increases in the Index A price reduced poverty by 5.67 and 6.38 percent respectively. For the Northern Region the biggest difference between the first and second group of simulation is the reduction in the Gini coefficient.

Price reform and the elimination of cotton subsidies were estimated to have most impact in the Eastern Region, because 64 percent of the cotton households in the Ugandan data set were from this region. Eliminating subsidies alone was not enough to reduced poverty in the region, but shifting the producer price to the Index A level was estimated to reduce poverty by 4.36 percent. Poverty was further decreased by the combination of price reform and the elimination of subsidy, but this region demonstrates the potential impact price reform within the Ugandan economy to reduce poverty amongst cotton farmers.

Chapter 7: Conclusion:

The objective of this research was to quantify the impact of the elimination of cotton subsidies in developed countries on poverty levels in rural Uganda. The quantitative analysis was designed to fill a gap in the debate surrounding cotton subsidies. Up to this point there has been no quantitative estimates of the economic impact of eliminating cotton subsidies on household poverty in Sub-Saharan Africa. Therefore this research represents an insightful investigation into to the impact of cotton subsidy elimination on poverty amongst cotton producing households in an African country.

The primary conclusion of this quantitative analysis is poverty amongst cotton producing households can best reduced through the combination of domestic price reform within Uganda and the elimination of price distorting cotton subsidies in developed countries. Overall the elimination of cotton subsidies alone was estimated to do little for poverty in Uganda. The elimination of cotton subsides was estimated to decrease poverty amongst cotton producing households in Uganda by 0.234 percent. The mean price received by Uganda's cotton farmers in the sample was one-fifth the world price, as measured by the Index A price. The low domestic price contributed to the limited impact of the elimination of cotton subsidies. Such a low farm-gate price indicates the need for price reform within the Ugandan cotton market.

Price reform within Uganda was simulated by increasing the producer price the Index A price level. Overall simulated price reform was estimated to decrease the number of cotton producing households in poverty by 4.67 percent and decrease the depth and severity of poverty by 5.21 and 7.97 percent respectively. The greatest decrease in poverty among cotton producing households occurred with the combination of price reform and the elimination of cotton subsidies. The combined policy change was estimated to reduce poverty by between 4.7 and 5.6 percent nationally depending on the price increase price as result of eliminating cotton subsidies.

Cotton production in Uganda in concentrated in the Eastern and Northern Regions. Sixty-four percent and 33 percent of production in the sample occur in the Eastern and Northern Regions respectively. In the Eastern Region the combination of price reform and subsidy elimination was estimated to decrease poverty by between 4.4 and 5.1 percent. This range was estimated to be equivalent to lifting between 31,000 and 37,000 people above the poverty line. The severity of poverty for this region was also estimated to decline by 7.4 and 8.2 percent. Income inequality in the Eastern Region was estimated to fall by 4.1 and 4.7 percent. In the Northern Region the combination of price reform and the elimination of cotton subsidies was estimated to reduce poverty by between 5.0 percent and 6.3 percent, which was estimated to be equivalent to lifting between 19,000 and 24,000 people above the poverty line. The severity of poverty was estimated to fall by between 9.2 and 9.8 percent. Income inequality was estimated to fall by between 4.0 and 4.1 percent.

In order to capture the potential poverty reducing benefits of cotton subsidy elimination the Ugandan Government must initiate price reform within the domestic market. A greatest focus on exporting Uganda cotton should pull the domestic price up towards the world price. A greater export focus will also increase Uganda's readiness to capture changes in international market share. The elimination of cotton subsidies in developed countries will reduce poverty in Uganda, but the positive effects of subsidy elimination will be greater when the Ugandan Government takes steps to lift the producer price to international levels.

Chapter 8.0: References:

Anderson, K., Valenzuela, E., & Jackson, L. A., 2006, *"GM Cotton Adoption, Recent and Prospective: A Global CGE Analysis of Economic Impacts."* The World Bank & the World Trade Organisation. Working paper February 2006.

Baffes, J., 2004, *"Cotton: Market Setting, Trade Policies and Issues."* Working Paper 3218, The World Bank Development Group.

Baffes, J. 2005, "*The Cotton Problem.*" The World Bank Research Observer, Vol. 20, No. 1 (Spring) pp.109-144.

Bell C. L. G., & Hazell, P., 1980, *"Measuring the Indirect Effects of an Agricultural Investment Project on its Surrounding Region."* American Journal of Agricultural Economics, Vol. 62, No. 1 (Feb., 1980), pp. 75-86.

Burnell, A., 1987, *"EC Agricultural Surpluses and Budget Control."* Journal of Agricultural Economics, Vol. 38, No. 1, pp.1-14.

COMPETE, 2002, *"The Path Forward For Uganda's Cotton and Textile Sector."* The COMPETE Project, United States Agency for International Development.

EC (European Commission), 2003, *"Accomplishing a Sustainable Agricultural Model for Europe Through the Reformed CAP-the Tobacco, Olive Oil, Cotton and Sugar Sectors."* Communication from the Commission to the Council and the European Parliament. Brussels, 23 September 2003, COM(2003) 554.

Elbehri, A. & Macdonald, S., 2004, *"Estimating the Impact of Transgenic Bt Cotton on West and Central Africa: A General Equilibrium Approach."* World Development, Vol. 32, No. 12, pp.2049-2064.

Engel, R.F., and Granger, C.W.J, 1987, *"Cointegration and Error Correction: Representation, Estimation and Testing."* Econometrica, Vol. 55, No. 2, pp.251-276.

Fang, C., & Beghin, J., 2003, "Protection and Comparative Advantage of Chinese Agriculture: Implications for Regional and National Specialisation." In Daniel Sumner and Scott Rozelle, eds., Agricultural Trade and Policy in China: Issues, Analysis and Implications. Ashgate Press, Aldershot.

Foster, J., Greer, J. & Thorbecke, E., 1984, *"A class of decomposable poverty measures."* Econometrica, Vol. 52, No. 3, pp. 761-766.

Goreux, L., 2004a, "*Cotton After Cancun*", Mimeo, January 2004.

Goreux, Louis. 2004b. *"Prejudice Caused by Industrialized Countries to Cotton Sectors in Western and Central Africa."* 2nd ed. January 2004. www.worldbank.org

Gillson, I., Poulton, C., Balcombe, K. & Page, S., 2004, *"Understanding the Impact of Cotton Subsidies on Developing Countries."* Working Paper, Overseas Development Institute.

Haggbalde, S., Hammer, J., Hazell, P. 1991, *"Modelling Agricultural Growth Multipliers."* American Journal of Agricultural Economics, Vol. 73, No. 2 (May 1991), pp.361-374.

Hazell, P., 1984, *"Rural growth linkages and rural development strategy."* Paper presented at the Fourth European Congress of Agricultural Economics, 3–7 September, Kiel, Germany

Huang, J., Rozelle, S., & Chang, M., 2004, "*Tracking Distortions in Agriculture: China and Its Accession to the World Trade Organisation.*" The World Bank Economic Review, Vol. 18, No. 1, pp. 59-84.

ICAC (International Cotton Advisory Cotton), 2002, *"Cotton: World Statistics."*

ICAC (International Cotton Advisory Committee), 2002, *"Production and Trade Policies Affecting the Cotton Industry."* Washington D.C.

Ismael, Y., Bennet, R. & Morse, S., 2002, *"Farm-level Economic Impact of Biotechnology: Smallholder Bt Cotton Farmers in South Africa."* Outlook on Agriculture, Vol. 31, No. 2, pp.107-111.

Karagiannis, G., 2004, *"The EU Cotton Policy Regime and the Implications of the Proposed Changes for Producer Welfare."* FAO Commodity and Trade Research Working Paper No.9.

Karagiannis, G., & Pantzios, C. J., 2002, *"To Comply or not to Comply with Policy Regulations - the Case of Greek Cotton Growers."* Journal of Agricultural Economics, Vol. 53, No. 2, pp.345-351.

Mohanty, S., Pan, S., Welch, M., & Ethridge, D. 2006, *"The Impacts of Eliminating the Step 2 Program on the U.S. and World Cotton Market."* Cotton Economics Research Institute, Texas Tech University, Lubbock, Texas. Briefing Paper CER-BR05-01. www.ceri.ttu.edu/policy

Minot, N. & Daniels, L., 2005, *"Impact of global cotton markets on rural poverty in Benin."* Agricultural Economics, Vol. 33, pp. 453-466.

OECD (Organisation for Economic Cooperation and Development), 2004, *"African Economic Outlook 2004/2005."* http://www.oecd.org/dev/aeo

Pan, S., Mohanty, S., Ethridge, D. & Fadiga, M., 2006, *"Economics and Marketing: The Impacts of U.S. Cotton Programs on the World Market: An Analysis of the Brazilian WTO Petition."* Journal of Cotton Science, Vol. 10, pp.180-192.

Poonyth, D., Sarris, A., Sharma, R., & Shangnan, S., 2004, *"The Impact of Domestic and Trade Policies on the World Cotton Market."* FAO Commodity and Trade Research Working Paper No.8, FAO.

Ravallion, M. & Benu, B., 1994, *"How Robust is a Poverty Profile?"* The World Bank Economic Review, Vol. 8, No. 1, pp.75-102.

Shepard, B., 2004, *"The Impact of US Subsidies on the World Cotton Market: A Reassessment"* March 2004, http://www.oecd.org/dataoecd/0/9/31592808.pdf

Sumner, D., 2006, *"Reducing Cotton Subsidies: The DDA Cotton Initiative"***.** Chapter 10, Agricultural Trade Reform & the Doha Development Agenda. Edited by Kym Anderson & Will Martin. 2006. Palgrave Macmilian & the World Bank

Sumner, D., 2003, *"A Quantitative Simulation Analysis of the Impacts of Cotton Subsidies on Cotton Prices and Quantities."* Presented to the WTO Cotton Panel October 2003. http://www.fao.org/es/ESC/en/20953/22215/highlight_47647en_sumner.pdf

Tokarick, S., 2003, "*Measuring the Impact of Distortions in Agricultural Trade in Partial and General Equilibrium.*" IMF Working Paper: WP/03/110. Washington DC.

UBOS (Ugandan Bureau of Statistics), 2003, *"Report on the Socio-Economic Survey."* Ugandan National Household Survey 2002/2003, Ugandan Bureau of Statistics.

UBOS (Ugandan Bureau of Statistics), 2000a, *"Report on the Socio-Economic Module."* Ugandan National Household Survey 1999/2000, Ugandan Bureau of Statistics.

UBOS (Ugandan Bureau of Statistics), 2000b, *"Report on the Crop Module."* Ugandan National Household Survey 1999/2000, Ugandan Bureau of Statistics.

WTO (World Trade Organisation), 2006, *"United States – Subsides on Upland Cotton."* Summary of Dispute to Date – DS267. www.wto.org/english/tratop_e/cases_e/ds267_e.htm

You, L. & Chamberlin, J., 2004, *"Spatial Analysis of Sustainable Livelihood Enterprises of Ugandan Cotton Production."* Environment and Production Technology Division, Working paper: 121 International Food Policy Research Institute. Washington D.C.

Chapter 9.0: Bibliography:

Anderson, J., 1998, *"The Uruguay Round and Welfare in Some Distorted Agricultural Economies."* Journal of Development Economics, Vol. 56, pp.393-410.

Blake. A., McKay, A. & Morrissey O., 2002, *"The Impact on Uganda of Agricultural Trade Liberalisation."* Journal of Agricultural Economics, Vol. 53, No. 2, pp. 365-381.

Benin, S. & Mugaruru, S., 2006, *"Determinants to Change in Household Level Consumption and Poverty in Uganda, 1992/93-1999/00."* Discussion Paper 27, International Food Policy Research Institute, Development Strategy and Governance Division.

Chacholiades, M., 1990, *"International Economics."* McGraw-Hill, Singapore.

Deininger, K. & Okidi, J., 2003, *"Growth and Poverty Reduction in Uganda 1999-2000:Panel Data Evidence."* Development Policy Review, Vol. 21, No. 4, pp.481-509

Dijkstra, A.G., & Van Donge, J.K., 2001, *"What does the 'Show Case' Show? Evidence of and Lessons from Adjustment in Uganda."* World Development, Vol. 29, No. 5, pp.841-863.

Edge, J.M., Benedict, J.H., Carroll, J.P & Reding, H.K., *"Bollgard Cotton: An Assessment of Global Economic, Environmental and Social Benefits."* Journal of Cotton Science, Vol. 5, pp.121-136.

Enke, S., 1951, *"Equilibrium Among Spatially Separated Markets: Solution by Electric Analogue."* Econometrica, Vol. 19, No. 1, pp.40-47.

Fabiosa, J., Beghin, J., de Cara, S., Elobeid, A., Fang, C., Isik, M., Matthey, H., Saak, A., Westhoff, P., Brown, D.S., Willott, B., Madison, D., Meyer, S. & Kruse, S., 2005, *"The Doha Round of the World Trade Organization and Agriculture Markets Liberalization: Impacts on Developing Countries."* Review of Agricultural Economies, Vol. 27, No. 3, pp.317-335.

Gounder, R. & Xayavong, V., 2005, *"Conditional Distribution of Growth In Sub-Saharan Africa: A Quantile Regression Approach."* Discussion Paper No. 05.09, Department of Applied and International Economics, Massey University, Palmerston North, N.Z.

Griffiths, W. E., Hill, R. C., Judge, G. C., 1993, *"Learning and Practicing Econometrics: Chapter 8: The Simple Linear Statistical Model."* John Whiley & Sons, Inc. New York.

Krueger, A., 1998. *"Why Trade Liberalisation is Good for Growth."* The Economic Journal, September 1998, pp. 1513-1522.

Krueger, A., Schiff, M. & Valdes, A., 1988, *"Agricultural Incentives in Developing Countries: Measuring the Effects of Sectoral and Economywide Policies."* The World Bank Economic Review, Vol. 2, No. 3, pp.255-271.

Mankiw, N.G., 2000, *"Macroeconomics."* (4^{th} edition). Worth Publishers. New York.

Macdonald, S., Meyer, L. and Somwaru, A., 2003, *"Perspectives on Cotton Global Trade Reforms."* Economic Research Service (ERS) & U.S. Department of Agriculture.

Oxfam, 2004, *"Finding the Moral Fibre: Why Reform is Urgently Needed for a Fair Cotton Trade."* Oxfam Briefing Paper 69.

Oxfam, 2002, *"Cultivating Poverty."* Oxfam Briefing Paper 30.

Samuelson, P.A., 1952, *"Spatial Price Equilibrium and Linear Programming."* The American Economic Review, Vol. 42, No. 3, pp.283-303.

Shakur, S. & Rae, A. N. 2006, *"WTO's Development Agenda and the South Asian Countries."* Department of Applied and International Economics, Palmerston North, Massey University, N.Z

Shakur, S. & Rae, A. N., 2005, *"Trade Reforms in South Asia."* Discussion Paper No. 05.10, Department of Applied and International Economics, Massey University, Palmerston North, N.Z

Takayama, T., and Judge, G.G., 1970, *"Alternative Equilibrium Models."* Journal of Regional Science, Vol. 10, No. 1, pp.1-12.

Appendix A: Key Equations:

$$Y_i = Q_c P_c + Y_{crop} + Y_{hld} + Y_{emp}$$

Y_i: Household income in Ugandan Shillings

Q_c: Quantity of cotton sold in one-kilogram units

P_c: Producer price of cotton sold

Y_{crop}: Household income from all crops except cotton

Y_{hld}: Household income from household activities excluding agriculture and employment

Y_{emp}: Household income from paid employment

$$y_i = \frac{1}{365} \times \left[\frac{Y_i / XR}{n} \right]$$

y_i is the income of household i in per person per day terms in U.S. dollars

Y_i: Household income in Ugandan Shillings

XR: Exchange rate: Ugandan Shillings per U.S. dollar

n: Number of individuals in household i

$$P_\alpha = \frac{1}{N} \sum_i \left[\frac{\mu - y_i}{\mu} \right]^\alpha$$

P_0 ($\alpha = 0$) is the percentage of households below the poverty line.

P_1 ($\alpha = 1$) measures the depth of poverty – the average monetary gap between the poverty line and the income of households below the poverty line.

P_2 ($\alpha = 2$) measures the severity of poverty – the average monetary gap between the poverty line and the income of households below the poverty line squared.

N is the number of households

μ is the poverty line

y_i is the income of household i in per person per day terms in U.S. dollars

$$\Delta hh = \Delta P_0 \times \left({hh_R}/{hh_T} \right) \times hh_E$$

$$\Delta popn = \Delta hh \times hh_S$$

Ä*hh:*	Equivalent number of households lifted out of poverty
Ä*popn:*	Equivalent number of people lifted out of poverty
hh_R:	Number of households in the regional sample
hh_T:	Total number of households in the national sample
hh_E:	Estimated number of rural households in Uganda
hh_S:	Mean number of people in a rural Uganda households