FOREIGN AID, ECONOMIC GROWTH, AND POVERTY REDUCTION IN TANZANIA

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Abstract

The aims of this research are to analyze the impact of foreign aid on national economic growth, to analyze why economic growth has interacted with poverty differently in Kilimanjaro and Ruvuma regions, and to investigate the determinants of household vulnerability to consumption and asset poverty in the two regions.

The methodology used includes descriptive as well as econometric techniques. Descriptive techniques include national growth diagnostics, regional consumption and asset growth incidence curves, regional household livelihoods profiles etc. Econometric techniques used include Vector Error Correction Model (VECM) and OLS/GLS regressions. The data for the research has been obtained from REPOA, the National Bureau of Statistics, the Bank of Tanzania, the World Bank and IMF. Analysis was mainly done using STATA software.

The analysis of the impact of foreign aid on national economic growth shows that, foreign aid (ODA) has a positive impact on real GDP per capita. The results also show that gross fixed capital formation that is not financed by aid and exports have a positive impact on real GDP per capita. Results also show that initially aid boosts exports although in the following years it slightly reduces exports. Note that this refers to exports as a share of GDP and not the amount or volume of exports. Also foreign aid slightly reduces gross fixed capital formation that is not financed by aid (% of GDP). This means that foreign aid slightly crowds out investment that is not financed by aid. Here also this refers to a reduction of its share of GDP and not a reduction of the amount or level of such investment.

The results show that the war with Uganda reduced the short run growth of real GDP per capita and the growth of exports (% of GDP). While post 1996 economic reforms have improved the short run growth of real GDP per capita and have made investment and foreign aid to be more productive. Thus foreign aid and also good investment climate and export oriented growth strategy is good for growth in Tanzania.

The analysis of economic growth and poverty reduction in the two regions show that in Kilimanjaro between 2003 and 2009, GDP growth has been accompanied by a marginal increase in consumption poverty from 26% to 32%. Consumption growth was not pro-poor and consumption Gini inequality slightly increased. Asset growth was pro-poor and Gini inequality in asset ownership declined. While in Ruvuma between 2004 and 2009, GDP growth has been accompanied by a marginal reduction in consumption poverty from 49% to

47%. Consumption growth was pro-poor and consumption Gini inequality slightly increased. Asset growth was also pro-poor and Gini inequality in asset ownership declined.

One of the reasons for less pro-poor growth in Kilimanjaro was the decline in adult equivalent farm output and income due to drought and population pressure on limited land. Ruvuma experienced improvement in adult equivalent farm output and income due to good weather, and land availability which eased population pressure. Another reason was high food price inflation, which affected Kilimanjaro more than Ruvuma as many households in Kilimanjaro were net food buyers while many of those in Ruvuma were net food sellers.

The analysis shows that in both regions growth of adult equivalent business income and growth of adult equivalent farm crop income increases consumption growth for all households and for poor households and thus reduces poverty. In Kilimanjaro, growth of non-farm business income has more impact on the consumption growth of the poor than growth of farm crop income. While in Ruvuma, growth of farm crop income has more impact on the consumption growth of the poor than growth of non-farm business income.

In both regions, growth of adult equivalent business income increases asset growth for all households (the overall sample which includes non-poor and poor) but not for poor households (the sample which includes the poor only). In Ruvuma growth of adult equivalent farm crop income increases asset growth for all households and for poor households while in Kilimanjaro it does so for all households but not for poor households.

The analysis of vulnerability to poverty in the two regions shows that 20% of individuals in Kilimanjaro and 40% of individuals in Ruvuma are vulnerable to consumption poverty. And 1% of individuals in Kilimanjaro and 36% of individuals in Ruvuma are vulnerable to asset poverty. Calculations also show that in both regions, the majority of people who are vulnerable to asset poverty are also vulnerable to consumption poverty. And the poverty rate is higher than mean vulnerability to poverty. Cross tabulations show that the percentage of people who are vulnerable to both consumption poverty and asset poverty is higher in Ruvuma than in Kilimanjaro.

Analysis show that in Kilimanjaro farm crop income, access to electricity, access to tap water and living in a village with tarmac or gravel road reduced vulnerability to consumption poverty and households with migrants were less vulnerable to consumption poverty. In Ruvuma land owned per adult equivalent reduced vulnerability to consumption poverty. In

Kilimanjaro age of household head, value of big livestock owned per adult equivalent and a higher number of coffee trees reduce vulnerability to asset poverty and households with migrants were less vulnerable to asset poverty. In Ruvuma the value of big livestock owned and a higher number of cashew nut trees reduced vulnerability to asset poverty.

In both regions improving farm crop income and non-farm business income will result in sustainable poverty reduction. This will be done via improving farm productivity, planting high value crops while maintaining food security, creating rural jobs via rural economic structural transformation and in Kilimanjaro improving rural roads, and access to electricity and water.

Keywords: Foreign aid, economic growth, poverty reduction, vulnerability to poverty, consumption poverty, asset poverty, Kilimanjaro, Ruvuma, Tanzania.

Abstrakt

Die Ziele der vorliegenden Forschung liegen in der Analyse des Einflusses von Entwicklungshilfe auf nationales Wirtschaftswachstum, in der Erforschung der Ursachen, weshalb Wirtschaftswachstum unterschiedliche Auswirkungen auf die Armut in den Regionen Kilimandscharo und Ruvuma aufweist, sowie in der Untersuchung der Determinanten der Vulnerabilität von Haushalten bezogen auf die Konsum- und Vermögensarmut in den beiden Regionen.

Die genutzten Methoden beinhalten deskriptive und ökonometrische Techniken. Die deskriptiven Techniken umfassen dabei unter anderem nationale Wachstumsdiagnostiken, regionale Konsum– und Vermögenswachstumskurven sowie Profile des Lebensunterhalts regionaler Haushalte. Das Fehlerkorrekturmodell (Vector Error Correction Model (VECM)) und OLS/GLS Regressionen bilden die für die Analyse genutzten ökonometrischen Techniken. Die der Forschung zugrunde liegenden Daten stammen von der REPOA, dem National Bureau of Statistics, der Bank of Tanzania, der Weltbank sowie dem Internationalen Währungsfond. Die Analysen wurden mittels der Software STATA durchgeführt.

Die Analyse des Einflusses von Entwicklungshilfe auf nationales Wirtschaftswachstum zeigt, dass sich die öffentliche Entwicklungszusammenarbeit (ODA) positiv auf das reale Bruttoinlandsprodukt (BIP) pro Kopf auswirkt. Zudem zeigen die Ergebnisse, dass die Bruttoanlageinvestitionen und Exporte, die nicht aus ODA finanziert werden, einen positiven Einfluss auf das reale BIP pro Kopf haben. Die Resultate zeigen weiterhin, dass ODA zwar Exporte zunächst erhöht, in den Folgejahren jedoch eine leichte Reduzierung der Exporte auslöst. Beachten Sie, dass dies bezieht sich auf die Exporte als Anteil des BIP und nicht die Menge oder das Volumen der Exporte. Zudem beeinflusst ODA die Bruttoanlageinvestitionen, die nicht durch Hilfen finanziert wurden, ebenfalls leicht negativ (in % des BIP). Dies bedeutet, dass ODA die nicht durch Hilfe finanzierten Investitionen leicht verdrängt. Auch hier bezieht sich dies zu einer Verringerung ihres Anteils des BIP und nicht eine Reduzierung der Betrag oder die Höhe einer solchen Investition.

Weiterhin zeigen die Resultate, dass der Krieg mit Uganda das reale BIP-Wachstum pro Kopf und das Wachstum der Exporte (in % des BIP) kurzfristig senkte. Nach 1996 konnten Wirtschaftsreformen jedoch das kurzfristige Wachstum des realen BIP pro Kopf verbessern und Investitionen sowie Entwicklungszusammenarbeit zu mehr Produktivität verhelfen.

Daher sind Entwicklungs-zusammenarbeit, ein gutes Investitionsklima sowie export-orientierte Wachstumsstrategien förderlich für das Wachstum in Tansania.

Die Analyse des Wirtschaftswachstum und der Reduzierung von Armut in den beiden Regionen zeigt, dass in Kilimandscharo zwischen 2003 und 2009 das BIP-Wachstum mit einer marginalen Steigerung der Konsumarmut von 26% auf 32% einherging. Der Anstieg des Konsums erfolgte nicht zu Gunsten der Armen und der Gini-Koeffizient der Konsumungleichheit stieg leicht an. Das Wachstum von Gütern jedoch erfolgte zu Gunsten der Armen und der Gini-Koeffizient der Ungleichheit bezüglich Vermögensbesitz verringerte sich. In Ruvuma kam es zwischen 2004 und 2009 zu einem Wachstum des BIP, das von einer marginalen Reduzierung der Konsumarmut von 49% auf 47% begleitet wurde. Der Anstieg des Konsums erfolgte zu Gunsten der Armen und der Gini-Koeffizient der Konsumungleichheit erhöhte sich leicht. Auch das Güterwachstum erfolgte zu Gunsten der Armen und der Gini-Koeffizient der Ungleichheit in Vermögensbesitz sank.

Einer der Gründe dafür, dass das Wachstum die Armen in Kilimandscharo weniger begünstigte, lag in einer Verringerung des Outputs der Farmen sowie des Einkommens (jeweils gemessen in erwachsenen Äquivalenten) aufgrund von Hitze und Bevölkerungsdruck auf das begrenzt verfügbare Land. Ruvuma konnte eine Verbesserung des Agraroutputs und des Einkommens verzeichnen, zum einen aufgrund des guten Wetters und zum anderen aufgrund der Verfügbarkeit von Land, wodurch der Bevölkerungsdruck gemindert wurde. Eine weitere Ursache lag in der hohen Inflation von Lebensmittelpreisen, die Kilimandscharo stärker traf als Ruvuma, da viele Haushalte in Kilimandscharo Netto-Lebensmittel-Käufer waren, während dies in Ruvuma nicht der Fall war.

Die Analyse zeigt, dass in beiden Regionen ein Wachstum von Einkommen durch Geschäftstätigkeit und durch Landwirtschaft das Konsumwachstum für alle Haushalte, also auch für die Armen, steigert und somit Armut reduziert. In Kilimandscharo hat das Wachstum von Einkommen aus nicht-landwirtschaftlicher Beschäftigung einen stärkeren Einfluss auf das Konsumwachstum der Armen als das Wachstum des landwirtschaftlichen Einkommens. In Ruvuma dagegen hat das Wachstum von Einkommen aus der Landwirtschaft einen höheren Einfluss auf die Armen als das Wachstum von Einkommen aus nicht-landwirtschaftlichen Beschäftigungen.

In beiden Regionen führt das Wachstum des Einkommens aus Geschäftstätigkeiten zu einer Erhöhung des Vermögenswachstums für alle Haushalte ausgenommen der Armen. In

Ruvuma erhöht das Wachstum des Einkommens aus der Landwirtschaft das Vermögenswachstum für alle Haushalte, auch der Armen, während in Kilimandscharo dies nicht für die armen Haushalte gilt.

Die Analyse von Vulnerabilität gegenüber Armut in den beiden Regionen zeigt, dass 20% der Individuen in Kilimandscharo und 40% der Individuen in Ruvuma anfällig gegenüber Konsumarmut sind. Zudem sind 1% der Individuen in Kilimandscharo und 36% der Individuen in Ruvuma anfällig gegenüber Asset-Armut. Berechnungen belegen, dass in beiden Regionen die Mehrheit der Menschen, die anfällig für Asset-Armut sind, auch anfällig für Konsumarmut sind. Und die Armutsquote höher als mittlere Anfälligkeit für Armut. Kreuztabellen zeigen, dass der Anteil der Menschen, die für beide Arten von Armut anfällig sind, in Ruvuma höher ist als der entsprechende Anteil in Kilimandscharo.

Analysen zeigen weiterhin, dass in Kilimandscharo das Einkommen durch Landwirtschaft, der Zugang zu Elektrizität sowie zu Leitungswasser und das Leben in einem Dorf mit Asphalt- oder Schotterstraßen die Anfälligkeit für Konsumarmut verringern und dass Haushalte mit Migranten eine geringere Anfälligkeit für Konsumarmut aufweisen. In Ruvuma reduziert Landbesitz pro Erwachsenenäquivalent die Anfälligkeit gegenüber Konsumarmut. In Kilimandscharo wird die Anfälligkeit gegenüber Güterarmut durch das Alter des Haushaltsvorstehenden, des Werts des Viehbestands pro Erwachsenenäquivalent und eine große Anzahl von Kaffeebäumen reduziert. Zudem sind in dieser Region Haushalte mit Migranten weniger anfällig für Asset-Armut. In Ruvuma führt ein hoher Wert des Viehbestands und eine große Anzahl von Cashewbäumen zu einer geringeren Vulnerabilität gegenüber Asset-Armut.

In beiden Regionen führen ein verbessertes Einkommen aus der Getreideproduktion und das außerlandwirtschaftliche Einkommen zu einer nachhaltigen Reduzierung von Armut. Dies erfolgt über eine erhöhte Produktivität in der Landwirtschaft, das Züchten von hochwertigen Pflanzen bei Beibehaltung von Nahrungsmittelsicherung, das Schaffen von mehr Beschäftigungsmöglichkeiten auf dem Land durch Transformation der ökonomischen Strukturen auf dem Land und in Kilimandscharo über die Verbesserung der Landstraßen sowie den Zugang zu Elektrizität und Wasser.

Schlüsselwörter: Entwicklungshilfe, Wirtschaftswachstum, Reduzierung von Armut, Vulnerabilität gegenüber Armut, Konsumarmut, vermögensarmut, Kilimandscharo, Ruvuma, Tansania.

Table of Contents

List of Tables

APPENDIX A

APPENDIX B

APPENDIX C

List of Figures

APPENDIX A

Acronyms and Abbreviations

BOT	Bank of Tanzania (Tanzania's central Bank)
CAG	Controller and Auditor General
IMF	International Monetary Fund
MKUKUTA	Mkakati wa Kukuza Uchumi na Kuondoa Umasikini Tanzania (Swahili name for NSGRP)
MKURABITA	Mpango wa Kurasimisha Rasilimali na Biashara Tanzania (Swahili name for PBFP)
MoEVT	Ministry of Education and Vocational Training
MoFEA	Ministry of Finance and Economic Affairs
NAO	National Audit Office
NBS	National Bureau of Statistics
NSGRP	National Strategy for Growth and Reduction of Poverty
PBFP	Property and Business Formalization Program
PCCB	Prevention and Combatting of Corruption Bureau
RAWG	Research and Analysis Working Group, MKUKUTA Monitoring System, Ministry of Finance and Economic Affairs.
REPOA	A Tanzanian Development Research Organisation
SACCOS	Savings and Credit Cooperative Societies
TZS	Tanzania Shilling (Tanzania's currency)
UN	United Nations
URT	United Republic of Tanzania
USD	United States Dollar

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CHAPTER 1 : INTRODUCTION

1.1 Background

Since 1995 Tanzania has experienced rapid economic growth mainly due to economic reforms, increased foreign aid, debt relief, increased foreign investment and favorable world agricultural commodity prices (Mwase and Ndulu, 2008). But the rapid growth was accompanied by little poverty reduction. In 2005 the government introduced the National Strategy for Growth and Reduction of Poverty (NSGRP I). One of the main aims of this new policy was to generate higher economic growth that is accompanied by poverty reduction.

The NSGRP I resulted in further improved economic growth although growth is still below the 8% per annum target required to achieve the Millennium Development Goal (MDG) 1 and the Tanzanian Development Vision 2025. Also this higher growth has been accompanied by a marginal decline in poverty i.e. between 2000/01 and 2007 the national poverty rate declined slightly from 36% to 34% (NBS, 2009; RAWG, 2009).

A new Household Budget survey from 2011/12 shows that the national poverty rate between 2007 and 2011/12 declined from 34% to 28%. The latest survey uses a slightly different approach which in order to compare it with the 2007 survey it slightly adjusts the poverty rate in 2007 (NBS, 2014). The new national poverty figures show a better but still modest reduction in poverty.

In 2010/11 the government introduced a second National Strategy for Growth and Reduction of Poverty (NSGRP II) which lasted until 2014/15 (MoFEA, 2010b). It is too early to comment on how NSGRP II is affecting economic growth and poverty reduction in Tanzania.

1.1.1 **The Tanzanian economy**

The agricultural sector is the backbone of the Tanzanian economy and it is dominated by small scale subsistence farmers with low levels of output per capita, productivity and output quality. 44% of all food consumed in rural areas is grown by farmers themselves. Many of these subsistence farmers rely on rain fed agriculture, have low levels of education, poor storage facilities, use little or no fertilizer and use simple hand tools for farming. As a result

Tanzanian agriculture is still traditional agriculture with low levels of productivity and output and many small scale farmers live in poverty (MoFEA, 2008; NBS, 2009; RAWG, 2009).

The share of agricultural sector in GDP was 27% in 2012. The agricultural sector employs around 75% of the labour force and 70% of the population lives in rural areas. In 2012, the share of the service sector in GDP was 48%, while the share of industry was 24%. The share of manufacturing was 9%. The industry sector is the fastest growing sector (14% per annum; 2001-2012), followed by the services sector (12% per annum; 2001-2012) and then followed by the agriculture sector (5% per annum; 2001-2012). Within the industry sector the mining sector grew by 16% per annum (2001-2012) and the manufacturing sector grew by 13% per annum (2001-2012) (RAWG, 2012; NBS, 2013a; 2013b).

In 2012, traditional agricultural exports contributed to 11% (957 million USD) of the total value of exports of goods and services. Gold exports contributed to 25% (2.2 billion USD) of the total value of exports of goods and services and travel (a component of tourism) contributed to 18% (1.6 billion USD) of the total value of exports of goods and services. However, the share of the mining sector in total GDP was only 4% and thus the mining sector has a small contribution to the national economy. It is growth in the agriculture sector that has the highest impact on poverty reduction as the agriculture sector employs the majority of people (RAWG, 2009, 2012; BOT, 2013; World Bank, 2007b).

Tanzania's overall economic growth rate has been fluctuating since 1961, the year of independence. Between 1962 and 1972, the GDP growth rate was positive. In 1973 and 1976, there was a sharp slowdown in growth. This was mainly due to the international oil price hike, drought as well as institutional factors such as the compulsory villagisation policy in 1974-76 which might have dislocated peasants and temporarily affect agriculture production (Ellis, 1982). Growth recovered until between 1981 and 1983 when the growth rate was negative as a result of the lagged effects of the Tanzania - Uganda war and the 1979 oil price shock as well as reduction in foreign aid. Growth then recovered until 1992-93 when there was a recession mainly due to an increase in oil prices and a reduction in foreign aid (Helleiner et al., 1995; Wangwe, 1997; Mwase and Ndulu, 2008). It should be noted that a similar economic growth trend has been observed in other Sub-Sahara African countries (O'Connell and Ndulu, 2000).

From 1995 onwards Tanzania received higher foreign aid and experienced debt relief under the Heavily Indebted Poor Countries (HPIC) initiative and Multilateral Debt Relief Initiative

(MDRI). Foreign aid and debt relief encouraged government investment. The government also implemented deeper economic reforms which encouraged private domestic investment, attracted higher foreign investment and boosted exports. The economic reforms also improved macroeconomic stability. These factors together with favorable world agricultural commodity prices led to higher economic growth (Muganda, 2004; Nord et al., 2009). However this rapid growth has been accompanied by little reduction in consumption poverty at the household level. Although there have been some noticeable improvements in housing quality and ownership of consumer durables (NBS, 2009; NBS, 2014).

Our geographical focus is on two regions, one with good infrastructure, high population density, vibrant small retailers, drought, food deficits (Kilimanjaro) and another region which is remote, has food surpluses, good rainfall and has low population density (Ruvuma). The main reason of focusing on these two regions is that they have similar GDP per capita, similar sectoral composition but their growth poverty patterns are different, and they have different poverty levels, and also there is data available on these two regions. These similarities and differences provide interesting case study for analyzing growth-poverty interaction.

1.1.2 The Kilimanjaro economy

The total surface area of Kilimanjaro region is 13,209 square km. The population was 1.64 million people in 2012 (NBS, 2013b). The populous tribes are the Chagga and Pare. Kilimanjaro region has a reputation of being economically advanced and it borders economically important areas like Kenya to the North, Arusha to the West, and Tanga to the South. Kilimanjaro region is well connected to other areas. It has an International Airport and it is near to the international sea water ports of Mombasa and Tanga. It is connected to Dar Es Salaam and Arusha by the all-weather tarmacked Dar Es Salaam-Arusha highway. And due to recent major road construction virtually all districts of the region are connected with all-weather tarmacked roads. Kilimanjaro region has an important national park (the Kilimanjaro national park containing forests, wild life and Mount Kilimanjaro).

In 2006, the share of agriculture in the regional GDP was 67%, that of industry was 8% and that of the service sector was 25%. The share of manufacturing industry was 4% (NBS, 2010a). The manufacturing industry is dominated by light manufacturing and agro-processing

and is concentrated in Moshi Town, the capital of Kilimanjaro region and to a lesser extent in the district capitals.

The region is also nearby other major national parks with a lot of wildlife. As a result the region has a well-developed tourism sector. The major cash crop grown in the region is Arabica coffee. Other crops like bananas, maize, beans, avocadoes, mangoes, paprika, tomatoes, cassava, Irish potatoes, sweet potatoes, wheat, rice, sugarcane, sunflower and flowers are also grown. The region has large numbers of livestock (cattle, goats, pigs and poultry). Kilimanjaro region has one of the best socio-economic indicators among the regions of Tanzania. In 2009, 32% of the people in rural Kilimanjaro lived under the basic needs poverty line (author's calculation from the REPOA survey). In 2012, the regional GDP was 2,030 billion TZS (1,282 million USD) and the regional per capita GDP was 1,237,761 TZS (782 USD) (NBS, 2013a).

However land scarcity is a major issue facing the region as well as drought. Drought mainly affects the low lying districts of Mwanga and Same as well as many parts of the highland districts. Due to dense population and drought the region usually experiences food deficits as well as net out-migration.

1.1.3 The Ruvuma economy

The total surface area of Ruvuma region is 66,477 square km. The population was 1.38 million people in 2012 (NBS, 2013b). The populous tribes are the Matengo, Ngoni and Yao. Ruvuma region is far away from Dar Es Salaam (the commercial capital) and has a reputation of being less socio-economically advanced than Kilimanjaro although Ruvuma is advanced compared to many other Tanzanian regions. It is bordered by Lake Nyasa and then Malawi to the West, Mozambique to the South, Mtwara to the East, and to the North it is bordered by Lindi, Morogoro and Iringa regions. The Ruvuma River separates Ruvuma region and the Northern part of Mozambique. Only recently, a bridge has been built to connect these two parts. There is no international airport in Ruvuma region and the existing domestic airport is small and mainly used by small and light aircraft (which carry mainly government officials).

There is a tarmac highway that connects Ruvuma's capital Songea with the rest of the country via Iringa. The other roads that connect the district capitals with the regional capital have been improved (Songea - Mbinga road) although some are still in poor conditions

(Songea - Tunduru road). The nearby sea water port is Mtwara, but the port has a small capacity and is underutilized. Two of the regions that border Ruvuma namely Mtwara and Lindi were historically viewed as socio-economically underdeveloped compared to other Tanzanian regions. Although recently the economic condition of Mtwara and Lindi has improved due to the discovery of natural gas deposits within these two regions. The other two regions that border Ruvuma namely Iringa and Morogoro are not underdeveloped compared to other Tanzanian regions. While northern Mozambique is underdeveloped compared to Southern Mozambique.

Ruvuma region has some wildlife and it hosts a small part of the Selous Game Reserve which is the largest game reserve in Tanzania. But due to lack of good infrastructure and good hotels the region has a small tourism sector. The major cash crops grown in the region are Arabica coffee (in the highlands), Cashew nuts (in the lowlands) and tobacco. The region also grows other crops like maize, cassava, rice, beans, millet, bananas, wheat, sweet potatoes, groundnuts, papaya, simsim, sunflower, tomatoes and sugarcane. The region has livestock (cattle, pigs, goats and poultry) but the number of cattle is smaller than in Kilimanjaro. Ruvuma region has fresh water fishing activity due to the presence of Ruvuma River and Lake Nyasa.

In 2006, the share of agriculture in the regional GDP was 64%, that of industry was 8% and that of the service sector was 28%. The share of manufacturing industry was 5% (NBS, 2010b). The manufacturing industry is dominated by light manufacturing and agro-processing and is concentrated in Songea Town, the capital of Ruvuma region as well as in Mbinga district and to a lesser extent in the other district capitals. Only a small percentage of households are connected to the regional electricity grid. The advantage of Ruvuma (compared to Kilimanjaro) is that it doesn't face acute land shortages and also it doesn't have frequent droughts. As a result Ruvuma region usually records large food surpluses, while Kilimanjaro usually records food deficits.

In the past many social-economic indicators of Ruvuma were below the national average but recently there have been major improvements and only a few indicators are below the national average. Kilimanjaro's GDP is slightly higher than Ruvuma's but Ruvuma's GDP per capita income is slightly higher than that of Kilimanjaro region. In 2006, the share of agriculture, industry and service sectors was approximately the same in the two regions. In 2012, the regional GDP was 1,705 billion TZS (1,077 million USD) and the regional per

capita GDP was 1,237,972 TZS (782 USD) (NBS, 2013a). In 2009, 47% of the people in rural Ruvuma lived under the basic needs poverty line (author's calculation from the REPOA survey). Thus more people in Ruvuma lived under the basic needs poverty line compared to Kilimanjaro. Table 1.1 shows some of the discussed descriptive statistics for the nation and for the two regions. Figure 1.1 shows the map of Tanzania and the two regions.

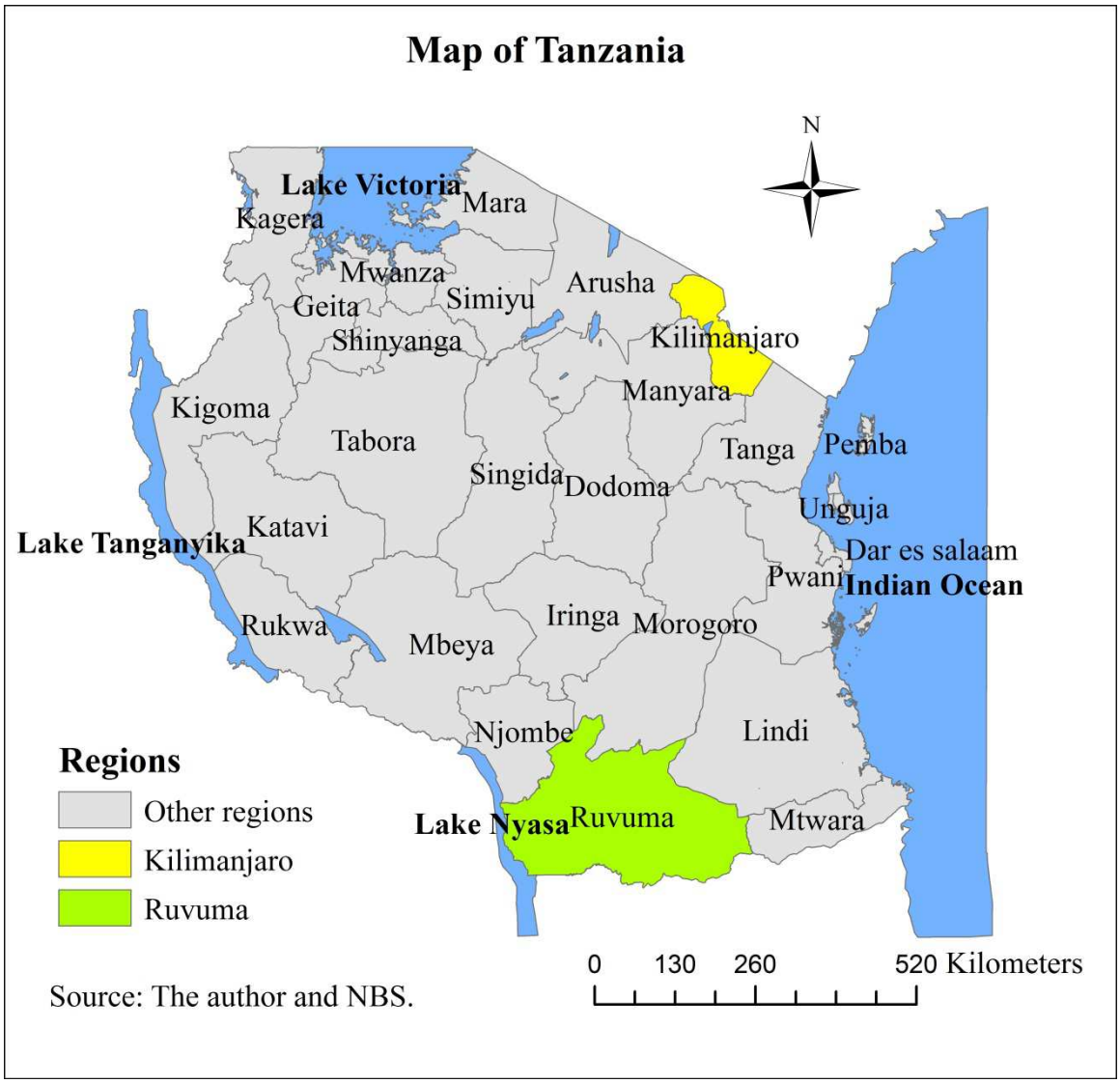
Note that the 2011/12 Household Budget Survey (HBS) adjusts the 2007 HBS Gini coefficient from 0.35 to 0.37 (NBS, 2014).

Table 1.1: Descriptive Statistics for the Nation and for the two regions

	Kilimanjaro	**Ruvuma**	**Tanzania**
Area (square km)	13,209	66,477	947,300
Population (2012)	1.64 mio.	1.38 mio.	44.93 mio.
GDP Per capita (2012)	782 USD	782 USD	609 USD
HBS poverty rate (2001-2007)	31% (2001)	41% (2001)	36% (2001); 34% (2007)
HBS poverty rate (2007-2011/12)	-	-	34% (2007); 28% (2011/12)
REPOA poverty rate	26% (2003); 32% (2009)	49% (2004); 47% (2009)	-
HBS Gini Coefficient (2001-2007)	0.29 (2001)	0.35 (2001)	0.35 (2001); 0.35 (2007)
HBS Gini Coefficient (2007-2011/12)	-	-	0.37 (2007); 0.34 (2011/12)
REPOA Gini Coefficient	0.32 (2003); 0.32 (2009)	0.34 (2004); 0.35 (2009)	-
Agriculture (% of GDP) (2006)	67%	64%	29%; 27% (2012)
Industry (% of GDP) (2006)	8%	8%	23%; 24% (2012)
Services (% of GDP) (2006)	25%	28%	47%; 48% (2012)

Source: The author's calculations from REPOA survey, and or NBS statistics, World Bank statistics.

Figure 1.1: Map of Tanzania in 2012, showing the regions of Kilimanjaro and Ruvuma



1.2 Problem Statement

Tanzania is a poor country with low per capita income; thus it needs high and inclusive economic growth so as to improve the income level of its people. The country has been one of the highest aid recipients in Africa for a long time and sometimes foreign aid has been around 20% of GDP and has financed 40% of the government budget. Foreign aid is viewed as a major source of funding the implementation of the National Strategy for Growth and Reduction of Poverty (NSGRP), the Millennium Development Goals (MDGs) and the Tanzanian Development Vision 2025 (MoFEA, 2010b). One of the aims of this study is to investigate the impact of foreign aid on national economic growth.

Advocates of foreign aid argue that it injects economic resources into the economy and thus boosts domestic savings, government revenues, technology and foreign exchange reserves (Bacha, 1990). Opponents of foreign aid argue that large inflows of foreign aid can cause a 'Dutch Disease' in the host economy via an appreciation of the real exchange rate, which in turn can damage the country's exports. Others argue that institutional factors such as the mechanism of delivering foreign aid (direct budget support, sectoral funding or project funding) and how the fiscal and monetary authorities use aid (good governance, invest in infrastructure) and administer aid (actively intervene to prevent real exchange rate appreciation) also matters in the way foreign aid impacts on GDP. Whatever the arguments for or against aid, it is important to know the relationship between foreign aid and GDP growth so as to know whether aid has been good for Tanzania. Note that it is not possible to also analyze foreign aid and regional economic growth as there is no data on the amount of foreign aid that goes to a specific region in Tanzania.

After looking at the impact of foreign aid on national economic growth, I look at the impact of regional economic growth on poverty reduction in the two regions of Kilimanjaro and Ruvuma. This is because: 1) It is important to know if economic growth is beneficial to the poor. 2) A regional level analysis is much closer to the household level and thus it will give us a better picture of growth-poverty interaction. 3) Regional GDP growth has impacted on regional poverty differently in the two regions thus making the two regions more interesting to study. 4) Suitable household panel data is available on these two regions. Calculations from REPOA data show that regional GDP growth has been accompanied by a marginal increase in poverty in Kilimanjaro from 26% in 2003 to 32% in 2009, while for Ruvuma regional GDP growth has been accompanied by a marginal reduction in poverty from 49% in 2004 to 47% in 2009. Thus it is important to explain this puzzle as by doing so we will get new insight on how to make growth more pro-poor. Note that the above analysis also indirectly complements the analysis of foreign aid and national economic growth. This is because after we have known the impact of foreign aid on national economic growth it is worthwhile to know the interaction of growth and poverty at the regional level.

After looking at the impact of regional economic growth on poverty reduction in the two regions of Kilimanjaro and Ruvuma, I analyze vulnerability to poverty within the two regions. Analysis of vulnerability to poverty is important in its own right and it also complements growth-poverty analysis in the two regions. Calculations from REPOA data show that around 20% of the people in Kilimanjaro and 40% of the people in Ruvuma are

vulnerable to consumption poverty. These levels of vulnerability are high (especially in Ruvuma) thus we need to investigate the determinants of vulnerability to poverty to get deeper insight on how to reduce vulnerability to poverty in the two regions.

1.3 Research objectives

The aims of this research are to analyze the impact of foreign aid on national economic growth, why economic growth has interacted with poverty differently in Kilimanjaro and Ruvuma regions, and to investigate the determinants of household vulnerability to consumption and asset poverty in the two regions. This will improve our knowledge and understanding of sustainable poverty reduction which requires pro-poor economic growth and eventual elimination of vulnerability to poverty.

In harmony with the above objectives, the research seeks to answer the following questions:

1) Does foreign aid improve economic growth? A national growth diagnostics exercise will set the stage for answering this question. A Vector Error Correction Model (VECM), Orthogonalized Impulse Response Functions (OIRFs) and Forecast error variance decompositions (FEVDs) will finally be used.

2) What factors make poverty reduction more responsive to economic growth? To answer this question I will use regional consumption and asset growth incidence curves, regional household livelihoods profiles, other descriptive techniques, and consumption and asset growth regressions.

3) What are the determinants of vulnerability to consumption and asset poverty? I will use the methodology of Christiaensen and Subbarao (2004) to analyze the determinants of vulnerability to poverty and to estimate vulnerability levels. I will also carry out cross-tabulations of vulnerability to consumption poverty and vulnerability to asset poverty.

From the above objectives and questions the following hypotheses will be tested:

1) Foreign aid positively determines economic growth. We expect foreign aid to inject resources into the economy and thus boost growth (Bacha, 1990). Although some argue that

conventional aid (aid that targets a country as opposed to project aid) is ineffective and sometimes it might harm growth (Easterly, 2008).

2) Growth of farm crop income and growth of non-farm business income increases the consumption growth and asset growth of the poor. From the settings, assets and activities framework (Hoddinott and Quisumbing, 2003) we know that income is used for consumption and accumulation of assets. Thus we expect that growth of farm crop income and growth of non-farm business income will increase consumption growth and asset growth of the poor.

3) Growth of farm crop income has a higher impact on the consumption growth of the poor than growth of non-farm business income. The poor are likely to be more reliant on farm crop income as opposed to non-farm business income (NBS, 2009; Christiaensen and Pan, 2010). Hence growth of farm crop income is expected to be more beneficial to the poor than growth of non-farm business income.

4) Individuals that are vulnerable to asset poverty are also vulnerable to consumption poverty. Asset ownership influences consumption; individuals with more assets have more income and thus have higher consumption (Hoddinott and Quisumbing, 2003). Thus those vulnerable to asset poverty are likely to also be vulnerable to consumption poverty.

5) The poverty rate is higher than mean vulnerability. Mean vulnerability is expected to be similar to the poverty rate in a normal year. In a bad year mean vulnerability is less than the poverty rate (Chaudhuri et al 2002; Christiaensen and Sarris, 2007). Since in the year of the last survey round, 2009, real GDP per capita growth in the two regions was low we assume that it was a bad year. Hence we expect the poverty rate to be higher than mean vulnerability.

1.4 Thesis outline

The thesis has been structured as follows: Chapter one is the introduction. Chapter two analyses the impact of foreign aid on economic growth in Tanzania, chapter three analyses the impact of economic growth on poverty reduction in Kilimanjaro and Ruvuma regions and chapter four analyses the determinants of vulnerability to poverty in the two regions. Chapter five is the conclusion.

CHAPTER 2 : THE IMPACT OF FOREIGN AID ON ECONOMIC GROWTH IN TANZANIA

2.1 Introduction

Economic growth is the sustained increase in a country's productive capacity. Economic growth is usually measured as growth in GDP; however the Sarkozy commission (Stiglitz et al., 2009) has criticized GDP as a national account measurement and has recommended the use of Net National Income (NNI), unfortunately Tanzania does not yet have long time series of NNI.

Tanzania has experienced low economic growth rates in the past. Since the year 2000 the economic growth rate has risen significantly but it is not high enough to meet the annual growth target of 8% that is required for achieving Millennium Development Goal 1. The main reasons for the recent growth revival have been economic reforms, high inward foreign investment and foreign aid inflows (Mwase and Ndulu, 2008). In this chapter we will investigate the impact of foreign aid on economic growth in Tanzania. Foreign aid is viewed as one of the means of enabling the country to achieve the Millennium Development Goals (MoFEA, 2010b).

Foreign aid has been an important source of external finance for Tanzania. At its peak in 1992 foreign aid was 29% of GDP and exceeded exports by 234% and had a volume of 1.3 billion USD. Since then the volume of foreign aid has tended to rise but its share of GDP and its importance relative to exports has fallen. In 2012, foreign aid was 10% of GDP and 34% of exports and its volume was 2.8 billion USD. Foreign aid has also been an important source of finance for the government and sometimes like in the years 2002/03-2005/06 it has financed around 40-42% of the government budget. Recently foreign aid continues to be important to the budget although its share of government budget has declined to 26% in 2011/12 and 16% in 2012/13 (own calculations from BOT, IMF and World Bank data).

Economic reforms have improved institutions and policies and thus are expected to make foreign aid more effective in Tanzania (Mwase and Ndulu, 2008). Large inflows of foreign aid in Tanzania have a potential for causing a 'Dutch Disease'. However, a 'Dutch Disease' can be prevented by the central bank intervening to prevent the appreciation of the real

exchange rate and by the government investing in infrastructure so as to boost competitiveness.

Recently the main modality of delivering foreign aid has been via direct budget support as well as sectoral funding mainly in health and education. Direct budget support improves donor coordination, boosts government finances and increases country ownership in the use of foreign aid. Sectoral funding improves donor coordination and improves the targeting of aid towards growth boosting sectors such as infrastructure, health and education. However both direct budget support and sectoral funding needs to be accompanied by good public finance management in the recipient country together with sound tax revenue targets in order to minimize aid fungibility and corruption.

For this chapter the research objective is: To analyze the impact of foreign aid on national economic growth. The research question is: Does foreign aid improve economic growth? The chapter begins with a section on the evolution of the Tanzanian economy, then sections of literature review, growth diagnostics, theoretical framework, the econometric model, data, results and discussion and then conclusion.

2.2 Evolution of the Tanzanian economy

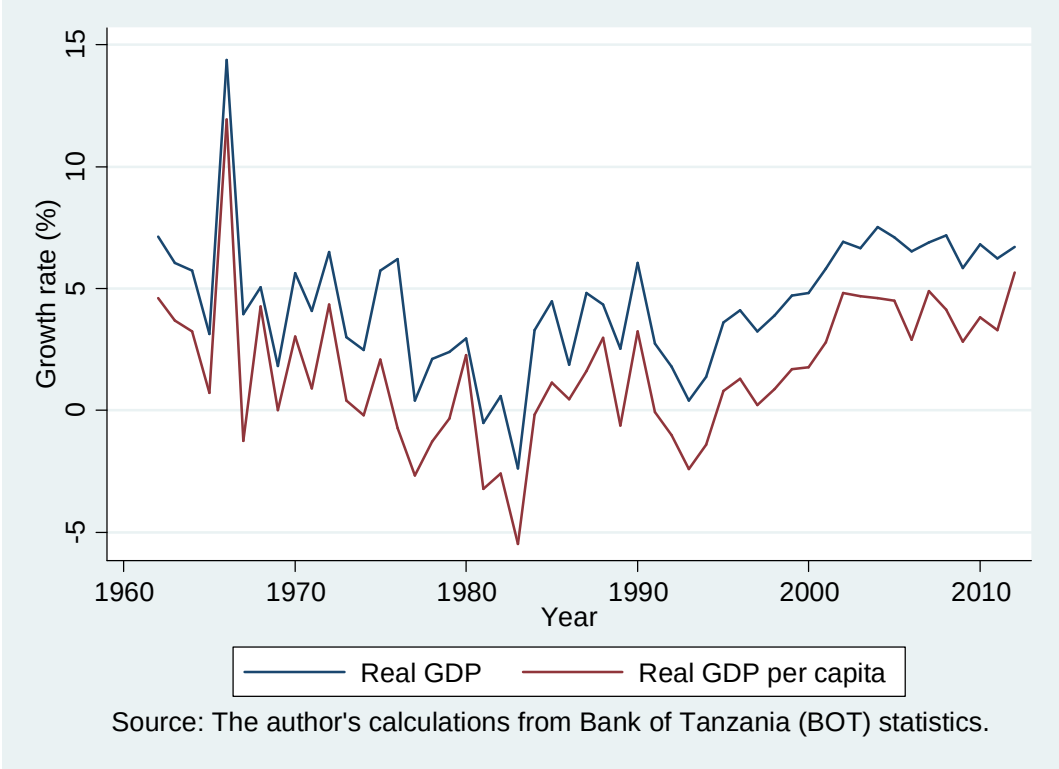
This section explains the evolution of the Tanzanian economy overtime. From independence in 1961 upto 1967 the economy was a market economy with emphasis on import substitution industrialization based on encouraging foreign investment in the manufacturing sector. Between 1967 and 1985 the Tanzanian economy was controlled by the state under the policy of Ujamaa socialism that was pioneered by the first President (Julius Nyerere). Economic output was dominated by state owned enterprises and a large proportion of the economy was either under direct state control or was tightly regulated by the state. Import substitution industrialization was now done under state owned enterprises and the exchange rate was fixed and overvalued. Between 1985 and 1995 there was a new president (Ali Mwinyi) and economic reforms were introduced. The type of reforms introduced in this period was mainly deregulation of the economy, currency devaluation, privatization and the reintroduction of multiparty politics.

Another president (Benjamin Mkapa) came in between 1995 and 2005, in this period deeper economic reforms were introduced. Nearly all state owned enterprises (including large

commercial banks) were privatized foreign investment was strongly encouraged especially in the mining sector. The economy started growing rapidly, domestic revenue collection rose, foreign investment increased greatly and foreign aid rose sharply there was also debt relief whereby a significant proportion of the Tanzanian foreign debt was cancelled (Mwase and Ndulu, 2008; Nord et al., 2009). In 2005 another new president (Jakaya Kikwete) came in and the policy so far has been to consolidate the economic reforms.

From figure 2.1 we can see the evolution of the Tanzanian economy across time. We can see that in the 1960s and 1970s the growth rate fluctuated due to volatility of cash crop prices, rainfall and international oil prices as well as the implementation of compulsory villagisation policy. In 1978 and 1979 there was war between Tanzania and Uganda this war had dramatic consequences for the economy and led to a period of economic crisis between 1980 and 1985. During this period Tanzania experienced a major recession and from our figure we can see that during this period the growth rate of GDP was not only negative but was also at the lowest historical level.

Figure 2.1: Growth rate of national real GDP and real GDP per capita

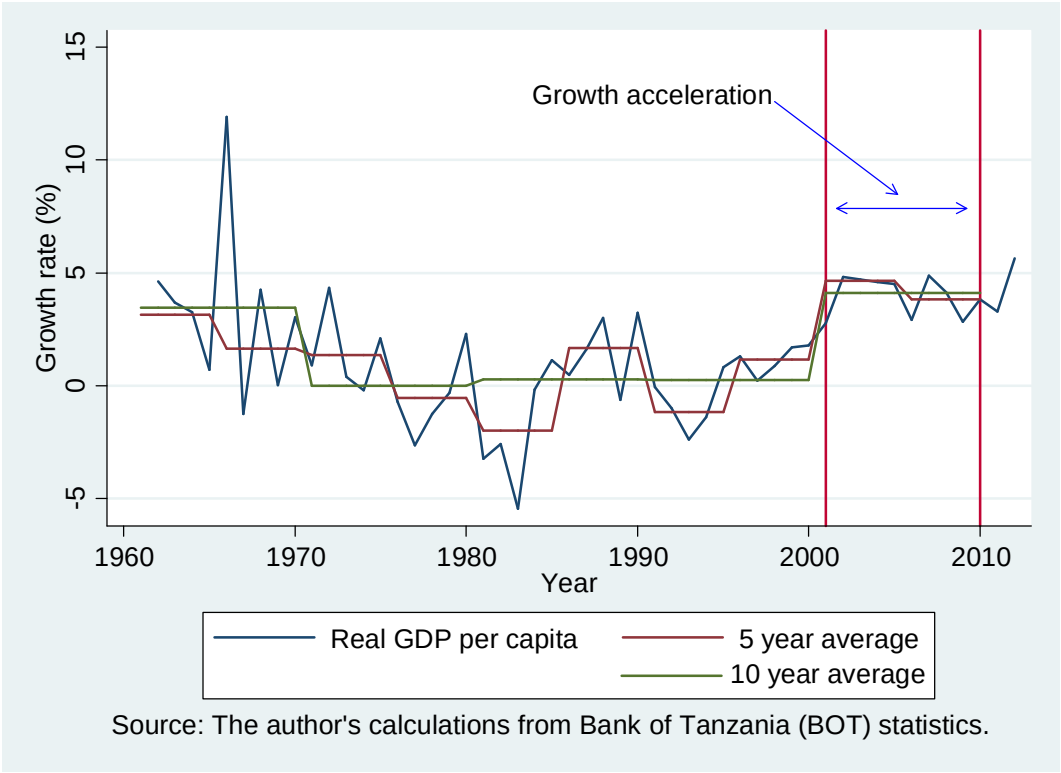


Source: The author's calculations from Bank of Tanzania (BOT) statistics.

After 1985 the economy recovered mildly especially in the late eighties and early nineties when a cash crop price boom boosted the economy, but between 1992 and 1995 the economy was in crisis as donors withdrew aid on grounds of government corruption. After 1995 the new president that came in managed to restore donor confidence by promising to fight corruption. From figure 2.1 we can see that after the year 1995 the growth rate of GDP has risen steadily. However there is a slight decline due to the negative consequences of the 2008/2009 international financial crisis in the form of lower tourism revenues and a decline in foreign investment (especially in the mining sector).

The mean growth rate of GDP during the socialist era (1967-1985) was 3% which is lower than that of the post reform period (4.8%). The mean growth rate of per capita GDP during the socialist era stagnated at 0.03% which is lower than that of the post reform period (2.16%). Note that a significant part of the post reform economic improvements occurred after 1995; where by the growth rate of real GDP was 5.8% while that of real GDP per capita was 3.1% (own calculations from BOT statistics). From figure 2.2 we can see that Tanzania experienced growth acceleration in the 2000s. While in the early 1980s Tanzania experienced the lowest 5 year average growth rate after independence.

Figure 2.2: Growth Acceleration



Source: The author's calculations from Bank of Tanzania (BOT) statistics.

Figure 2.3 shows the trend (from 1961-2012) of the three variables (aid, exports and non-aid Gross Fixed Capital Formation (GFCF) as shares of GDP) that will be analysed (alongside GDP per capita). The periods are subdivided into (1961-1966), (1967-1977), (1978-1985), (1986-1995) and (1996-2012) in order to reflect the major shifts in national policy and economic climate.

From figure 2.3 it can be seen that from independence in 1961 until 1966, aid as a share of GDP was relatively low and it was declining, exports as a share of GDP was relatively high and marginally declining and non-aid GFCF (Gross Fixed Capital Formation) as a share of GDP was relatively low but slightly increasing. Between 1967 and 1977, aid as share of GDP increased, exports as a share of GDP declined and non-aid GFCF as a share of GDP increased. This shift reflected increasing state intervention in the economy that was accompanied by higher aid and higher public investment (Mwase and Ndulu, 2008).

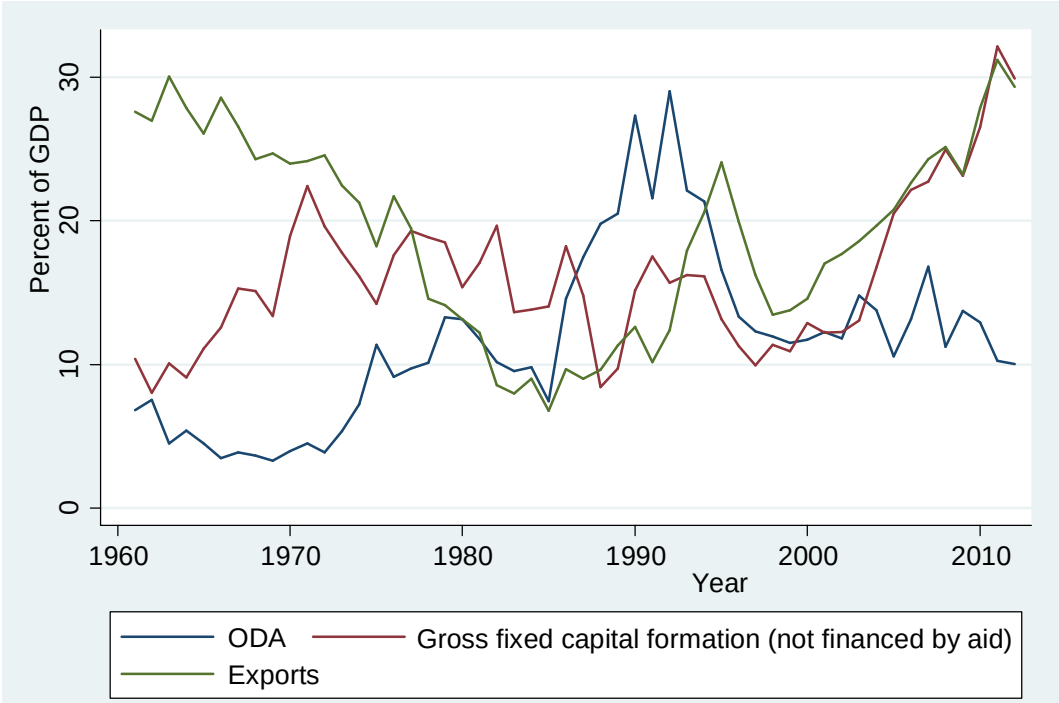
From 1978 to 1985 aid as a share of GDP initially increased and then declined, exports as a share of GDP rapidly declined and non-aid GFCF as a share of GDP increased and then declined. The rapid decline in exports and the eventual decline in non-aid GFCF during this

period was mainly caused by deteriorating terms of trade, the Tanzanian-Uganda war, oil price shocks and excessive (and usually inefficient) government intervention in the economy. The decline in aid towards the end of this period was caused by deteriorating relationship between the government and donors (Mwase and Ndulu, 2008).

From 1986 to 1995 aid as share of GDP rapidly increased and then declined, exports as a share of GDP rapidly increased and non-aid GFCF as a share of GDP rapidly declined and then increased. This recovery was ushered by the first wave of economic reforms which involved currency devaluation, trade and financial liberalisation. These reforms were also accompanied by higher foreign aid. But this wave of reforms lost momentum towards the end of this period as the government was hesitant to carry further reforms and its relationship with donors deteriorated (Muganda, 2004; Mwase and Ndulu, 2008).

From 1996 to 2012 aid as a share of GDP initially declined and then rose and then slightly declined, exports as a share of GDP initially declined and then rapidly increased and non-aid GFCF as a share of GDP initially declined and then rapidly increased. This final rise was due to the second wave of deeper economic reforms (macroeconomic stabilisation, further privatisation and public finance management reforms), high inward foreign investment, the emergence of non-traditional exports (mainly gold), high tourism receipts and an improvement in the relationship between the government and donors (Muganda, 2004; Mwase and Ndulu, 2008; Nord et al., 2009).

Figure 2.3: Trends of foreign aid, exports and non-aid Gross Fixed Capital Formation (GFCF) (as shares of GDP)



Source: The author's calculations from IMF, World Bank and NBS statistics.

A note on GDP as a measurement of economic activity

In this study we use GDP as our measurement of economic activity. However we should note that according to the Sarkozy commission (Stiglitz et al., 2009), GDP has some limitations as a measurement of economic activity. These limitations include 1) GDP cannot identify a growth bubble 2) GDP does not include environmental degradation 3) GDP has difficulty measuring goods and services produced by the government 4) GDP ignores non-income dimensions of welfare.

The Sarkozy commission has recommended amongst other things to 1) use other better measurements from the existing national accounts i.e. Net Domestic Product (NDP), Net National Income (NNI) or Net National Disposable Income (NNDI); 2) measure the output of government services rather than the inputs used; 3) measure changes in wealth (assets and liabilities) rather than just changes in income; 4) look at real income inequality rather than just nominal income inequality; 5) use subjective measurements of wellbeing as well as capability approach measures and fair allocations measures; 6) use measurements of

sustainable development; such as Adjusted Net Savings (ANS) which use the System of Environmental Economic Accounting (SEEA); and focus on overconsumption of or underinvestment in environmental resources (Stiglitz et al., 2009). However due to lack of alternative data in this study we use GDP as our measurement of economic activity.

2.3 Literature review

This section reviews studies which analyse the impact of foreign aid on economic growth. These studies can be grouped into cross country and single country studies. Foreign aid injects economic resources into the economy. It augments domestic savings, increases government revenues (general budget support), provides technology and improves foreign exchange reserves (Chenery and Syrquin, 1975; Bacha, 1990; Burnside and Dollar, 2001; Sachs, 2005).

Important cross country studies on aid and economic growth include Burnside and Dollar (2000) who show that aid is good for growth when the recipient country has good policies (low inflation, budget surplus and openness to trade). Hansen and Tarp (2001) argue that Burnside and Dollar's (2001) results are not robust if the outliers that they excluded are included, although they also argue that aid in general increases growth.

Collier and Dehn (2001) found that increasing aid in countries experiencing negative shocks (export price shocks) reduces the negative impact of such shocks on economic growth. They argue that the inclusion of export price shocks upholds the results of Burnside and Dollar (2000) even when (their) outliers are included. Collier and Dehn (2001) also argue that aid will be more effective when it is targeted to countries experiencing negative shocks rather than towards countries with good policies.

Kraay and Raddatz (2007) empirically dispute the presence of poverty traps that are based on low savings and low technology. Hence they claim that large increases in aid (that are based on the assumed presence of such traps) will not necessarily generate growth miracles in poor countries. Easterly (2008) observes that rapid large scale aid increases have been ineffective and that such an approach has been recycling ideas which indicate a lack of learning on how to improve aid effectiveness. He asserts that gradual aid increases to specific sectors such as education and health have performed well compared to large scale aid increases.

Guillaumont and Wagner (2012) state that most aid-growth studies miss an important dynamic that the impact of aid on economic growth declines over time (and eventually becomes negative) in countries where aid is successful; that is once a country starts to grow rapidly, it no longer receives aid. This dynamic weakens the conclusions of cross country studies which combine slow growing developing countries (which receive aid) and fast growing developing countries (which do not receive aid). To remedy this they investigated whether aid can help to launch growth episodes and also lengthen their duration. They found the evidence for this hypothesis and further concluded that the impact of aid on growth acceleration is greater in vulnerable economies that have external shocks such as instability of exports.

Gomanee, Girma and Morrissey (2005) studied the impact of foreign aid on economic growth in 25 Sub-Saharan countries from 1970 to 1997. They used residual generated regressors to calculate the proportion of investment that is not financed by foreign aid. Gomanee et al. (2005) argue that their regression specification explicitly takes into account the fact that aid mainly operates via transmission mechanism such as investment. They found that foreign aid improves economic growth in Sub-Sahara Africa.

The literature review now turns to single country studies. One such study is M'Amanja and Morrissey (2006). These authors did a study on the impact of foreign aid on economic growth in Kenya (1964-2002). They analysed the impact of foreign aid (in the form of net external loans), imports, public investment and private investment (all of which were expressed as a share of GDP) on economic growth (real GDP per capita) using a Vector Error Correction Model (VECM). All variable were in logarithmic form. M'Amanja and Morrissey (2006) found that private investment and imports positively influence per capita income and net external loans negatively influence long run growth. They also found that private investment is negatively related to imports and government investment but positively related to foreign aid (net external loans). Their analysis has demonstrated that foreign aid in the form of net external loans is harmful to economic growth, but they did not analyse whether foreign aid in the form of grants and debt relief is beneficial to the economy as these unlike loans do not have to be repaid.

M'Amanja, Lloyd and Morrissey (2005) analysed the impact of aid on growth in Kenya between 1964 and 2002 using a Vector Error Correction Model (VECM). Aid was decomposed into grants and loans and it was assumed to be transmitted via government

spending and tax revenues. Their study found that aid grants increases long run growth while aid loans reduce it. White and Wignaraja (1992) show that large inflows of foreign aid can cause a 'Dutch disease' in the host economy via an appreciation of the real exchange rate, which in turn can damage the country's exports and its manufacturing base. However, Nkusu (2004) suggests that in recipient countries with idle resources (unemployed factors of production) aid does not necessarily cause a Dutch disease if that aid is used to employ the idle resources and ease supply constraints i.e. improve infrastructure.

Juselius, Møller and Tarp (2011) did a study on the impact of foreign aid on economic growth in 36 Sub Saharan African countries from the mid-1960s to 2007 using a Cointegrated Vector Autoregressive (CVAR) model. They analysed the impact of aid on four variables, namely; real GDP, real investment, real private consumption and real government consumption. Each country was analysed individually. They found that aid improved investment and or economic growth in 27 out of 36 countries. Thus aid was beneficial in many countries. Juselius et al. (2011) also included Tanzania in their analysis. They found that aid had a positive and significant effect on investment in Tanzania, but they argued that this result was influenced by the 1992-1995 period whereby aid greatly influenced investment. However they also found that aid had a negative but insignificant effect on GDP, private consumption and government consumption.

Bwire, Morrissey and Lloyd (2013) analysed the impact of aid on growth in Uganda between 1972 and 2008 using a CVAR model. They used growth in private per capita consumption as a proxy for economic growth. Aid was assumed to be transmitted via government fiscal variables (government spending, domestic borrowing and tax revenue). Bwire et al. (2013) found that aid improved growth in private per capita consumption. Aid also improved government spending, tax revenue and reduced government domestic borrowing. The above literature review leads us to test the following research hypothesis: Foreign aid positively determines economic growth.

The original contribution of this chapter is: 1) it uses a VECM to analyse the impact of foreign aid on GDP per capita in a single country (Tanzania). Using as control variables investment that is not financed by foreign aid in the spirit of Gomanee et al. (2005), and exports; 2) it calculates and draw the respective Orthogonalized Impulse Response Functions and Forecast error variance decompositions; 3) it carries out a growth diagnostic exercise for Tanzania.

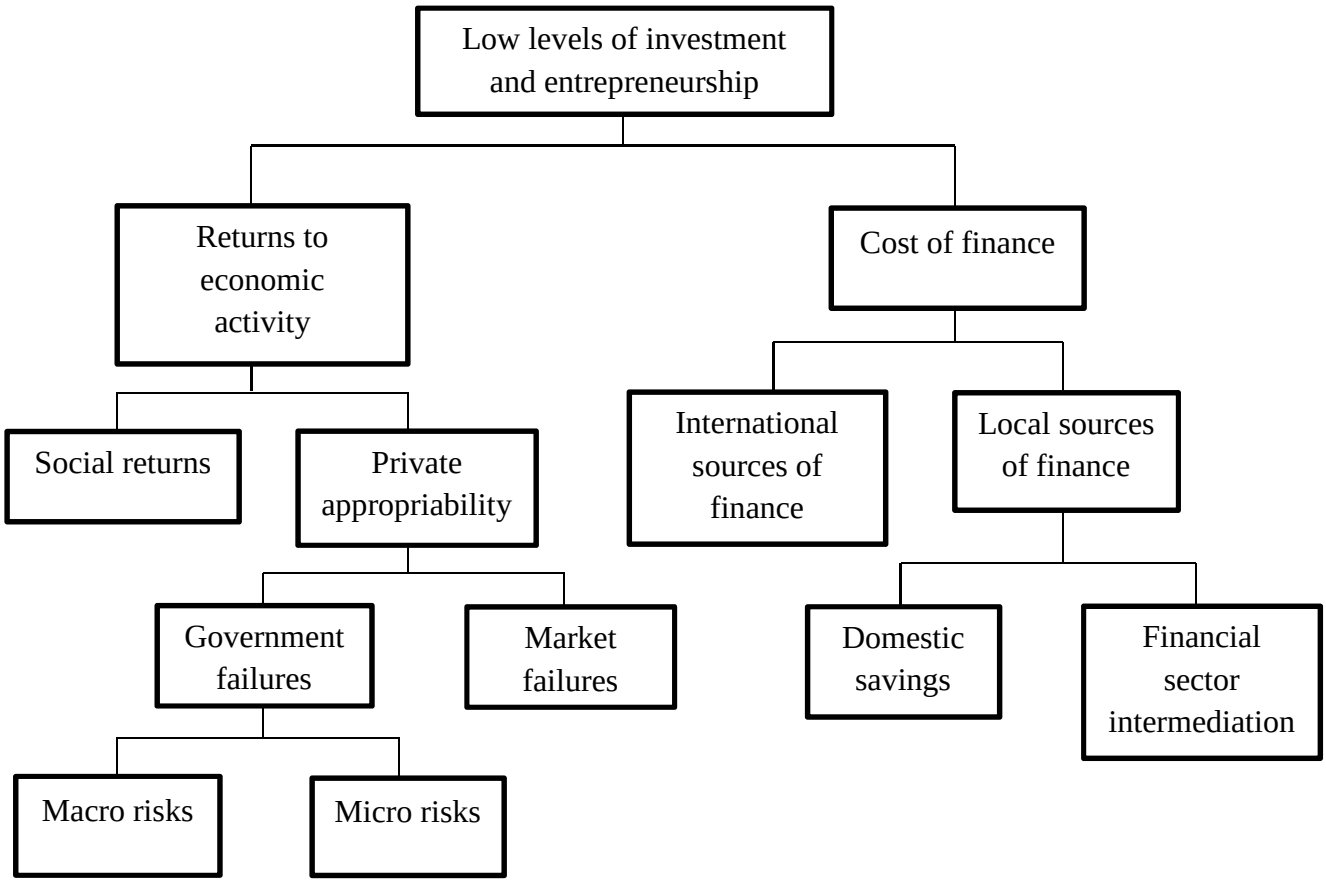
2.4 Growth diagnostics exercise for Tanzania

This section carries out a simple growth diagnostics exercise for Tanzania so as to investigate what is preventing higher economic growth. It first begins with a general explanation of growth diagnostics, and then it briefly explains the growth process of Tanzania so as to motivate the main question of the growth diagnostics exercise. It proceeds to apply the growth diagnostic tree, and then it gives other factors that influence or hinder economic growth in Tanzania, and finally it gives the conclusion of the growth diagnostics exercise.

2.4.1 General explanation of growth diagnostics

Growth diagnostics are conducted using a growth diagnostic tree (see figure 2.4). The growth diagnostic tree lists the binding constraints that are preventing higher economic growth. When we conduct a growth diagnostic exercise we check (by moving from the top of the tree towards the bottom) to see if the constraint in the box is relevant to Tanzania. We move down the tree until we identify the binding constraint (the greatest obstacle) to higher economic growth (Hausmann, Rodrik and Velasco, 2005; Hausmann, Klinger and Wagner, 2008; Lundstrom and Garrido, 2010).

Figure 2.4: Growth diagnostics tree



Source: Hausmann et al. (2005); Lundstrom and Garrido (2010).

According to Hausmann et al. (2008) the main characteristics of a binding constraint are: 1) The price or shadow price of the constraint is high; 2) Changes in the constraint would produce significant changes in economic growth; 3) Agents would be trying to overcome or circumvent the constraint; 4) Agents that have less intensive use of the constraint will have better chances of surviving and growing.

The growth diagnostics approach asks the following question: is Z the cause of low economic growth (or the factor that prevents higher growth) in a given country at this time period? The advantage of this approach over other approaches is that it enables us to identify the underlying constraint (usually via prices and shadow prices); something that is difficult to do with other methods such as growth regressions.

In the growth diagnostic approach the determinants of growth are given greater probability of being complements than substitutes. The economy operates a little more (but not exactly) like

Liebig's barrel where by output (economic growth) equals the shortest stave (binding constraint); growth increases only by increasing the shortest stave (until the next shortest stave/next binding constraint). The most binding constraint is the constraint that generates the highest social welfare loss (Hausmann et al., 2008).

Hausmann et al. (2008) suggest following these steps in the growth diagnostic approach: 1) Expound the growth process and determine a relevant question. 2) Carry out a differential diagnosis. 3) Give an explanation of the factors that cause the presence of a particular constraint (posit a syndrome). Syndromes have testable implications such as the observation of a signal (high shadow price). 4) Further implications are tested to corroborate evidence of the syndrome. 5) Iterating on positing a syndrome and testing further implications until convergence. Beliefs on the relevancy of a syndrome are updated in an implicit Bayesian manner based on the ratio of the conditional probability of observing the signal if the syndrome is correct relative to the unconditional probability of observing the signal (Hausmann et al., 2008).

The simple background growth model for the growth diagnostic exercise follows a balance growth path whereby the rate of economic growth equals the rate of asset accumulation (Hausmann et al., 2005).

$$g = \frac{\dot{c}_t}{c_t} = \frac{\dot{k}_t}{k_t} = \alpha[r(1-\beta) - \theta]$$

Whereby g is the (per capita) growth rate of the economy, c is consumption per capita, k is capital per capita, r is the expected social return to investment, (1-β) is the proportion of r that is privately appropriable and θ is the opportunity cost of investment funds. A greater difference between the net benefits and costs of investment implies a higher rate of asset accumulation and thus a higher growth rate.

2.4.2 Brief explanation of the growth process of Tanzania

This sub-section gives a brief economic history of Tanzania so as to motivate the main question of the growth diagnostic exercise. This is then followed by the rest of the growth diagnostic exercise. In 1961 the GDP per capita of Tanzania was 54 USD; it was below that

of Sub-Saharan Africa (132 USD) which was below that of the world (455 USD). In 2012 the GDP per capita of Tanzania was 609 USD which was below that of Sub-Saharan Africa (1433 USD) which was below that of the world (10,206 USD). Thus with time Tanzania's GDP per capita is roughly the same proportion of that of Sub-Saharan Africa while it has become a smaller proportion of world's GDP per capita.

In the late 1970s and early 1980s, Tanzania's GDP per capita declined and real GDP per capita growth was generally negative. It is only after 1996 that Tanzania has had a continuous positive growth and it even experienced growth acceleration. The reasons for Tanzania's past malaise were volatility of cash crop prices, some periods of drought, decline of terms of trade, high international oil prices, a low base of manufacturing and service sectors and inefficient state intervention in the economy. The 1978/79 war with Uganda also increased economic hardship. Overreliance on traditional low productivity agriculture that depends on rainfall and uses low levels of agro-mechanization and fertilizers has also contributed to low growth. Low levels of human capital and bad infrastructure have also hindered growth.

The recent recovery in Tanzania came after economic reforms which have improved the local business environment as well as the agriculture sector. The country has further diversified its crop base and it has increased the size of its manufacturing and service sectors. As a result it is slightly less dependent on agriculture and rainfall. Recent investments in infrastructure (roads, water supply and electricity) and education have also contributed to the improved growth. However poverty particularly in rural areas is still a big challenge and there is a need for more improvement in many sectors of the economy.

The key challenge for Tanzania is how to further boost per capita GDP growth and household incomes particularly in rural areas and thus reduce poverty. Thus the main question of the growth diagnostic exercise for Tanzania is: what is constraining private investment from being higher?

2.4.3 Applying the growth diagnostic tree

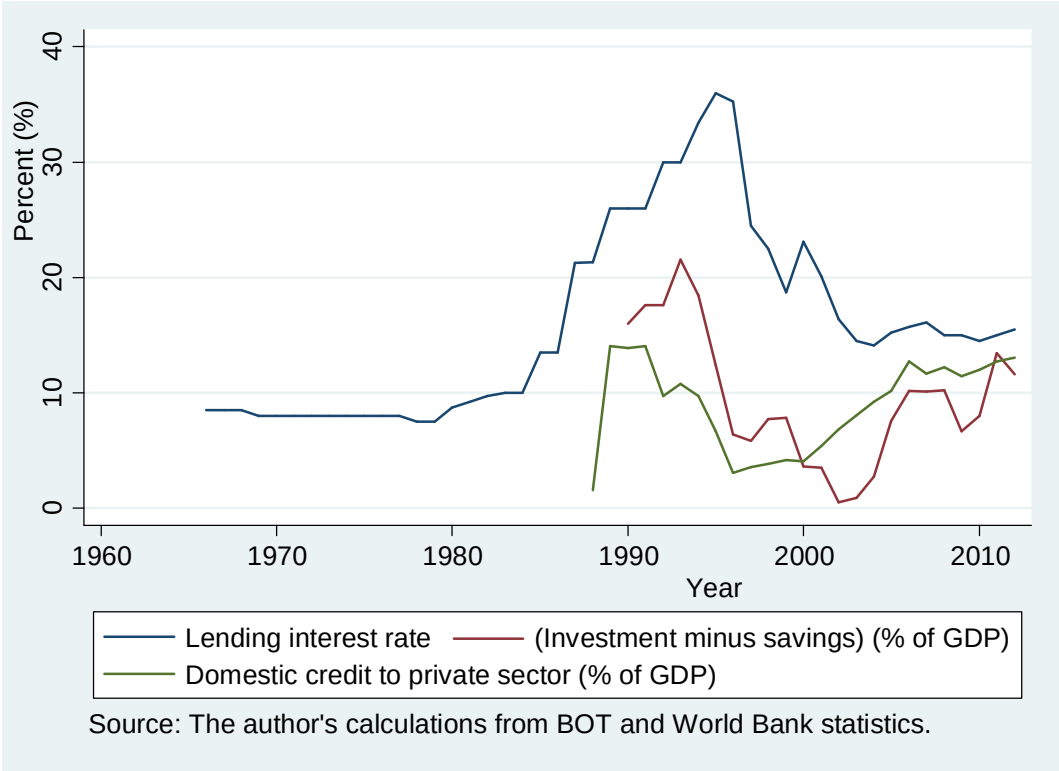
We start at the top of the tree and go downwards and justify why we choose a particular direction of the tree as we go downwards. The tree questions will be in bold so as to make them easier to follow. The first question from the growth diagnostic tree is: **Is the lack of higher private investment mostly caused by a demand problem (low returns to**

economic activity) or a supply problem (high cost of finance)? As we are going to see in the following analysis the answer is it is mostly caused by high cost of finance.

According to the 2003 and 2005 World Bank Investment climate surveys of Tanzanian rural and urban non-farm businesses, the highest percentage of entrepreneurs (at least 60%) stated that access to finance (availability and cost) was the major obstacle for the operation and growth of firms in Tanzania (World Bank, 2007a). Later on the 2013 Executive opinion survey of the World Economic Forum found that access to financing was the most problematic factor for doing business in Tanzania, with a weight of 24.2% followed by corruption (16.9%), inadequate supply of infrastructure (11.5%), inefficient government bureaucracy (10.2%), inflation (7.6%) etc. (Schwab and Sala-i-Martín, 2013).

The cost of finance is high due to historical reasons. Under the state control regime credit to the private sector as percentage of GDP was negligible and interest rates were controlled by the state. The private sector was significantly credit constrained. The 1985 economic reforms started the liberalization of interest rates, lending interest rates sharply increased. Budget and current account deficits during this period also created inflationary pressure and thus contributed to the high interest rates. Deeper reforms after 1995 have improved public finances, curbed inflation and have steadily increased credit to the private sector. As a result lending interest rates started to decline after 1995 (see figure 2.5). Note that as the gap between investment rate and saving rate narrows the lending interest rate falls. This reflects the fact that a high lending interest rate reflects the high cost of finance which is caused by a high demand for loans and a low supply of savings.

Figure 2.5: Tanzania's lending interest rate, the investment rate minus the savings rate and domestic credit to private sector as percentage of GDP



Source: The author's calculations from BOT and World Bank statistics.

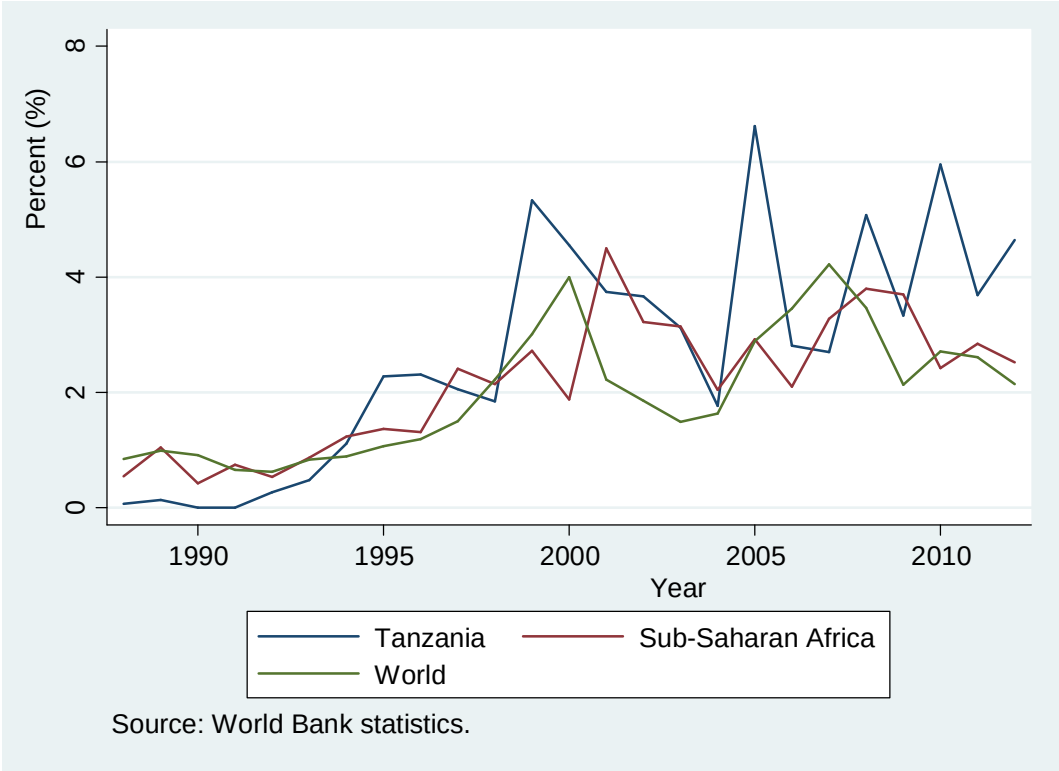
The decline in national interest rates has been accompanied by higher economic growth nationally. However, the shadow price of finance is still relatively high as lending interest rates were around 15.5% in 2012.

Economic agents avoid high costs of finance by relying on own savings and money from friends and relatives when starting or expanding their businesses. Economic activities with low start up financial costs are more numerous than those which require large amounts of finance i.e. small businesses are more numerous compared to large businesses. Successful medium and large firms in Tanzania are those with access to concessional loans from financial institutions or those with diversified business portfolios.

There has also been a surge in inward FDI to Tanzania after the introduction of economic reforms, this further shows that lack of credit is the most binding constraint as opposed to expected returns to investment, as inward FDI comes from countries without credit constraints and flows to areas with good expected returns to investment. The recent decline in

inward FDI is due to the financial crisis in FDI source countries and not due to a decline in Tanzania's expected returns to investment (see figure 2.6).

Figure 2.6: Tanzania's net inward FDI as percentage of GDP



Source: World Bank statistics.

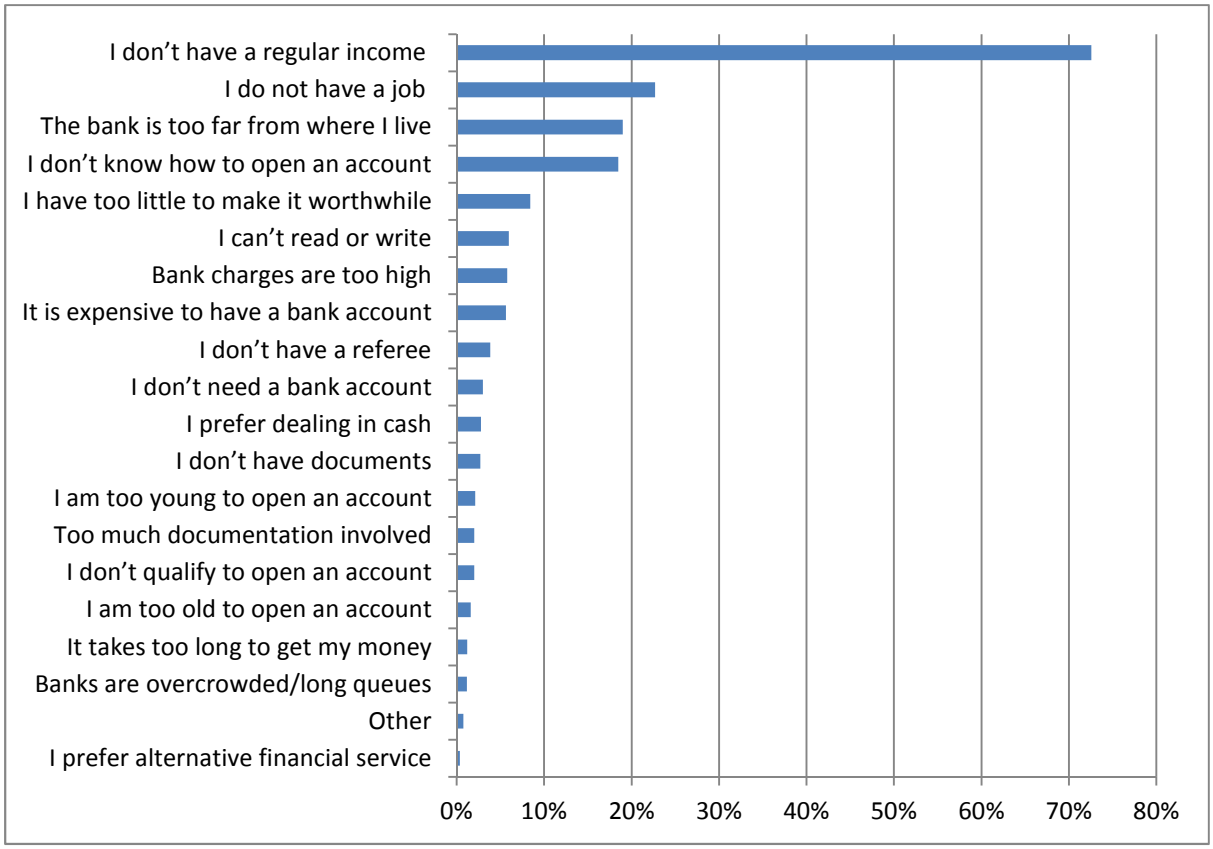
Thus from the above it is clear that the main reason for low private investment in Tanzania is the high cost of finance. Moving down the growth diagnostic tree: **is the high cost of finance mostly caused by low levels of international finance or by low levels of local finance?** As we can see from the above analysis Tanzania has been receiving a lot of FDI from abroad. Also Tanzania has been a major beneficiary of foreign aid. This rules out lack of international finance being the main problem. Thus the answer to the above question is: the high cost of finance is caused mainly by low levels of local finance.

Moving down the tree: **are the low levels of local finance mostly caused by low domestic savings or inefficient financial sector intermediation?** The following analysis shows that the answer is: the low levels of local finance are caused mainly by low domestic savings. According to the 2009 FinScope financial survey 11.8% of individuals in Tanzania formally

save, 17.2% saved only informally, 41.4% save at home or in kind and 29.6% don't save. 8.6% of individuals had savings in a bank (FinScope, 2013).

The constraint of low domestic savings is mainly caused by lack of regular income. The 2009 FinScope financial survey data (see figure 2.7) shows that in Tanzania the top five reasons people give for not having a bank account (an important indicator of financial savings) are 1) I don't have a regular income (72.57%) 2) I don't have a job (22.69%) 3) The bank is too far from where I live (19%) 4) I don't know how to open a bank account (18.48%) 5) I have too little to make it worthwhile (8.41%).

Figure 2.7: Reasons for not having a bank account in Tanzania in 2009

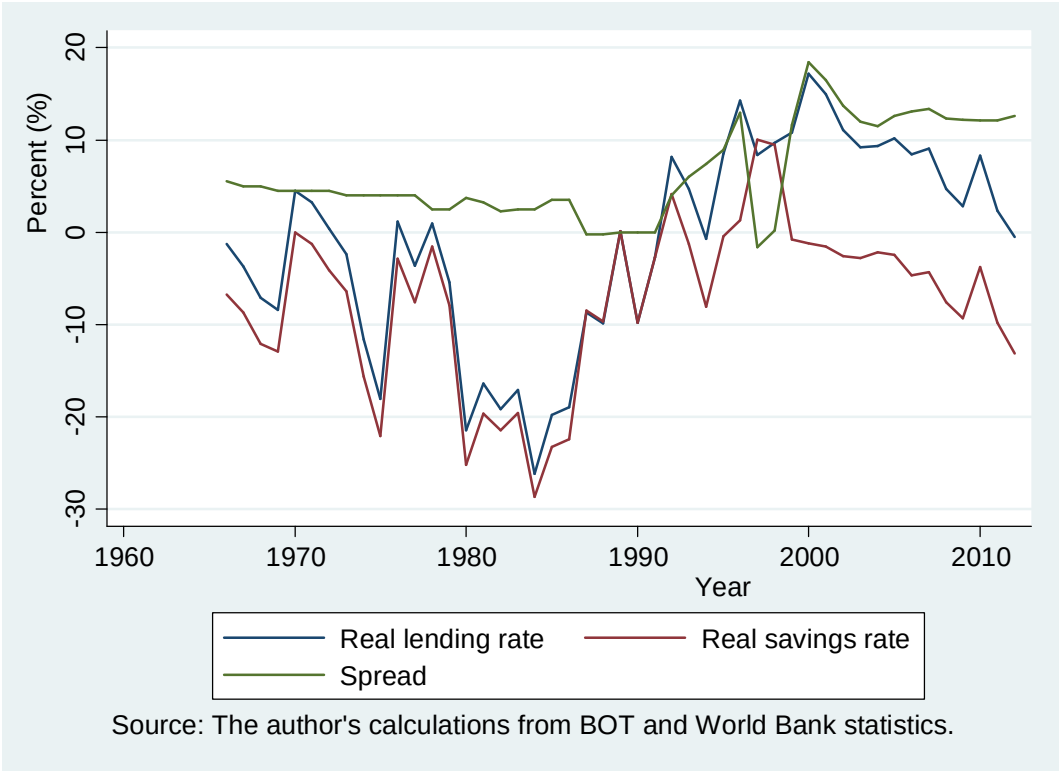


Source: Own calculations from the 2009 Tanzania FinScope survey data from the Financial Sector Deepening Trust.

Although lack of regular income is the main reason for low savings this does not mean that financial sector intermediation is perfectly efficient. The spread (the difference between lending and saving interest rates) which is an indicator of inefficient financial sector

intermediation is still high although since 2000 it has slightly declined and real saving interest rates are still negative (see figure 2.8).

Figure 2.8: Tanzania's real lending and savings interest rates and the interest rate spread



Source: The author's calculations from BOT and World Bank statistics.

The widespread introduction of microfinance in Tanzania and the reorientation of banking services to accommodate small savers and small and medium enterprises (SMEs) has significantly reduced both the savings and credit constraints and boosted private investment in the country. However the savings and credit constraint continues to be the most binding constraint in the country and more needs to be done to relax these constraints. Loan interest rates are still high and people continue to rely on personal savings and money from friends and relatives to start businesses.

Tanzania scored 3.72 in the financial market development index of the Global Competitiveness report (2013-2014) and ranked 99 out of 148. The score for availability of financial services was 3.7 and ranked 119 out of 148, that of affordability of financial

services was 3.6 and ranked 120 out of 148. The score of ease of access to loans was 2.7 and ranked 83 out of 148, that of soundness of banks was 4.2 and ranked 114 out of 148 (Schwab and Sala-i-Martín, 2013).

2.4.4 Other factors that influence or hinder economic growth in Tanzania

The above application of the growth diagnostic tree has shown that low domestic savings is the most binding constraint on economic growth in Tanzania. In order to complete the growth diagnostic exercise for Tanzania we look at other factors that influence or hinder economic growth in the country. These factors can be economic e.g. macroeconomic instability and imperfect markets, and or non-economic e.g. geography and governance (Hausmann et al., 2005). The factors that influence or hinder economic growth in the country include:

Geography and Regional Potential- Tanzania has abundant land and low population density although in the highlands area like Mount Kilimanjaro there is high population density and shortage of land. Thus there is room for increasing land under cultivation especially in the lowly populated areas. In 2012 the population of Tanzania was 44.9 million, the total surface area was 947,300 square km (land area 885,800 square km), the population density was 51 people per square km. The population density is above that of SSA (39) but slightly below that of the world (54).

The population of 44.9 million people provides a sizeable domestic market. The country is also a member of the East African community (EAC) and Southern African Development Community (SADC). In addition the country is a member of the United Nations and the World Trade Organization (WTO) thus it has access to international markets for its exports. The value of the domestic market size index of Tanzania was 3.4 and it ranked 73 out of 148 countries while that of the foreign market size index was 4.1 and ranked 87 out of 148 countries in the Global Competitiveness Report (2013-2014) (Schwab and Sala-i-Martín, 2013). Thus Tanzania has a fairly good domestic market and a good access to international markets. However, its low GDP per capita limits its domestic market, the low GDP per capita of neighbouring countries limits the regional market and its reliance on primary commodities prevents it from further benefiting from international markets.

Economic growth can be improved by increasing land under cultivation, improving agricultural productivity, growing high valued crops, practicing modern dairy farming and

diversifying into manufacturing and the service sectors. However, food crops should not be neglected so as to promote food security. The country does not experience natural disasters although sometimes it experiences periods of rainfall volatility and droughts. The volume of rivers usually declines during droughts and thus reducing water available for hydroelectric production and irrigation (IUCN, 2003; RAWG, 2009; MoFEA, 2010a).

Tanzania has plenty of natural resources such as forests, wild life, big lakes, big rivers, mineral deposits (gold, diamonds, gemstones, uranium) and natural gas deposits. These natural resources can be used to support mining, timber, fisheries and tourist industries. Good governance is necessary to make sure that these natural resources benefit the country. The country has great potential to expand its tourist sector due to the presence of Mount Kilimanjaro, major national parks (with plenty of wildlife) and white sand beaches. Dar Es Salaam, the commercial capital, has manufacturing activity, a reasonably developed banking sector, hotels and higher education institutions. In general since independence the country has experienced national unity, peace and stability and it has a good degree of social cohesion and a common national language (Kiswahili).

Infrastructure- Tanzania has international airports, all weather tarmac roads that connect its regions and some neighboring countries. There are also railway lines linking various regions and also some neighboring countries but the railway lines are hardly operating. Recent road projects have improved the roads within the country but many roads are still in poor conditions. In 2009 only a small percentage of roads were paved (14.9%) compared to 16.3% in Sub-Saharan Africa and 57.6% in the world (in 2010) (see table 2.1).

The majority of people have access to water from improved sources (53.4%, in 2010) compared to 62.07% in Sub-Saharan Africa and 88.47% in the world. Tap water is mainly available in major urban centers and prosperous rural areas although sometimes the taps are dry (especially when there is water rationing). Few people in Tanzania have access to fixed telephone lines (0.39% in 2010) compared to 1.45% in Sub-Saharan Africa and 17.83% in the world. However, Tanzania fares well as far as access to some other types of Information and Communication Technologies is concerned. In 2010, 46.8% of people had mobile phone subscriptions compared to 45.22% in Sub-Saharan Africa and 77.14% in the world. And 11% of people were internet users compared to 10.63% in Sub-Saharan Africa and 29.58% in the world.

Tanzania's population has a low access to electricity (14.8%) compared to 34.58% in SSA and 77.63% in the world (in 2010). Electricity supply is unreliable especially during droughts when the hydroelectric dams have little water. Some regions are not connected to the national electricity grid instead they rely on a regional electricity grid based on diesel generators owned by the national electricity company. The reason for unreliable and low supply of electricity is underinvestment in electricity supply and distribution (especially in rural areas) due to lack of government funds. Due to poor electricity supply some household and firms own diesel electricity generators some use biogas electricity and other use solar power.

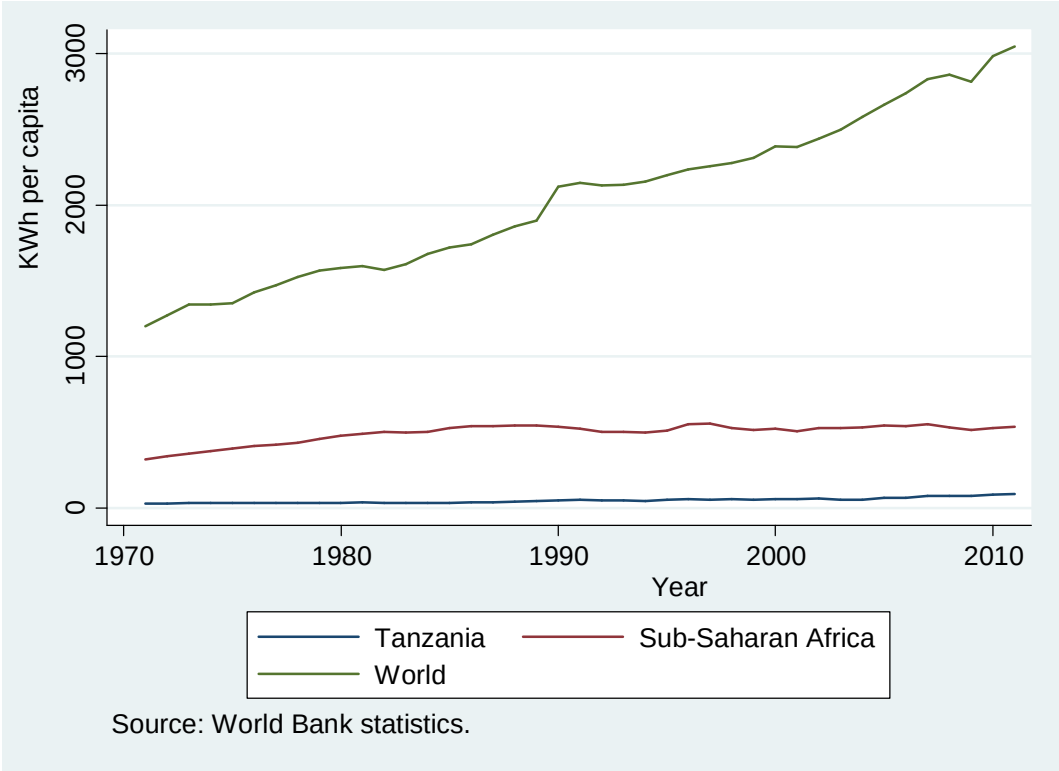
Table 2.1: The percentage of people with access to various infrastructure variables in Tanzania in 2010

2010	Tanzania	Sub-Saharan Africa	World
Electricity	14.8%	34.58%	77.63%
Improved water Source	53.4%	62.07%	88.47%
Paved roads (% of total roads)	14.9%*	16.3%	57.6%
Fixed telephone lines	0.39%	1.45%	17.83%
Mobile phone subscriptions	46.8%	45.22%	77.14%
Internet users	11%	10.63%	29.58%

Source: World Bank data. * Data from year 2009.

Figure 2.9 shows per capita electricity consumption in Tanzania, Sub-Saharan Africa and in the world. From this figure we can see that electricity consumption in Tanzania is lower than in Sub-Saharan Africa and much lower than that of the world. Low electricity supply and consumption in Tanzania hinders economic diversification away from agriculture towards manufacturing and service sectors. It also discourages domestic as well as foreign investment in the country.

Figure 2.9: Tanzania, Sub-Saharan Africa and world's electricity consumption (KWh per capita)



Source: World Bank statistics.

Human capital- Tanzania has better levels of literacy and primary education achievement compared to SSA. It has a high net enrollment ratio in primary education (97.99% in 2008) compared to SSA average (76.33% in 2011) and also compared to the world average (89.29% in 2011) (see table 2.2). Primary school pass rates have recently improved indicating improvement in the quality of primary education (MoEVT, 2007; 2010; 2011; 2012).

Gross enrollment in secondary schools has recently improved due to the national campaign of building community secondary schools in every ward. Despite this, Tanzania has lower gross secondary school enrollment (31.72% in 2010) compared to SSA (40.96% in 2011) and the world average (70.65% in 2011). The expansion of secondary school enrollment has been accompanied by a decline in the quality of secondary education; secondary school pass rates have deteriorated as many community schools have few teachers and poor facilities (MoEVT, 2007; 2010; 2011; 2012). The recent increase in the number of tertiary education institutions has increased student enrollment at the tertiary level (MoEVT, 2010; 2012). However, gross

tertiary level enrollment (2.11% in 2010) is lower than SSA average (7.57% in 2011) and also lower than the world average (30.08% in 2011).

The health of Tanzanians is better than the SSA average but below the world average. Life expectancy is 60.07 years (in 2011) which is higher than the SSA average (55.92 years in 2011) but lower than the world average (70.54 years in 2011). Infant and under 5 mortality rate is 39.3 and 57.3 per 1000 live births respectively and is better than the SSA average (65.92 and 101.55) but slightly below the world average (36 and 49.6). Tanzania has a Human Development Index score of 0.476 (in 2012) which is slightly higher than that of SSA (0.475) but lower than that of the world (0.694). Note that due to limited opportunities in rural areas skilled individuals usually migrate to work in urban areas especially Dar Es Salaam and major towns like Dodoma, Arusha, Mwanza and Mbeya.

Table 2.2: Tanzania education and health indicators

2011	Tanzania	Sub-Saharan Africa	World
Literacy rate	73.21%*	59.83%	84.08%
Net primary school enrollment	97.99%**	76.33%	89.29%
Gross secondary school enrollment	31.72%*	40.96%	70.65%
Gross tertiary level enrollment	2.11%*	7.57%	30.08%
Life expectancy (years)	60.07	55.92	70.54
Infant mortality rate (per 1000 live births)	39.3	65.92	36
Under 5 mortality rate (per 1000 live births)	57.3	101.55	49.6
Human Development Index (2012)	0.476	0.475	0.694

Source: World Bank data. * Data from year 2010, ** data from year 2008.

Macroeconomic instability- Tanzania experiences low to moderate macroeconomic instability. Since 1999 Tanzania has experienced single digit inflation rate with the exception of four recent years (2008, 2009, 2011 and 2012) when it experienced moderate double digit inflation rate. In 2012 the inflation rate in Tanzania (16%) was higher than the SSA average (6.45%) and higher than the world average (3.69%). This moderate double digit inflation has

been mainly caused by high world oil prices and high food prices. Sometimes local droughts that also affect neighboring countries have also contributed to high food prices.

In recent years the government deficit (including grants) has been low and sustainable however in the past year or so it has started to rise. In 2012, the government cash deficit was 7.2% of GDP and the budget deficit was 6.1% of GDP in 2012/13 (World Bank data; MoFEA, 2014). Foreign aid grants and foreign aid loans finance a significant part of government spending; 10.8% and 5.3% respectively in 2012/13. The country has a slightly low percentage of tax revenue to GDP (16.1% in 2012). Foreign non-concessional borrowing has started to rise and in 2012/13 it was 8.4% of government spending (BOT and World Bank data).

Tanzania has a moderately large current account deficit (12.88% of GDP in 2012) mainly due to high world oil prices and high oil imports as well as high capital goods imports. However, huge inflows of foreign aid (both current and capital transfers) and FDI greatly improve the overall balance of payments position. Tanzania's external debt position has greatly improved after it benefited from debt forgiveness under the Heavily Indebted Poor Country (HIPC) initiative and the Multilateral Debt Relief Initiative (MDRI). In 2012 the external debt stock was sustainable (41.4% of GNI) and the total debt service was low (1.9% of exports and primary income). However, recently the external debt has started to rise due to increased foreign borrowing by the government so as to fund government projects.

The recent global financial crisis slightly affected the Tanzanian economy by slightly reducing tourism revenues, exports and inward FDI (BOT, 2011a); real GDP growth declined from 7.17% per annum in 2008 to 5.85% in 2009. The national economy was slightly affected due to limited exposure of local banks to global financial institutions and diversified trade patterns which include unaffected economies (Asia). In 2008, the real exchange rate appreciated by 17.75% thus reducing domestic competitiveness (the author's calculations from NBS, BOT, World Bank and IMF statistics).

Governance, Corruption and Government Efficiency- Tanzania is a moderately corrupt country it has a score of 33 (in 2013) and ranks 111 out of 175 in Transparency International's Corruption Perception Index (CPI). Tanzania ranks 21 out of 48 among Sub-Saharan African countries, its score of 33 is equal to the average score of Sub-Saharan African countries (33) but below the world's average score of 43 (Transparency International, 2013).

The National Anti-Corruption survey shows that public officials are the leading perpetrators of corruption in the country (PCCB, 2009). Corruption reduces private appropriability of returns to investment and thus discourages private investment. Corruption involves tax officials, law enforcement agencies and local government officials. According to the national anti-corruption survey 49.7% of enterprises have encountered corruption in the country (PCCB, 2009).

However, The National Anti-Corruption survey shows that corruption has declined in recent years (PCCB, 2009). Mismanagement of public funds has declined due to increasing auditing by the office of Controller and Auditor General (CAG) (NAO, various years). In addition, the introduction of multi-party democracy in 1995 has increased political competition between the ruling party and the opposition parties. The opposition has managed to win a significant number of parliamentary seats and has managed to run the some local governments. This has improved political accountability in the country.

The World Bank's Country Policy and Institutional Assessment (CPIA) shows that in 2012 Tanzania fared well compared to Sub-Saharan Africa and world averages in governance indicators such as transparency, accountability and corruption in the public sector, quality of public administration and equity of public resource use. But it is rated slightly lower in the quality of budgetary and financial management (see table 2.3).

Table 2.3: Tanzania governance indicators

2012	Tanzania	Sub-Saharan Africa	World
Transparency, accountability, and corruption in the public sector rating	3	2.71	2.91
Quality of public administration rating	3	2.83	2.94
Quality of budgetary and financial management rating	3	3.04	3.23
Equity of public resource use rating	4	3.28	3.45

Source: World Bank data.

Barriers to and Costs of Doing Business- In 2012, Tanzania's ease of doing business index (136) was below the world average (95) but above sub-Saharan Africa's average (142.4) (see table 2.4). Tanzania had a better business regulatory environment rating (3.5) compared to Sub-Saharan Africa average (3.05) and the world average (3.17). The cost of business start-up procedures (% of GNI per capita) was lower in Tanzania (31.8%) compared to the Sub-Saharan Africa average (73.01%) and the world average (33.9%). It took fewer days to start a business in Tanzania (26 days) compared to the Sub-Saharan Africa average (33.96 days) and the world average (29.58 days). However Tanzania's burden of customs procedure rating (3.4) was below that of Sub-Saharan Africa (3.78) and that of the world (4.09).

In 2014, Tanzania's overall economic freedom score was 57.8 (106 out of 178 countries) and it was above Sub-Saharan Africa's average score (54.6) but below the world's average score (60.3). However, Tanzania's business freedom score (a sub component of the overall economic freedom score) was 47 (159 out of 178 countries) which was below Sub-Saharan Africa's average score (51.8) and also below the world's average score (64.9) (Heritage foundation, 2014).

The leading obstacles of doing business in Tanzania include (in descending order) access to finance (with a weight of 24.2%), corruption (16.9%), inadequate supply of infrastructure (11.5%), inefficient government bureaucracy (10.2%), inflation (7.6%), tax rates (5.6%), inadequately educated workforce (5.2%) etc. (Executive Opinion Survey of the World Economic Forum, Schwab and Sala-i-Martín, 2013).

Many businesses are informal and trade based. Those who start these businesses are those who are able to avoid the binding constraints of low savings. Also since many businesses are informal this means that the costs of business formalization are high for these households. This means that the Property and Business Formalization Program (MKURABITA) has had some successes but it has a long way to go in lowering barriers and costs of doing business in Tanzania.

Table 2.4: Tanzania cost of doing business indicators

2012	Tanzania	Sub-Saharan Africa	World
Ease of doing business index	136	142.4	95
Business regulatory environment rating	3.5	3.05	3.17
Cost of business start-up procedures (% of GNI per capita)	31.8%	73.01%	33.9%
Time required to start a business (days)	26	33.96	29.58
Burden of customs procedure rating	3.4	3.78	4.09

Source: World Bank data.

Market Failures- The introduction of economic reforms have liberalized the economy and has abolished state dominance in many areas ranging from the production of manufacturing goods to the buying of cash crops. But liberalization has also been accompanied by some problems i.e. in the agriculture sector private cash crop buyers sometimes behave in a monopolistic fashion and underpay the cash crop farmers. These market failures reduce private appropriability (the net return on private investment) in the cash crop sectors and discourage rural investment in general.

In order to solve this problem the government has recently introduced the warehouse receipt system. This system together with farmer based cooperatives has reduced market failures, coordination failures, transaction costs and improved price discovery in the cash crop sectors and thus improving private appropriability in these sectors. There has also been some contract farming which has also reduced market failures in those sectors.

The non-farm sector in urban Tanzania generally does not face significant market failures due to the presence of good roads and local markets which foster competition, improves market coordination, self-discovery and reduce transaction costs. However in some rural areas the non-farm sector does face some market failures due to high transaction costs caused by the absence of good roads and thin markets. However, the recent road construction projects in the country will improve transportation and thus reduce transaction costs.

Tanzania had a score of 3.5 in the Global Competitiveness Index (2013-2014) and ranked 125 out of 148. The score for goods market efficiency was 3.89 and it ranked 118 out of 148, that of labour market efficiency was 4.49 and she ranked 49 out of 148. The score of agriculture policy costs was 3.7 and it ranked 84 out of 148 (Schwab and Sala-i-Martín, 2013).

2.4.5 Conclusion

In conclusion the above growth diagnostic exercise shows that low domestic savings is the binding constraint on economic growth in Tanzania. The above analysis shows that although there are other constraints these constraints are not as important as low domestic savings. One way of relaxing the low domestic savings constraint and increase investment is by encouraging foreign aid to Tanzania. Foreign aid is expected to relax the savings constraint in Tanzania and thus boost investment and economic growth.

2.5 Theoretical framework

The theoretical relationship between aid and growth was initially based on the Two-Gap Model of Chenery and Strout (1966). The two gap model argued that developing economies had inadequate savings (savings gap) and foreign exchange (foreign exchange gap) thus they had low levels of investment and growth. Thus foreign aid would increase savings and foreign exchange and thus boost investment and growth.

The two gap model relied on the Harrod-Domar growth model. The Harrod-Domar growth model assumes that increasing savings will increase investment and growth. In the Chenery and Strout (1966) model foreign exchange earnings are needed so as to import the required capital goods to use in investment and growth.

Critics point that since the two-gap model relies on the Harrod-Domar growth model it unrealistically assumes there is a constant capital-output ratio, factors of production are imperfect substitutes, there is a linear relationship between capital and output, growth is mainly dependent on capital accumulation, aid affects growth only through investment and all aid is spent on investment (aid is not fungible). Critics also point that aid can be endogenous i.e. its impact can depend on host country institutions and policies, and aid can have a non-linear impact on growth (Easterly, 1999; Hansen and Tarp, 2000). Later on Bacha

(1990) added a third constraint of the fiscal gap (in addition to the savings and foreign exchange constraints). Thus foreign aid would also augment government revenues and thus increase government (investment) spending and growth.

The gap models can also be viewed in the context of the neo-classical growth model. This will remove criticisms that are based on the Harrod-Domar growth model such as a constant capital-output ratio and imperfect substitution of factors of production.

The theoretical model of foreign aid and economic growth used in this chapter is based on the Ramsey growth model which is also known as the Ramsey-Cass-Koopmans model (Ramsey, 1928; Cass, 1965; Koopmans, 1965; Acemoglu, 2009, chapter 8). The Ramsey growth model is adopted to include foreign aid (Obstfeld, 1999), exports and imports. Time arguments (t) have been omitted for convenience.

Households have the following utility function:

$$U = \int_0^{\infty} \frac{c^{1-\theta}}{1-\theta}\, e^{-(\beta-n)t} dt \qquad (1)$$

whereby c is consumption per capita, θ is intertemporal elasticity of substitution, β is the subjective rate of time preference and n is the rate of population growth.

The economy's production function is:

$$y = Zk^{\alpha} \qquad (2)$$

whereby y is output per capita, k is capital per capita, Z is productivity which can be affected by institutions and policies, and α-output elasticity of capital.

Investment is represented by:

$$\dot{k} = y - c - (\delta + n)k + a + (x - m) \qquad (3)$$

whereby n is population growth rate, δ is the depreciation rate of capital, a is foreign aid per capita, x is exports per capita and m is imports is imports per capita. (x-m) can be seen as foreign savings per capita.

The social planner's problem is:

$$\text{Maximize } U = \int_0^{\infty} \frac{c^{1-\theta}}{1-\theta}\, e^{-(\beta-n)t} dt \qquad (4)$$

Subject to:

$$\dot{k} = y - c - (\delta + n)k + a + (x - m) \qquad (5)$$

With $c(0) = c_0$, $k(0) = k_0$, $y = Zk^{\alpha}$ and $c \leq Zk^{\alpha}$.

The social planner has the following Hamiltonian:

$$H = \frac{c^{1-\theta}}{1-\theta} e^{-(\beta-n)t}dt + \lambda [Zk^{\alpha} - c - (\delta + n)k + a + (x - m)]$$

The first order conditions are:

$$\frac{\partial H}{\partial c} = u'(c) - \lambda = 0 \qquad (6)$$

$$\frac{\partial H}{\partial k} = -\dot{\lambda} + (\beta - n)\lambda = \lambda(f'(k) - \delta - n) \qquad (7)$$

The transversality condition is:

$$\lim_{t\to\infty}[e^{-(\beta-n)t}\lambda(t)a(t)] = 0$$

The equilibrium conditions are:

$$\frac{\dot{c}}{c} = \frac{1}{\theta}[\alpha Z k^{\alpha-1} - \delta - \beta] \qquad (8)$$

And

$$\dot{k} = [Zk^{\alpha-1} - (\delta + n)]k - c + a + (x - m) \quad (9)$$

The steady state values are:

$$\bar{c} = \left(\frac{\alpha Z}{\delta+\beta}\right)^{\frac{1}{1-\alpha}}\left[\left(\frac{\alpha}{\delta+\beta}\right)^{\frac{\alpha-1}{1-\alpha}} - (\delta + n)\right] + a + (x - m) \qquad (10)$$

$$\bar{k} = \left(\frac{\alpha Z}{\delta+\beta}\right)^{\frac{1}{1-\alpha}} \qquad (11)$$

$$\bar{y} = Z^{\frac{1}{1-\alpha}}\left(\frac{\alpha}{\delta+\beta}\right)^{\frac{\alpha}{1-\alpha}} \qquad (12)$$

From the above we can see that at the steady state foreign aid only increases consumption per capita; it does not affect steady state capital per capita. However, for economies which have not reached their steady state level foreign aid increases capital per capita and output per

capita (Obstfeld, 1999). For equations showing transitional dynamics see Obstfeld (1999) and Xayavong et al. (2005).

Thus in the neoclassical model with consumers who maximize intertemporal utility, increasing foreign aid will increase capital per capita and output per capita for economies that have not reached their steady state levels. For a more complicated model which includes the government sector and international capital markets see Chatterjee and Turnovsky (2005). For a model which allows aid to improve long run productivity and thus improve long run GDP per capita see Dalgaard et al. (2004).

2.6 Econometric Model

This section presents the Vector Error Correction Model (VECM) that is used to analyse the impact of foreign aid on economic growth. The selected variables come from the above theoretical framework (Chenery and Strout, 1966; Obstfeld, 1999). The Vector Error Correction methodology was first introduced by Johansen (1988, 1991 and 1996). In this section the following VECM is used:

$$\Delta X_t = \pi X_{t-1} + \sum_{i=1}^{q-1} \gamma_i \Delta X_{t-i} + \Theta Z_t + \epsilon_t \quad (1)$$

X is a vector containing ln national real GDP per capita, ln foreign aid (percentage of GDP), ln Gross Fixed Capital Formation (not financed by aid) (percentage of GDP) and ln exports (percentage of GDP). Z is a vector containing year dummies and a constant. ε_t is the error term. The time period of analysis is from 1961 to 2012.

The VECM is a model of two or more non-stationary time series that estimates the long run relationship between variables and the short run adjustment when there is disequilibrium (Johansen, 1996). It assumes that all variables are endogenous. Cointegration occurs when a linear combination of two or more non-stationary variables has a lower order of integration (Johansen, 1996). I.e. if the two or more non-stationary variables are integrated of order 1 (that is their first difference is stationary), then there is cointegration when there is a linear combination of the variables that is stationary.

Assuming there is 1 cointegrating vector; equation 1 can also be presented as follows:

$$\begin{bmatrix}\Delta X_{1t}\\ \Delta X_{2t}\\ \Delta X_{3t}\\ \Delta X_{4t}\end{bmatrix} = \begin{bmatrix}\alpha_1\\ \alpha_2\\ \alpha_3\\ \alpha_4\end{bmatrix}\begin{bmatrix}\beta_1\\ \beta_2\\ \beta_3\\ \beta_4\end{bmatrix}' \begin{bmatrix}X_{1t-1}\\ X_{2t-1}\\ X_{3t-1}\\ X_{4t-1}\end{bmatrix} + \sum_{i=1}^{q-1}\gamma_i \Delta X_{t-i} + \Theta Z_t + \begin{bmatrix}\epsilon_{1t}\\ \epsilon_{2t}\\ \epsilon_{3t}\\ \epsilon_{4t}\end{bmatrix} \quad (2)$$

Whereby X_1 is ln national real GDP per capita, X_2 is ln foreign aid (percentage of GDP), X_3 is ln Gross Fixed Capital Formation (not financed by aid) (percentage of GDP) and X_4 is ln exports (percentage of GDP). $\pi=\alpha\beta'$and the αs are the corresponding short run adjustment coefficients and the βs are the corresponding long run cointegrating coefficients. If there is disequilibrium the αs are the adjustment coefficients that take the variables back to equilibrium. The βs show the long run relationship between cointegrating variables when there is equilibrium (Johansen, 1996).

If the VECM has i lags, this means that the underlying Vector autoregressive (VAR) model has i+1 lags. Before running the model I will test for unit roots, for number of lags and for the presence of cointegrating vectors. After running the model I will test for stability of the VECM, stationarity of the cointegrating equation and for autocorrelation in the residuals. I will also test whether foreign aid is exogenous and also if it is not needed in the long run cointegrating relationship as sometimes it is customary to do this (Juselius et al., 2011). α_2 is the short run adjustment coefficient for foreign aid. If $\alpha_2=0$ then foreign aid is exogenous in the long run. If there is 1 lag in the VECM then this also means that foreign aid is also exogenous in the short run (Juselius et al., 2011). So if we cannot reject the null hypothesis H_0: $\alpha_2=0$ then this means we cannot reject the hypothesis that foreign aid is exogenous. β_2 is the long run coefficient for foreign aid. If $\beta_2=0$ then foreign aid can be excluded from the long run cointegrating relationship. If we reject the null hypothesis H_0: $\beta_2=0$ then we cannot exclude foreign aid from the cointegrating relationship (Juselius et al., 2011).

2.7 Data

The following data and data sources have been used for the analysis: Data for national GDP per capita was obtained from the Central Bank of Tanzania (BOT) as well as the National Bureau of Statistics (NBS). Macroeconomic variables such as GDP are estimated according to international statistical standards. Real GDP per capita data is in constant 2001 Tanzanian shillings.

Data on foreign aid, Gross fixed capital formation and exports was obtained from the International Monetary Fund and the World Bank (World Development Indicators). Foreign aid is equivalent to Overseas Development Assistance (ODA). Non-aid gross fixed capital formation was calculated from gross fixed capital formation using the methodology of residual generated regressors of Gomanee et al. (2005). Non-aid gross fixed capital formation is the proportion of gross fixed capital formation that is not financed by foreign aid. The descriptive statistics of the variables used in the Vector Error Correction Model are in Appendix A (see tables A7, A8, A9 and A10).

2.8 Results and discussion

This section presents and discusses the results of the econometric model of the impact of foreign aid on economic growth. The results of the Beta coefficients of the estimated VECM are presented in Table 2.5. The dependent variable is Ln real GDP per Capita. The results show that foreign aid (ODA) has a positive and significant impact on real GDP per capita. Foreign aid injects economic resources into the economy; it increases government revenue, investment, foreign exchange reserves, creates jobs, provides technology and thus increases real GDP per capita (Chenery and Syrquin, 1975; Bacha, 1990; Sachs, 2005). Hence this result is consistent with economic theory.

This result is in line with that of M'Amanja et al. (2005) who found that aid (in the form of grants) has a positive effect on long run growth in Kenya. It is also in line with the results of cross sectional studies such as Hansen and Tarp (2001) who found that in general aid is beneficial for growth. Mwase and Ndulu (2008) argue that foreign aid has played a positive role in Tanzania and that it has boosted economic growth. Nord et al. (2009) also argue that aid has been effective in Tanzania especially after post 1996 economic reforms where by it has had a high impact on economic growth.

The results also show that GFCF that is not financed by aid has a positive and statistically significant impact on real GDP per capita. Capital accumulation (investment) increases the country's capacity to produce goods and services and thus increases output and growth. In the neoclassical model an increase in investment increases per capita output and growth for economies that are below their steady state levels (Obstfeld, 1999). Hence this result is consistent with economic theory.

The results show that the estimated coefficient of gross fixed capital formation that is not financed by aid is larger than that of foreign aid. This means that a one unit increase in gross fixed capital formation that is not financed by aid has a larger impact on GDP per capita than a one unit increase in foreign aid. Gomanee et al. (2005) also found that foreign aid and investment that is not financed by aid increases economic growth although they used pooled data of different countries and different control (independent) variables and they used growth rate (instead of per capita GDP) as their dependent variable. Juselius et al. (2011) found that aid boosted investment in Tanzania although it had an insignificant impact on economic growth. However their analysis differed from this study as they did not look at non-aid financed investment, and they used shorter time series and different control variables.

The results show that exports have a positive and significant impact on real GDP per capita. Exports bring in income and foreign exchange into the economy, they encourage innovation, increase the employment of resources (land, labour and capital), increase productivity and efficiency and thus increase real GDP per capita (Feder, 1983; Grossman and Helpman, 1991; Thirlwall, 2011). This result is consistent with that of Bwire et al. (2013) who in their study on the Ugandan economy found that exports (together with aid and public spending) improved growth in private per capita consumption which they used as a proxy for economic growth.

Table 2.5: Results of VECM long run (Beta) coefficients

Variable	Coefficients
Ln Foreign aid (% of GDP)	0.0723427*** (2.63)
Ln GFCF (not financed by aid) (% of GDP)	0.388444*** (9.38)
Ln Exports (% of GDP)	0.1052537** (2.55)
Constant	10.90195
***P<0.01, ** p< 0.05 and *P<0.1. The dependent variable is Ln Real GDP per Capita. Z statistics in brackets.	

Source: The author's calculations.

The results of the alpha coefficients of the estimated VECM are presented in Table 2.6. The alpha coefficients show how a variable adjusts to its equilibrium path. A negative sign means that the variable adjusts towards its equilibrium and a positive sign means that a variable adjusts away from its equilibrium. The larger the alpha coefficient the faster the variable adjusts relative to its equilibrium path.

The results show that the alpha coefficients of gross fixed capital formation that is not financed by aid and exports (% of GDP) are positive and statistically significant. The other alpha coefficients are not statistically significant. Thus gross fixed capital formation that is not financed by aid and exports (% of GDP) move away from their equilibrium. This means that they keep on increasing.

The results of the short run equation for growth in real GDP per capita (equation 1) show that the dummy variable for the year 1966 is positive and statistically significant. This reflects the sharp economic boom that happened in 1966. This sharp economic boom might partly be explained by the fact that during that year Tanzania had a sharp growth in exports (% of GDP) of 9.1% (The author's calculations from World Bank data) that was mainly caused by higher volume of coffee and cotton exports (URT, 1973) and improved export prices of agricultural cash crops of African countries (especially coffee) (FAO, 1967) and to a lesser extent by improved weather in Tanzania compared to the previous year. The tonnage of Tanzanian coffee exports increased sharply by 79.4% while that of cotton exports rose by

53.4% (the author's calculations from Table E of Economic Survey, 1972-1973: URT, 1973). It should also be noted that Tanzania introduced its own currency in 1966 after the breakup of the East African Currency Board in 1965 (BOT, 2011b). Maybe this also partly contributed to the sharp boom.

The Dummy variable for the post war years (DPW) is negative and statistically significant. This shows that the war (with Uganda) negatively affected the short run growth rate of real GDP per capita. The war started from October 1978 to June 1979 (Acheson-Brown, 2001; Francis, 1994), but the negative short term effects of the war were sharply felt between 1981 and 1983. Note that Tanzanian forces remained in Uganda few years after the war. The war reduced short term growth of real GDP per capita because it diverted resources (foreign exchange, manpower) away from economic production towards military effort. The country spent around 500 million USD in the war effort. This increase in war related spending (defence, transport etc.) increased the budget deficit, it also increased the trade deficit as most of the war related equipment was imported (Gordon, 1984; Havnevik et al., 1988). The Dummy variable for post 1996 reform period (DP1996) is also positive and statistically significant. This shows that the deeper economic reforms that happened after 1996 had a positive effect on the short run growth rate of real GDP per capita (Utz, 2008; Mwase and Ndulu, 2008).

The results of the short run equation for growth in foreign aid (% of GDP) (equation 2) show that the dummy variable for the post 1996 reform period (DP1996) is negative and statistically significant. During these years there was a short run decline in the growth of foreign aid (% of GDP) due to a decline in the share of aid in GDP. This means that post 1996 economic reforms have made foreign aid to be more productive and a given unit of foreign aid produces more GDP.

The results of the short run equation for growth in Gross Fixed Capital Formation (not financed by aid) (% of GDP) (equation 3) show that the dummy variable for the years 1987 and 1988 (D1987-88) is negative and statistically significant. The years 1987 and 1988 were part of the early reform period that started in 1986 which was accompanied by a sharp devaluation of the exchange rate and an increase in the real effective exchange rate and a short-term improvement in competitiveness. In 1986, 1987 and 1988, the TZ Shilling US Dollar exchange rate was devalued by 62.67%, 67.56% and 43.51% respectively; the corresponding devaluation of the nominal effective exchange rate was 71.41%, 84.14% and

52.64% and that of the real effective exchange rate was 44.1%, 11.05% and 18.8% respectively (the author's calculations from BOT and IMF statistics).

The effects of these devaluations were especially felt in 1987 and 1988. During these two years there was a short run decline in the growth of Gross Fixed Capital Formation (not financed by aid) (% of GDP) due to a decline in the GDP share of overall investment. The growth of overall investment was positive but the share of investment in GDP declined. This means that the early phase of reforms made investment to be more productive in the short-run. The dummy variable for post 1996 reform period (DP1996) is negative and statistically significant. This shows that the post 1996 reform period was accompanied by a short run decline in the growth of Gross Fixed Capital Formation (not financed by aid) due to a decline in the GDP share of overall investment. One possible explanation is that investment productivity had improved during the post 1996 reform period (Mwase and Ndulu, 2008) and thus more output could be produced by a given unit of investment.

The results of the short run equation for growth of exports (% of GDP) (equation 4) shows that the dummy variable for the post war years (DPW) is negative and statistically significant. This shows that the war (with Uganda) caused a short run decline in the growth of exports (% of GDP). Exports declined as some resources (labour, foreign exchange etc) were diverted away from the production of export crops towards military effort. Coffee exports from Kagera region suffered as the region was a battle zone (Gordon, 1984; Avirgan and Honey, 1983). The war also reduced industrial production and industrial exports as there was little foreign exchange to buy intermediate inputs for industrial production (Gordon, 1984; Avirgan and Honey, 1983). It should be noted that exports as share of GDP were on a downward trend before the war but the war led to a new low.

Table 2.6: Results of VECM short run coefficients

Variable	Equation 1 DLn Real GDP per Capita	Equation 2 DLn Foreign aid (% of GDP)	Equation 3 DLn GFCF (not financed by aid) (% of GDP)	Equation 4 DLn Exports (% of GDP)
Constant	0.008815** (2.33)	0.0180982 (0.41)	-0.0070106 (-0.26)	-0.0067923 (-0.24)
D1966	0.1103198*** (5.69)	-0.2654945 (-1.17)	0.1410371 (1.01)	0.1013766 (0.69)
DPW	-0.0457199*** (-3.96)	-0.1540246 (-1.14)	-0.0875689 (-1.05)	-0.181675** (-2.07)
D1987-88	0.0141301 (1.01)	0.1365794 (0.83)	-0.3739147*** (-3.72)	0.0078602 (0.07)
DP1996	0.0261988*** (3.42)	-0.1658005* (-1.85)	-0.1636259*** (-2.97)	-0.0667578 (-1.14)
Alpha coefficient	-0.01691 (-0.45)	0.7230756 (1.64)	1.340285*** (4.94)	0.5213336* (1.81)
***P<0.01, ** p< 0.05 and *P<0.1. Z statistics in brackets.				

Source: Own calculations.

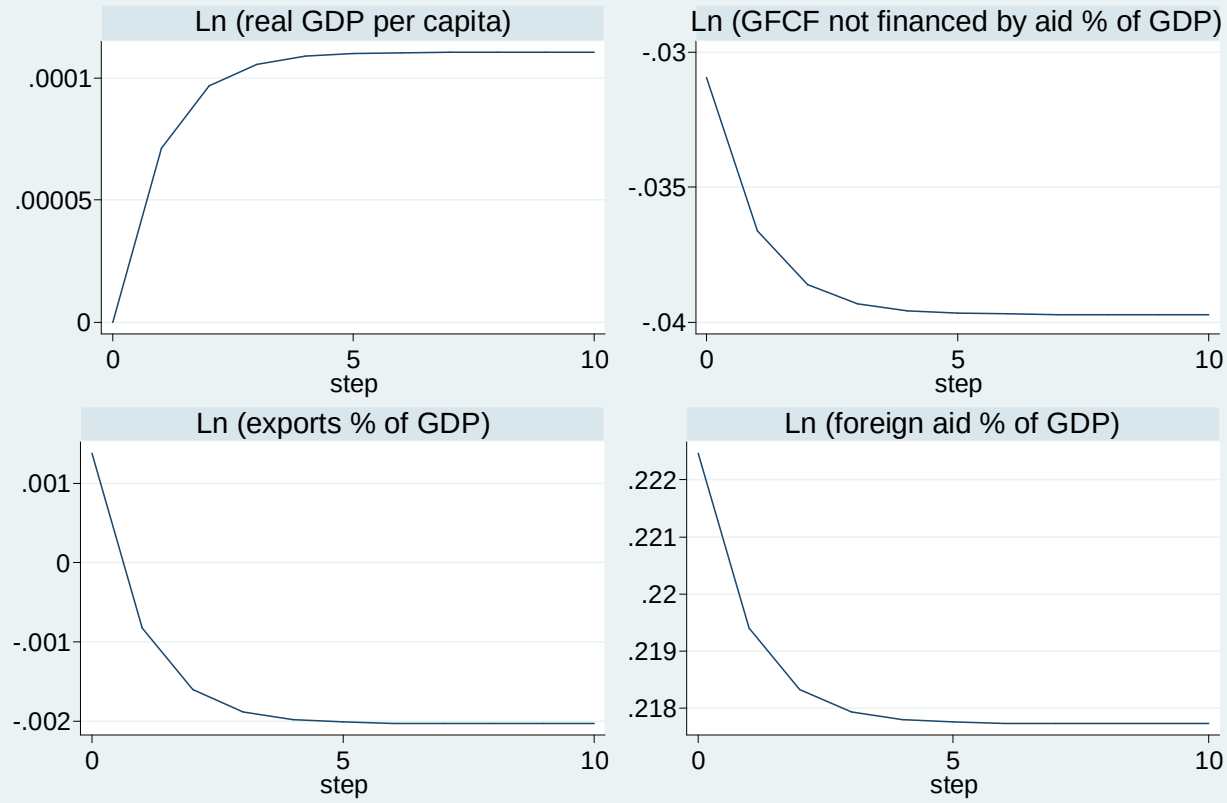
I use Stata to calculate and draw Orthogonalized Impulse Response Functions (that proceed from the above VECM) in order to analyse the impact of a shock on foreign aid on itself and on the other variables. Orthogonalized Impulse Response Functions show the impact of a one standard deviation shock on one variable on other variables and or on itself holding other factors constant (Sims, 1980; Lütkepohl, 2005, Chapter 2).

Orthogonalized Impulse Response Functions of aid (see figure 2.10) show that a one standard deviation shock that increases foreign aid increases real GDP per capita permanently. The foreign aid shock does not have any impact on real GDP per capita in the current period but after one year it increases per capita real GDP, this positive effect slightly increases and then it flats out after seven years above the long run equilibrium. A one standard deviation shock that increases foreign aid reduces gross fixed capital formation (that is not financed by aid) permanently. The negative impact starts in the current period and slightly increases until it flats out after nine years below the long run equilibrium. This means that foreign aid slightly crowds out investment that is not financed by foreign aid. Note that this means foreign aid

slightly reduces the share in GDP of investment that is not financed by foreign aid. It does not mean that the level or amount of investment that is not financed by foreign aid is reduced.

A one standard deviation shock that increases foreign aid decreases exports permanently. The foreign aid shock increases exports during the current period but after one year the impact becomes negative. This negative impact slightly increases and it flats out below the long run equilibrium after nine years. This means that an increase in foreign aid slightly decreases exports. Note that this reduces exports as a share of GDP and not the amount or volume of exports. A one standard deviation shock that increases foreign aid increases foreign aid permanently. The positive impact starts in the current period but it slightly declines and after nine years it flats out above the long run equilibrium.

Figure 2.10: Orthogonalized Impulse Response Functions of aid



Orthogonalised Impulse Response Functions of Ln (foreign aid % of GDP) on the respective variables

Source: The author's calculations.

I use Stata to calculate and draw Forecast error variance decompositions (FEVDs) (that proceed from the above VECM) in order to analyse the impact (explanatory power) of a

shock on foreign aid on its own forecast error variance and on the forecast error variance of other variables. Forecast error variance decompositions (FEVDs) show the impact (explanatory power) of a one standard deviation shock on one variable on the forecast error variance of other variables and or on its own forecast error variance holding other factors constant (Lütkepohl, 2005, Chapter 2).

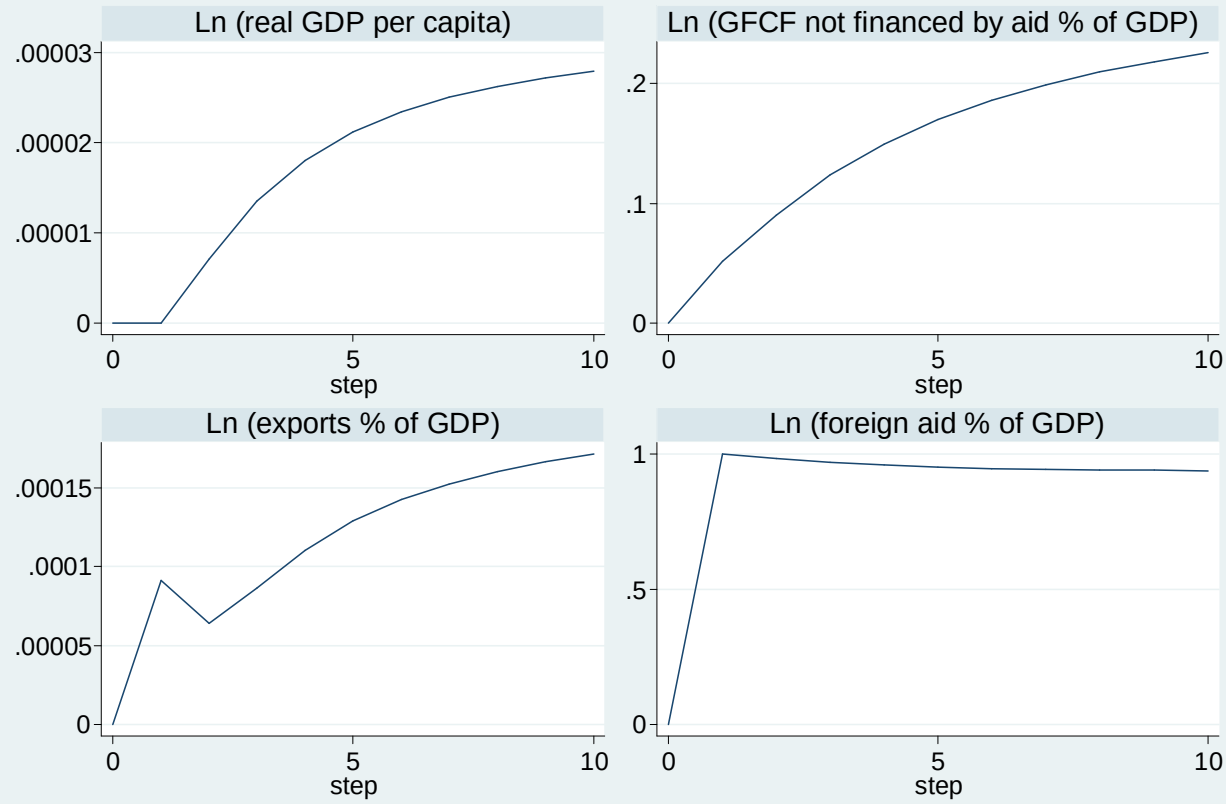
Forecast error variance decompositions (FEVDs) of aid (see figure 2.11) show that a one standard deviation shock that increases foreign aid explains a small proportion of the forecast error variance of real GDP per capita. The proportion explained starts from 0% in the current period and remains so in year one and then it slightly increases until it reaches a maximum of 0.0028% in year ten. This means that a shock on foreign aid explains a small proportion of random variations in real GDP per capita.

A shock that increases foreign aid explains a small but significant proportion of the forecast error variance of gross fixed capital formation (that is not financed by aid). The proportion explained starts from 0% in the current period and gradually increases until it reaches a maximum of 22.58% in year ten. Thus shocks on foreign aid play a small but significant part in the variation of gross fixed capital formation (that is not financed by aid).

A shock that increases foreign aid explains a very small proportion of the forecast error variance of exports. The proportion explained rises from zero in the current period to 0.0091% in the first year; it falls in the second year and then gradually rises to a maximum of 0.0171% in year ten. This means that shocks on foreign aid play a very small part in variations of exports.

A shock that increases foreign aid explains a very large proportion of the forecast error variance of foreign aid. The proportion explained rises from zero in the current period to a maximum of 99.99% in year one and gradually declines to 93.8% in year ten. This is normal as a shock on a variable is likely to explain a high proportion of its own variation.

Figure 2.11: Forecast Error Variance Decompositions (FEVDs) of aid

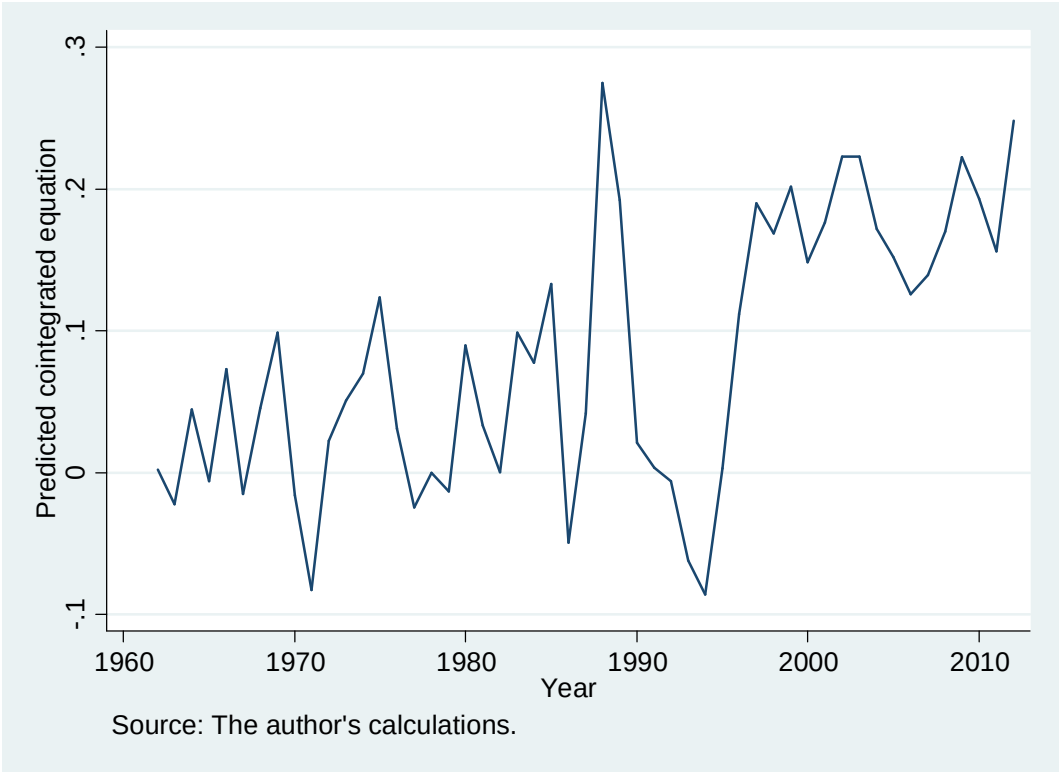


Forecast error variance decompositions of Ln (foreign aid % of GDP) on the respective variables

Source: The author's calculations.

The (in sample) predicted cointegrated equation (see figure 2.12) is stationary at the 5% level of significance (using the Augmented Dickey Fuller test).

Figure 2.12: The predicted cointegrated equation



Source: The author's calculations.

The results of the Wald test for the null hypothesis H_0: $\alpha_2=0$ are $\chi^2(1)=2.67$ and the p-value is 0.102; this means we cannot reject the null hypothesis that foreign aid is exogenous. The results of the LR test for the null hypothesis H_0: $\beta_2=0$ are $\chi^2(1)= 3.079$ and the p-value is 0.079; thus we reject the null hypothesis that foreign aid can be excluded from the cointegrating relationship. This means that foreign aid should be included in the cointegrating relationship. The results of the unit root tests, optimal lag tests, Johansen cointegration test and VECM diagnostic tests are in Appendix A.

2.9 Conclusion

This chapter analysed the impact of foreign aid on economic growth. It tested the hypothesis that foreign aid positively determines economic growth. The analysis using Vector Error Correction model (VECM) shows that foreign aid (ODA) has a positive impact on real GDP per capita. These results are in line with cross country studies like Collier and Dehn (2001) and Burnside and Dollar (2000) which found that aid is good for growth.

The results also show that gross fixed capital formation that is not financed by aid and exports have a positive impact on real GDP per capita. Foreign aid is found to boost exports in the current period although in the following years it slightly reduces exports. Note that this refers to exports as a share of GDP and not the amount or volume of exports. These results slightly reflect those of White and Wignaraja (1992) who found that foreign aid reduced exports in Sri Lanka. However, Nkusu (2004) has argued that if there are idle resources and if aid is invested wisely (i.e. in infrastructure), aid will not necessarily reduce exports and cause a Dutch disease.

The analysis shows that foreign aid slightly reduces gross fixed capital formation that is not financed by aid (% of GDP). This means that foreign aid slightly crowds out investment that is not financed by aid. Note that this refers to investment that is not financed by aid as a share of GDP and not the amount or level of such investment. War with Uganda reduced the short run growth of real GDP per capita and the growth of exports (% of GDP). While post 1996 economic reforms have improved the short run growth of real GDP per capita and have made investment and foreign aid to be more productive.

Due to lack of data it was not possible to analyze the impact of foreign aid on economic growth in the two regions of Kilimanjaro and Ruvuma. Future research in this area might consider the impact of foreign aid on economic growth in the agricultural sector (in countries where such data is available).

Thus foreign aid and also good investment climate and export oriented growth strategy is good for growth in Tanzania. This agrees with Tanzania development vision 2025 which aims to make Tanzania a middle income semi-industrialized country via foreign aid, good investment climate and export promotion. However Tanzania might need more time than 2025 to achieve the aim of vision 2025. It also might need more time than 2015 to achieve the Millennium Development Goals.

CHAPTER 3 : THE IMPACT OF ECONOMIC GROWTH ON POVERTY REDUCTION IN KILIMANJARO AND RUVUMA

3.1 Introduction

National Strategy for Growth and Reduction of Poverty (NSGRP I) has improved economic growth but growth has been accompanied by a marginal decline in poverty; between 2000/01 and 2007 the national poverty rate declined slightly from 36% to 34% (NBS, 2009; Mkenda et al., 2010). And between 2007 and 2011/12 it declined from 34% to 28% (NBS, 2014).

Regionally GDP growth has impacted on poverty differently in the two regions. GDP growth has been accompanied by a marginal increase in poverty in rural Kilimanjaro, while for rural Ruvuma GDP growth has been accompanied by a marginal reduction in poverty. This chapter tries to explain this puzzle and thus improve our insight on how to make growth more pro-poor.

Potential reasons why poverty has slightly increased in rural Kilimanjaro include the presence of drought and shortage of land which has limited household farm output and income. Rural Ruvuma has land availability especially in the low lands and good weather which has improved household farm output and income and led to the slight decrease in poverty. However the poverty rate of rural Ruvuma is still much higher than that of rural Kilimanjaro. In both regions economic diversification and improving agricultural productivity is the long term solution for sustainable poverty reduction.

For this chapter the research objective is to analyze why economic growth has interacted with poverty differently in Kilimanjaro and Ruvuma regions. The research question is: What factors make poverty reduction more responsive to economic growth? The chapter begins with a section on the livelihood trends in the two regions, then literature review, theoretical framework, econometric model, data, results and discussion, and finally the conclusion.

3.2 Livelihood trends

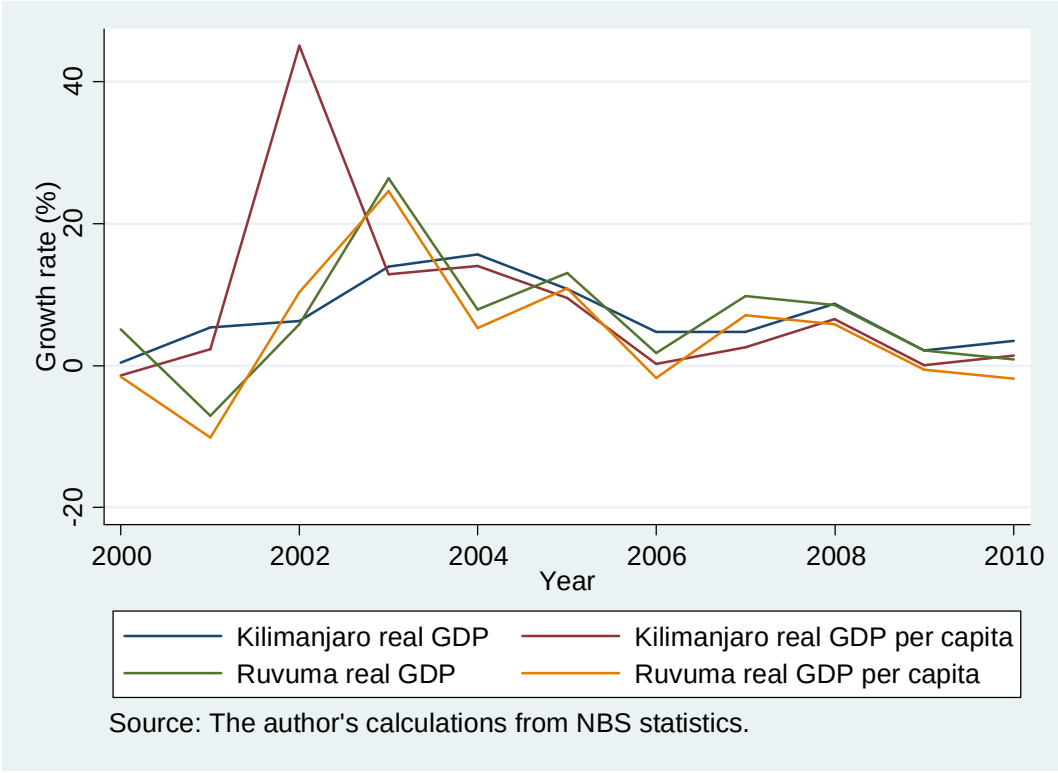
This section gives an overview of livelihood trends between the first and last round of the REPOA survey (2003 and 2009) in Kilimanjaro and (2004 and 2009) in Ruvuma. Livelihood trends enhance our knowledge of economic growth and poverty in the two regions and thus

help us to understand growth-poverty interaction in the two regions. It first begins with an overview of economic growth in the two regions, and then household members' main activity and sector of employment and finally poverty trends.

The author's calculations show that Kilimanjaro experienced high real GDP per capita growth rate of 12.9% in 2003 (first round of survey) and a low growth rate of 0.02% in 2009 (last round of the survey). Real GDP per capita growth between the two periods was generally high with the exception of 2006 and 2007 when it was low but still positive (see figure 3.1). The average annual growth rate between 2003 and 2009 was 6.5% (see table 3.1).

In Ruvuma the real GDP per capita growth rate was 5.3% in 2004 (first round of survey) and it was -0.6% in 2009 (last round of survey). Between the two periods real GDP per capita growth was positive and good with the exception of 2006 when it was negative (see figure 3.1). The average annual growth rate between 2004 and 2009 was 4.8% (see table 3.1).

Figure 3.1: Real GDP and Real GDP per capita growth rate in Kilimanjaro and Ruvuma



Source: The author's calculations from NBS statistics.

The above real GDP per capita calculations were obtained by using the national real GDP deflator as regional GDP deflators are unavailable. If the author uses survey price deflators the average annual growth rate for Kilimanjaro falls from 6.5% to 1.3% (2003-2009) and that of Ruvuma falls from 4.8% to -0.3% (2004-2009) (see table 3.1).

Thus for Kilimanjaro an average annual growth rate of 1.3% was accompanied by an increase in poverty from 26.3% to 31.8% between 2003 and 2009. While in Ruvuma an average annual growth rate of -0.3% was accompanied by a marginal reduction of poverty from 49.3% to 47.4% between 2004 and 2009. This greatly reduces the puzzle of the mismatch between economic growth and poverty reduction in the two regions.

Note that the average annual inflation (national GDP deflator) was 9.1% (2003-2009) and 8.9% (2004-2009). This was lower than the average annual inflation (survey price index) of 16.4% in Kilimanjaro (2003-2009) and 16.5% in Ruvuma (2004-2009). The average annual inflation (national consumer price index) was 9.4% (2003-2009) and 9.8% (2004-2009).

Table 3.1: Average annual real GDP per capita growth in the two regions (2003/4-2009)

	Kilimanjaro			**Ruvuma**		
	Nominal 2003	Real 2009 (GDP deflator)	Real 2009 (Survey deflator)	Nominal 2004	Real 2009 (GDP deflator)	Real 2009 (Survey deflator)
GDP per capita	377,778	524,822	408,216	460,501	571,324	452,494
Average annual growth		6.5%	1.3%		4.8%	-0.3%

Source: Own calculations from REPOA survey.

This section now looks at the main activity of household members, and their sector of employment in the first and last rounds in the two regions. The calculations from the REPOA rural survey show that in both regions the main activity of more than 50% of the people is self-employment in agriculture (see table 3.2). The most notable trend is the significant increase in the number and percentage of people who rely on regular wages in private sector (agricultural workers) in Ruvuma. Kilimanjaro has a higher number and percentage of people

relying on irregular wages than Ruvuma; this indicates that disguised unemployment is higher in Kilimanjaro than in Ruvuma.

In both regions there has been a significant increase in the number and percentage of household members (above 15 years old) who are students as a result of the government campaign of building community secondary schools for every ward in the country. Another observation is that the number and percentage of people too old is higher in Kilimanjaro than in Ruvuma. This indicates longer life expectancy and a higher old age dependency ratio in Kilimanjaro.

Table 3.2: The main activity of household members (above 15 years old) in the two regions

	Kilimanjaro				**Ruvuma**			
	2003		2009		2004		2009	
Main activity of the household member	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Regular wage earner in private sector	81	3	98	3	17	1	342	14
Regular wage earner in public sector	50	2	62	2	20	1	21	1
Irregular wage earner	98	3	110	3	10	0	8	0
Self employed	2,092	69	1,937	58	2,085	83	1,474	61
Unpaid family worker	9	0	7	0	0	0	5	0
Student	451	15	900	27	268	11	473	20
Looking for work	22	1	37	1	12	0	1	0
Not working and not looking for work	11	0	9	0	10	0	0	0
Household work	68	2	48	1	41	2	15	1
Retired, pensioner	4	0	2	0	0	0	0	0
Too old	97	3	105	3	32	1	35	1
Disabled	33	1	24	1	19	1	16	1
Other	6	0	25	1	2	0	9	0
Total	3022	100	3364	100	2516	100	2399	100

Source: Own calculations from REPOA survey.

The calculations from the REPOA survey also show that in both regions the sector of employment of the main activity for more than 75% of the people is agriculture. The percentage of people in rural Kilimanjaro working in the non-primary sector (industry and service) has slightly increased (by 0.3%), while that of Ruvuma has also slightly increased (by 0.7%). However in both periods a higher percentage of people in rural Kilimanjaro work in the non-primary sector; 11% in both 2003 and 2009, compared to 5% in both 2004 and 2009 in Ruvuma (see table 3.3).

Table 3.3: The sector of employment (of the main activity) of household members (above 15 years old)

	Kilimanjaro				**Ruvuma**			
	2003		2009		2004		2009	
Sector of employment	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Agriculture	1,937	83	1,821	80	1,992	93	1,712	90
Fishing	7	0	10	0	1	0	2	0
Livestock	43	2	35	2	6	0	5	0
Mining and quarrying	10	0	6	0	6	0	14	1
Other primary	79	3	140	6	25	1	71	4
Forestry	-	-	7	0	-	-	1	0
Manufacturing, production, crafts	57	2	46	2	12	1	15	1
Construction	35	1	43	2	11	1	6	0
Other industry	31	1	17	1	8	0	8	0
Wholesale, retail, shop	49	2	47	2	20	1	13	1
Restaurant, food preparation	19	1	24	1	19	1	12	1
Repair work	2	0	9	0	5	0	1	0
Transport, storage and communication	18	1	17	1	5	0	8	0
Banking, finance, real estate and business	1	0	1	0	0	0	1	0
Public service,	46	2	36	2	22	1	28	1

army, education, health								
Other service and government	0	0	18	1	0	0	12	1
Total	2334	100	2277	100	2132	100	1909	100

Source: Own calculations from REPOA survey.

This section now looks at poverty trends in the two regions. The author's calculations from REPOA survey show that in rural Kilimanjaro consumption poverty has increased while asset poverty has decreased (see tables 3.4 and 3.5). In rural Ruvuma consumption poverty has marginally declined and asset poverty has declined. In spite of this, rural Ruvuma is still much poorer than rural Kilimanjaro as far as consumption and asset poverty is concerned (see tables 3.4 and 3.5).

The increase in consumption poverty in Kilimanjaro is due to the increase in consumption poverty in the two districts of Rombo and Moshi rural. The marginal decrease in consumption poverty in Ruvuma is due to the decrease in consumption poverty in the two districts of Mbinga and Tunduru (see table 3.4).

Table 3.4: Consumption poverty rates in the two regions

Consumption Poverty					
Kilimanjaro			**Ruvuma**		
District	**2003**	**2009**	**District**	**2004**	**2009**
Rombo	36.3%	42.5%	Songea rural	44.2%	48.7%
Mwanga	38.3%	37.3%	Tunduru	67.4%	64.7%
Same	45%	43.4%	Mbinga	40.5%	35.9%
Moshi rural	18.4%	29.9%	Namtumbo	54%	56%
Hai	15.1%	13.4%			
Overall	26.3%	31.8%	Overall	49.3%	47.4%

Source: The author's calculations from REPOA survey.

The decrease in asset poverty in Kilimanjaro is due to the decrease in asset poverty in all districts. The decrease in asset poverty in Ruvuma is also due to the decrease in asset poverty in all districts (see table 3.5).

Table 3.5: Asset poverty rates in the two regions

Asset Poverty					
Kilimanjaro			**Ruvuma**		
District	**2003**	**2009**	**District**	**2004**	**2009**
Rombo	17.3%	10.9%	Songea rural	59.2%	51.4%
Mwanga	35.3%	4.9%	Tunduru	73.8%	69.7%
Same	50.6%	41%	Mbinga	50.8%	36.7%
Moshi rural	12.4%	7.1%	Namtumbo	76%	50.3%
Hai	11.6%	4.3%			
Overall	19.3%	11.5%	Overall	61.2%	48.6%

Source: Own calculations from REPOA survey.

The calculations show that Kilimanjaro had a higher percentage of non-poor households (59.6%) than Ruvuma (35.3%) while it had a lower percentage of chronic poor households (8.3%) compared to 23.9% in Ruvuma (see table 3.6). A household is chronic poor if it is poor both in the first (2003 in Kilimanjaro and 2004 in Ruvuma) and in the last round (2009 in both regions) of the survey. A household is non-poor if it is not poor in both rounds.

In Kilimanjaro, the percentage of households moving out of consumption poverty (12.3%) is lower than that moving into consumption poverty (19.7%). In Ruvuma the percentage of households moving out of consumption poverty (20.6%) is marginally higher than that moving into consumption poverty (20.2%) (see table 3.6). Thus in both regions consumption poverty is more transitory than chronic.

Table 3.6: Cross-tabulations of consumption poverty in 2003/2004 and consumption poverty in 2009 in the two regions

Consumption Poor 2003/2004	Consumption Poor 2009			
	Kilimanjaro		Ruvuma	
	No	Yes	No	Yes
No	59.6%	19.7%	35.3%	20.2%
Yes	12.3%	8.3%	20.6%	23.9%

Source: The author's calculations.

Within Kilimanjaro Hai had the highest percentage of non-poor households (75.9%) and the lowest percentage of chronic poor households (1.5%) (see table 3.7). Rombo had the lowest percentage of non-poor households (43.3%) and Same had the highest percentage of Chronic poor households (20.1%). Chronic consumption poverty is low among the districts of Kilimanjaro with the exception of Same.

In Ruvuma Mbinga had the highest percentage of non-poor households (43.4%) and the lowest percentage of chronic poor households (12.4%). Tunduru had the lowest percentage of non-poor households (16.8%) and the highest percentage of chronic poor households (42.3%) (see table 3.7). Chronic consumption poverty is prevalent among the districts of Ruvuma with the exception of Mbinga.

Table 3.7: Consumption poverty non-poor and chronic poor in the two regions

Non-poor and chronic poor - Consumption Poverty					
Kilimanjaro			**Ruvuma**		
District	**Non-poor**	**Chronic poor**	**District**	**Non-poor**	**Chronic poor**
Rombo	43.3%	12.4%	Songea rural	42.2%	23.2%
Mwanga	55.6%	16.5%	Tunduru	16.8%	42.3%
Same	46.8%	20.1%	Mbinga	43.4%	12.4%
Moshi rural	64.2%	5.1%	Namtumbo	33%	30.4%
Hai	75.9%	1.5%			
Overall	59.6%	8.3%	Overall	35.3%	23.9%

Source: The author's calculations.

The author's calculations show that Kilimanjaro had a higher percentage of non-asset poor households (78.4%) than Ruvuma (32.3%) while it had a lower percentage of chronic asset poor households (4.7%) compared to 34.8% in Ruvuma (see table 3.8).

In Kilimanjaro, the percentage of households moving out of asset poverty (11.7%) is higher than that moving into asset poverty (5.3%). In Ruvuma the percentage of households moving out of asset poverty (21.1%) is higher than that moving into asset poverty (11.7%) (see table 3.8). Thus in Kilimanjaro asset poverty is more transitory than chronic while in Ruvuma it is slightly more chronic than transitory.

Table 3.8: Cross-tabulations of asset poverty in 2003/2004 and asset poverty in 2009 in the two regions

Asset Poor 2003/2004	Asset Poor 2009			
	Kilimanjaro		Ruvuma	
	No	Yes	No	Yes
No	78.4%	5.3%	32.3%	11.7%
Yes	11.7%	4.7%	21.1%	34.8%

Source: The author's calculations.

Within Kilimanjaro Hai had the highest percentage of non-asset poor households (88.6%), while Mwanga had the lowest percentage of chronic asset poor households (1.7%). Same had the lowest percentage of non-asset poor households (35.3%) and the highest percentage of chronic asset poor households (22.9%) (see table 3.9). Chronic asset poverty is low among the districts of Kilimanjaro with the exception of Same.

In Ruvuma Mbinga had the highest percentage of non-asset poor households (42.9%) and the lowest percentage of chronic asset poor households (21.3%). Tunduru had the lowest percentage of non-asset poor households (15.4%) and the highest percentage of chronic asset poor households (56.8%) (see table 3.9). Chronic asset poverty is quite prevalent among the districts of Ruvuma with the exception of Mbinga (although Mbinga still has significant levels of chronic asset poverty).

Table 3.9: Asset poverty non-poor and chronic poor in the two regions

Non-poor and chronic poor - Asset Poverty					
Kilimanjaro			**Ruvuma**		
District	**Non-poor**	**Chronic poor**	**District**	**Non-poor**	**Chronic poor**
Rombo	81.4%	3.5%	Songea rural	36.3%	33.1%
Mwanga	70.2%	1.7%	Tunduru	15.4%	56.8%
Same	35.3%	22.9%	Mbinga	42.9%	21.3%
Moshi rural	85.2%	1.8%	Namtumbo	22.9%	42.5%
Hai	88.6%	2.1%			
Overall	78.4%	4.7%	Overall	32.3%	34.8%

Source: The author's calculations.

3.3 Literature review

This section reviews studies which analyze the relationship between growth and poverty. These studies can be grouped in two main groups namely multi country studies and single country studies. Multi country studies involve analyzing growth poverty relationships using econometric techniques for a group of countries. Such studies are usually cross sectional in nature. But these studies have been criticized for grouping together countries with different structures, policies and at different levels of development (Luebker et al., 2002; Lindauer and Pritchett, 2002). Different policies and structures among different countries can average each other out and lead to wrong conclusions (Luebker et al., 2002).

Such studies include Dollar and Kraay (2002) who applied econometric techniques on a group of 92 countries for a period of 40 years. They found that average incomes of the bottom 20% of the population (the poor) rises with average incomes and the share of income of the bottom 20% does not vary with income that is growth does not affect inequality. They thus concluded that growth is good for the poor as it increases their income and it does not affect inequality. Dollar and Kraay (2002) also found that reduction of inflation and size of government (government consumption) boost growth and increase the income share of the bottom 20% of society. They found that government spending on education and health does not help the poor, they reasoned that this is because the benefits of such spending went to the middle classes and the rich.

Luebker et al. (2002) has criticized Dollar and Kraay's (2002) study that it does not state the theoretical foundation of the regressions used and thus it is difficult to justify the inclusion of the variables as well as the direction of causality between the variables. Also according to Gore (2007), Dollar and Kraay's (2002) study failed to look at the impact of economic growth on non-income dimensions of poverty.

Single country studies have applied econometric techniques for the same country mainly using time series data and sometimes panel data. Single country studies aim at improving upon the criticisms of multi-country studies. Some single country studies do their analysis at the state or regional level (Datt and Ravallion, 2002). Other single country studies like Ravallion and Chen (2003) calculate the rate of pro-poor growth.

Datt and Ravallion (2002) did a study to investigate whether growth was pro-poor in India. Their study was done at the state level. Their data was for 40 years and covered 14 states of

India. They used regression analysis to estimate the impact on poverty of sectoral growth, human capital and other factors. They found that apart from aggregate economic growth, inequalities in human capital as well as geographical and sectoral composition of growth were important in influencing the impact of growth on poverty reduction in the different states of India.

Datt and Ravallion (2002) also found that non-agriculture growth was less pro-poor in states with initial low human capital, low agricultural productivity and low rural living standards (relative to urban areas). They concluded that although growth reduced poverty, geographical and sectoral imbalances dampened pro-poor growth. States with the largest concentration of the poor didn't experience faster growth than other states and sometimes the wrong pattern of sectoral growth occurred in the wrong state i.e. states were the bulk of the poor relied on agriculture experienced faster non-agricultural relative to agricultural growth.

Datt and Ravallion (2009) did another study on pro-poor growth in India; this time they used data of 50 years. They were investigating whether economic reforms have affected pro-poor growth. They found that there was no significant evidence that economic reforms have affected pro-poor growth although inequality has slightly increased in the post reform period. They also found that after economic reforms urban economic growth benefits significantly both rural and urban poor as opposed to their study in pre-reform era (Ravallion and Datt, 1996), whereby only rural growth benefited the rural and urban poor and urban growth benefited the urban poor only.

The three studies on India by Datt and Ravallion greatly improve upon the cross country studies like Dollar and Kraay (2002). However, they provide a vague definition of pro-poor growth as growth that is accompanied by poverty reduction. Lindauer and Pritchett (2002) have criticized growth regressions saying that the relationships might not be linear i.e. the impact on poverty of an increase in GDP growth rate from 1% to 10% will be different from that of an increase in GDP growth rate from 10% to 20%.

Bourguignon (2002) argues that the use of linear regressions to estimate growth elasticity of poverty is a model misspecification as it ignores the underlying non-linear identity between economic growth, inequality and speed of poverty reduction. In his study he used non-linear regression models and assumed that the distribution of income was log-normal. He found that non-linear regressions had a better fit than linear ones.

Bourguignon (2002) also found that growth elasticity of poverty is lowered by higher inequality and lower level of development. He argued that reducing inequality reduces poverty directly as well as increasing the rate of poverty reduction for a given percentage increase in economic growth. However there are limits to redistribution and thus in the long run growth is the main source of poverty reduction. His study however, groups together countries with different economic structures and policies and thus falls within the criticism of Luebker et al. (2002) and Lindauer and Pritchett (2002).

Klasen and Misselhorn (2008) accept Bourguignon's (2002) arguments that there is a non-linear relationship between economic growth, inequality and speed of poverty reduction as well as log-normality of the distribution of income. However they argue that the growth semi elasticity of poverty reduction (GSEP) is a better measure of sensitivity of economic growth to poverty reduction than the growth elasticity of poverty reduction (GEP). This is because for a given percentage change in GDP, analyzing the percentage point change in poverty (i.e. the magnitude of poverty reduction) will give us a better picture than analyzing the percentage change in poverty. In their cross country study of more than 100 countries, Klasen and Misselhorn (2008) found that the growth semi elasticity of poverty was determined by change in mean income, variation in inequality as well as interaction variables such as variation in inequality multiplied by initial inequality. The relationship was nonlinear and the nonlinear models had better statistical fit than the linear models.

Ravallion and Chen (2003) explicitly defined pro-poor growth as growth that improves the absolute welfare of the poor. They also provide a theoretical framework in the form of a Growth Incidence Curve. A Growth Incidence Curve (GIC) shows the average growth rate in income/expenditure for each percentile of the income/expenditure distribution between two periods of time. And the rate of pro-poor growth is equal to the mean growth rate for the income/expenditure of the poor. They argued that an economy can be more equal but there might not be an absolute gain in welfare by the poor. Thus a GIC as well as calculating the rate of pro-poor growth will show whether or not economic growth has improved the welfare of the poor. In their study Ravallion and Chen (2003) calculated the rate of pro-poor growth for China in the 1990s. They found that although inequality slightly increased poverty declined for all income percentiles and that the rate of pro-poor growth was 3.9%. This means that growth was pro-poor despite a slight increase in inequality.

Kakwani and Son (2006) criticise the method of Ravallion and Chen (2003) in that it violates the monotonicity axiom and it does not use the poverty rate of the final (second) period in its calculations. They also argue that the relative criterion of pro-poor growth is better than the weak absolute criterion that was used by Ravallion and Chen (2003). Klasen (2008) extended pro-poor analysis to include non-income dimensions of poverty. He argued that income poverty is only one dimension of poverty and that it is important to look at non-income dimensions of poverty like education and health to see if they have grown in a pro-poor manner. For non-income dimensions of poverty the poor are defined as those who lack that particular dimension i.e. the education poor are those with no education.

In his study of Bolivia, Klasen (2008) computed unconditional and conditional non-income GICs (NIGIC) for education, child vaccination, child survival and nutrition. An unconditional non-income Growth Incidence Curve (GIC) shows the average growth rate in the non-income variable for each percentile of the non-income variable distribution between two periods of time. While a conditional non-income GIC shows the average growth rate in the non-income variable for each percentile of the income distribution between two periods of time.

Klasen (2008) found that the poor and middle groups in the education distribution had benefited from education growth. Growth in child survival, child vaccination and nutrition was also pro-poor. Conditional NIGICs shows that child survival, child vaccination and nutrition were unrelated to the family's position on the income distribution. While the income poor benefited slightly more from education growth than the income rich. However in all cases the very income poor and the very non-income poor didn't benefit. Thus we can see that Klasen's pro-poor growth analysis in both income and non-income dimensions of poverty has given a better picture of poverty than only analyzing income pro-poor growth.

There are also a number of studies on growth and poverty from Tanzania. Mkenda et al. (2010) argue that although Tanzania experienced significant economic growth, poverty declined marginally and the number of poor people actually increased. Although inequality was roughly constant inequality among the poor increased. The main sectors that were driving growth (mining, construction and communications) contributed little in terms of employment as they employed less than 10% of the labour force. They concluded that the main reason that growth had little impact on poverty was that agriculture sector which employs 74% of the labour force grew slowly and at a rate that is less than average GDP.

Hoogeven and Ruhinduka (2009) argue that although income poverty marginally declined non-income poverty like ownership of assets, education, child and infant mortality declined appreciably. They argued that the main obstacles to pro-poor growth were low human capital (education, nutrition and health), under developed infrastructure (roads, electricity and ports) and institutions that discouraged households' incentives to increase production (bad regulation of the cash crop economy).

Atkinson and Lugo (2010) criticized the finding by Mkenda et al. (2010) that overall inequality did not change. They argue that although relative inequality as measured by the Gini coefficient did not change absolute inequality actually increased. They recommend amongst other things to use multiple deprivation indicators at the household level.

Hoogeveen and Ruhinduka (2009), Atkinson and Lugo (2010) and Mkenda et al. (2010) argue that real per capita food consumption in Tanzania was roughly stagnant (between 2000/1 and 2007) and there was a small increase in per capita food production and that food prices rose significantly. This implies that food inflation might be one of the reasons that growth was accompanied by marginal poverty reduction. Datt and Ravallion (1998) also argue that higher food prices increased absolute poverty in India.

Mpango (2008) did a descriptive analysis of spatial dimensions of growth and poverty in Tanzania. He argued that regional variations of growth depend on human capital, non-agriculture activities, historical reasons and government policy. However his study did not link growth and poverty together as he analysed them separately.

The relationship between growth and poverty can also be analyzed by looking at the determinants of the growth of household welfare variables like consumption or assets. By looking at the determinants of consumption (or asset) growth we can simultaneously analyze factors that boost growth and at the same time reduce poverty at the household level between two time periods. Dercon (2003) uses household panel data to analyse the determinants of consumption growth in 6 villages in Ethiopia between 1989 and 1997. He found that rainfall shocks affected consumption growth; better rainfall increased it while drought reduced it. Famine reduced consumption growth while access to roads increased it. Dercon (2003) also found that the effects of rainfall shocks and famine lingered on for many years.

Dercon et al. (2008) extended the rural Ethiopian data used in Dercon (2003) to include 15 villages and to cover the period between 1994 and 2004. Dercon et al. (2008) found that

access to agricultural extension services and all weather roads boosted household consumption growth and reduced poverty. They also found that output price shocks reduced consumption growth and increased poverty.

Building on earlier studies (Dercon, 2003; Dercon et al., 2008), Dercon et al. (2011) wanted to analyze why some households were chronically poor despite high economic growth. Using a 15 year panel data (1994-2009) from rural Ethiopia they found that low initial levels of education and assets as well as bad roads and being remote from towns was the source of chronic poverty and inability to benefit from growth. Dercon et al. (2011) also found that the chronic poor and the non-chronic poor equally benefit when accessing extension services and all weather roads.

Quisumbing and Baulch (2009) used household panel data to analyse (amongst other things) the determinants of asset growth in rural Bangladesh. The households in their study were grouped into three sites that were based on baseline policy interventions namely the agricultural technology, microfinance and educational transfer sites. They found that functionally landless households (those with less than half an acre) had lower (land) asset growth in the microfinance and educational transfer sites and also lower (non-land) asset growth in the agriculture and educational transfer sites. Households with more land and non-land assets at the baseline had lower land and non-land asset growth respectively. Quisumbing and Baulch (2009) also found that the number of years of education of the household head increase (non-land) asset growth in the agriculture technology site and illness shocks reduce (land) asset growth in the microfinance site. Their non-parametric analysis rejected the presence of multiple equilibria asset poverty traps.

The above literature review leads us to test the following research hypotheses: 1) growth of farm crop income, and growth of non-farm business income increases the consumption growth and asset growth of the poor; 2) growth of farm crop income has more impact on the consumption growth of the poor than growth of non-farm business income.

The original contribution of this chapter is: 1) it explains growth poverty puzzle using panel data; 2) it analyses determinants of consumption growth and asset growth of the poor; 3) it investigates the impact of various types of income growth (farm income vs business income etc.) on consumption and asset growth; 4) tests the existence of multiple equilibrium poverty traps in consumption and asset poverty; 5) analyses uninvestigated determinants of

consumption and asset growth i.e. infrastructure variables; 6) provides new ways of using Growth Incidence Curves (GIC) curves i.e. for assets, net food buyers vs net food sellers.

3.4 Theoretical framework

Pro-poor growth can be generally defined as economic growth that is beneficial to the poor (UN, 2000; OECD, 2001). The concept of pro-poor growth is important in understanding how growth has interacted with poverty in the two regions of Kilimanjaro and Ruvuma. The various definitions of pro-poor growth can be grouped into three categories; Strong absolute pro-poor growth, weak absolute pro-poor growth and relative pro-poor growth (Kakwani and Son, 2006; Klasen, 2008).

Strong absolute pro-poor growth occurs if the absolute increase in the income of the poor is greater than that of the non-poor. When this occurs not only the incomes of the poor have increased but also absolute inequality has declined. Proponents of this view argue that you can have a decline in relative inequality but absolute inequality can be increasing. And that absolute inequality is important in analyzing the sense of relative deprivation between the poor and non-poor (Amiel and Cowell, 1999; Klasen, 2004).

Weak absolute pro-poor growth occurs if the growth rate of the income of the poor is greater than zero. That is if the incomes of the poor have increased (Ravallion and Chen, 2003). Proponents of this view argue that what matters is the fact that the income of the poor have risen and that the poor are less poor than before. Changes in inequality don't matter much.

Relative pro-poor growth occurs if the income growth of the poor is greater than that of the non-poor. In this case inequality must decline. Proponents of this version argues that reducing inequality is important in its own right as poverty involves a sense of relative deprivation vis-à-vis the rest of society (Kakwani and Pernia, 2000; Klasen, 2008).

Economic growth has the ability to not only reduce poverty for the poor near the poverty line but also for the poor deep under the poverty line (Ravallion, 2004). Impact of growth on poverty depends on: a) Inequality, initial levels of human capital and income (Datt and Ravallion, 2002) b) Sectoral pattern and nature of growth (Mkenda et al, 2010; Wuyts, 2008) c) Institutional factors (Klasen, 2004; Klasen, 2007; Hoogeven and Ruhinduka, 2009) d)

Food inflation (Datt and Ravallion, 1998; Wuyts, 2008; Mkenda et al, 2010; Atkinson and Lugo, 2010).

Many growth theories usually focus more on the determinants of economic growth but they do not explicitly show the link between economic growth and poverty reduction. Heterodox growth theories are more useful in explaining growth poverty reduction linkages than orthodox growth theories (Gore, 2007). This is because heterodox growth theories usually explain the process of structural transformation as well as the movement of factors of production between sectors and any potential changes in factor incomes and inequality (Gore, 2007). Also many Heterodox growth theories have realistic assumptions that fit with real situations in many developing countries i.e. they assume that at least in the short run all the conditions of a perfect market do not hold.

On the other hand orthodox growth theories rely on the production function and explain the growth process usually assuming that many of the conditions of perfect markets hold (such as full employment etc.). Such assumptions are more relevant to developed economies than developing economies. Usually the main explanation on growth-poverty linkages that can be derived from orthodox growth theories is that growth increases per capita income this in turn reduces poverty assuming that inequality does not change.

Orthodox exogenous growth theory

Implications of the Solow model (Solow, 1956; 1957) on the growth-poverty relationship: In the Solow growth model increases in the savings rate and capital accumulation per worker will increase the level of per capita income and thus reduce the poverty rate assuming that growth does not affect income inequality. Increases in population growth rate and depreciation rate of capital will decrease the level of per capita income and thus increase the poverty rate assuming inequality does not change. However, in the long run, technological improvement is the only source of sustainable growth of per capita income and poverty reduction.

The Solow growth model implicitly assumes that inequality does not change because during the growth process; the factors (Labour and Capital) shares of income remain constant. These are determined by the coefficients of Capital and Labour in the Cobb-Douglas production function. Also inequality within labour and capital is constant as both capital and labour are

homogenous. A multi-sector version of the Solow model assumes that all sectors grow at the same rate and factor returns are equal among sectors. Thus different sectoral growth rates that accompany structural transformation are not explained by this model and this weakens the ability of the Solow model in explaining growth poverty relationships. Since the model assumes full employment, then individuals are poor if they voluntarily choose not to work or if their wages are below the poverty line (working poor) or if they have many dependents.

Orthodox endogenous growth theory

Implications of the Romer (1986) model on the growth-poverty relationship: In this model increases in the marginal product of knowledge, reduction in the discount rate, and reduction in the elasticity of inter-temporal substitution of consumption increases the growth rate of per capita income and thus increase the rate of poverty reduction assuming that growth doesn't affect income inequality. Increases in capital accumulation and the size of population as well as improvement in the level of technology will increase growth rate of per capita income and thus increase the rate of poverty reduction assuming inequality does not change.

In this model inequality between capital and labour during the growth process does not change as in the Solow growth model. Inequality within capital is constant as capital is homogenous. But we do not know whether inequality within labour is constant as labour is differentiated between workers who produce final output and workers who do research. But it is likely that if growth is generated by improved productivity in the research sector, research workers might benefit more than other workers, but such increase in inequality will not exclude the other workers from enjoying the benefits of growth.

Heterodox growth theory

Implications of the Neo Lewis-Fei-Ranis growth model (Rannis, 2003) on the growth-poverty relationship: The movement of surplus labour from agriculture to industry creates employment and generates wage income, and thus reduces income poverty. Income distribution can follow two paths: 1) Initially income distribution might worsen as the share of national output shifts from the more equal agricultural sector to the less equal industrial sector until a turning point is reached when income distribution becomes more equal; 2)

Income distribution might improve as the increase in employment in the industrial sector will increase overall employment this in turn will increase the share of wages in national income. Structural transformation in the form of urbanization also alleviates poverty since urban incomes are higher than rural incomes (Cour, 2003).

Institutions and the growth - poverty relationship

Societies with good institutions (good governance, rule of law) will be able to constrain the power of the elite (reduce corruption and elite capture) this will not only boost economic growth but it will also lead to a more equitable distribution of resources (less inequality) and thus reduce poverty. Also good institutions will create a good atmosphere for innovation and innovators will be able to enjoy the fruits of their work; this will enhance growth and reduce poverty (Acemoglu et al., 2001; Acemoglu et al., 2004).

Summary and synthesis

The implications of the above growth theories on poverty is via their explanation of employment growth, productivity growth, inequality, wages, household income, firm profits and structural change (Gore, 2007).

Economic growth affects poverty via affecting the livelihoods (assets and income generating activities) of various socio-economic groups in the economy (entrepreneurs, workers, farmers etc.). The livelihoods of these socio-economic groups are linked to economic sectors, spatial locations, production structures and institutions (Gore, 2007). For example economic growth will increase aggregate demand and this in turn will increase sectoral ouput of sectors whose products have high income elasticity of demand. The sectoral output growth will affect sectoral employment according to the labour intensity of production (Gore, 2007). Thus economic growth will be accompanied by poverty alleviation in sectors with high Income elasticity of demand (IED) and high labour intensity in the production process.

As the growth process continues the share in the national income of the sectors with high income elasticity of demand will grow while that of the sectors with low income elasticity of demand will decline. Under normal circumstances sectors with an increasing share of national income will have an increasing share of national employment. Spatially areas where

the sectors with increasing share of national income are located will have an increasing share of economic activity and probably lower poverty.

The theoretical model for economic growth and poverty reduction

The theoretical model comes from the Ramsey growth model (Ramsey, 1928; Cass, 1965; Koopmans, 1965; Acemoglu, 2009, chapter 8). The Ramsey model is adapted to a setting of agricultural households (Jalan and Ravallion, 2002). These farm households can consume what they produce (Singh et al., 1986). Factor and product markets are not perfectly competitive i.e. credit constraint might prevent perfect capital mobility among farm households and transaction costs might create market failures in product markets.

The farm household's production function is $y = Vk^{\alpha}$. Whereby y is output per capita, k is capital per capita (which includes land, physical capital and human capital) and V is other factors that affect farm output such as shocks (drought and illness), institutions and geographical location, and α-output elasticity of capital. The production function has constant returns to scale and faces diminishing returns to capital and labour. Time arguments (t) have been omitted for convenience.

The household's utility function is $U = \int_0^{\infty} \frac{1}{1-\theta} c^{1-\theta}\, e^{-(\beta-n)t} dt$. Where by c is consumption per capita, θ is intertemporal elasticity of substitution, β is the subjective rate of time preference and n is the rate of population growth.

The household optimization problem is:

$$\text{Maximize } U = \int_0^{\infty} \frac{1}{1-\theta} c^{1-\theta}\, e^{-(\beta-n)t} dt$$

Subject to:

$$\dot{a} = w + (r - n)a - c$$

Where by a is household assets per capita, ȧ is change in household assets per capita, w is the wage rate and r is the interest rate.

The household has the following Hamiltonian:

$$H = \frac{c^{1-\theta}}{1-\theta} e^{-(\beta-n)t} dt + \lambda [w + (r - n)a - c]$$

The first order conditions are:

$$\frac{\partial H}{\partial c} = u'(c) - \lambda = 0 \qquad (1)$$

$$\frac{\partial H}{\partial a} = \lambda(r - n) = -\dot{\lambda} + (\beta - n)\lambda \qquad (2)$$

The transversality condition is:

$$\lim_{t \to \infty} [e^{-(\beta-n)t} \lambda(t) a(t)] = 0$$

The first order conditions (1) and (2), give us the following Euler equation:

$$r = \beta - \left[\frac{u''(c)c}{u'(c)}\right] \frac{\dot{c}}{c} \qquad (3)$$

The firm's optimisation problem is:

$$\pi = F(K, L) - (r + \delta)K - wL$$

Whereby δ is the rate of depreciation of capital. Firms use the quantity of capital (K) and labour (L) that maximizes their profit (π).

The first order conditions are:

$$\frac{\partial \pi}{\partial K} = 0 \implies f'(k) = r + \delta \qquad (4)$$

$$\frac{\partial \pi}{\partial L} = 0 \implies f(k) - kf'(k) = w \qquad (5)$$

At equilibrium a=k, assets per capita equals capital per worker and so:

$$\dot{k} = f(k) - (n + \delta)k - c \qquad (6)$$

The general equilibrium is obtained by combining the household and the firm's optimization problems. We then get the following equation which is the optimal consumption growth rate:

$$\mathrm{dlnc} = \frac{1}{\theta}[V\alpha k^{\alpha-1} - \beta - \delta] \qquad (7)$$

Thus at equilibrium consumption growth is affected by V, k, θ, α, δ and β.

An increase in consumption growth will reduce poverty for the individual farm household. Thus factors that increase consumption growth will reduce poverty for the average farm household and thus make poverty reduction more responsive to economic growth. Transitional dynamics that affect household consumption growth such as farm crop income growth, non-farm business income growth, wage income growth and growth in household size can also be included in the above model (Dercon, 2003; Dercon et al., 2008). Economic growth that is accompanied by growth of farm crop income, non-farm business income or wage income at the household level will be accompanied by poverty reduction.

Some rural households are net food buyers while others are net food sellers. Thus an increase in the price of food might have different impacts on rural households. Food inflation or an increase in food prices will adversely affect households that are net food buyers especially if higher food prices are not counteracted by higher wage or business income. An increase in food prices might benefit households that are net food sellers if the wage and business income of such households do not fall. For more information on the effect of higher food prices on rural poverty see Ravallion (1990). Thus although economic growth (and more so agriculture GDP growth) is likely to reduce poverty in the rural areas of the two regions stagnation of household income is likely to make growth less pro-poor and food inflation might negatively affect net food buyers while benefiting net food sellers.

3.5 Econometric Model

This section presents the consumption and assets growth regressions for the two regions of Kilimanjaro and Ruvuma. The selected variables come from the above theoretical framework and the above literature review.

The consumption growth regression is represented by:

$$\ln C_{it} - \ln C_{it-1} = K + \ln C_{it-1} + \ln X_{it-1} + \Delta \ln V_i + SH_{it} + \varepsilon_{it}$$

Ln C_{it} is ln of real adult equivalent household consumption in the third round (year 2009), Ln C_{it-1} is ln of real adult equivalent household consumption in the first round; for Kilimanjaro it is year 2003 and for Ruvuma it is year 2004. X represents other independent variables in the first round (in period t-1) that affect consumption growth such as household size, access to tap water or education.

$\Delta \ln V_i = \ln V_{it} - \ln V_{it-1}$ and it represents the growth of some selected variables between period t-1 and period t. This includes growth of adult equivalent household size, growth of adult equivalent farm income and growth of adult equivalent wage income. SH_{it} represents shocks that affected household consumption growth like drought or major harvest losses. The time period of these shocks range from 5 years before the first round up to the third round. K is a constant and ε_{it} is a random error term.

The asset growth regression is represented by:

$$\ln A_{it} - \ln A_{it-1} = K + \ln A_{it-1} + \ln W_{it-1} + \Delta \ln V_i + SO_{it} + \varepsilon_{it}$$

Ln A_{it} is ln of real adult equivalent household asset value in the third round (year 2009), Ln A_{it-1} is ln of real adult equivalent household asset value in the first round; for Kilimanjaro it is year 2003 and for Ruvuma it is year 2004. W here represents other independent variables in the first round (in period t-1) that affect asset value growth such as household size, access to tap water or living in a village with tarmac or gravel road.

$\Delta \ln V_i = \ln V_{it} - \ln V_{it-1}$ and it represents the growth of some selected variables between period t and period t-1. This includes growth of adult equivalent household size, growth of adult equivalent farm income and growth of adult equivalent wage income. SO_{it} represents shocks that affected household asset growth like drought, death or illness. The time period of these shocks range from 5 years before the first round up to the third round. K is a constant and ε_{it} is a random error term.

3.6 Data

Data for the consumption and assets Growth Incidence Curves and growth regressions was obtained from the REPOA rural vulnerability household panel survey for Kilimanjaro and Ruvuma regions (see section 4.5 for more information about REPOA data).

The descriptive statistics of the variables used in the consumption and asset growth regressions are in Appendix B (see tables B1 and B2).

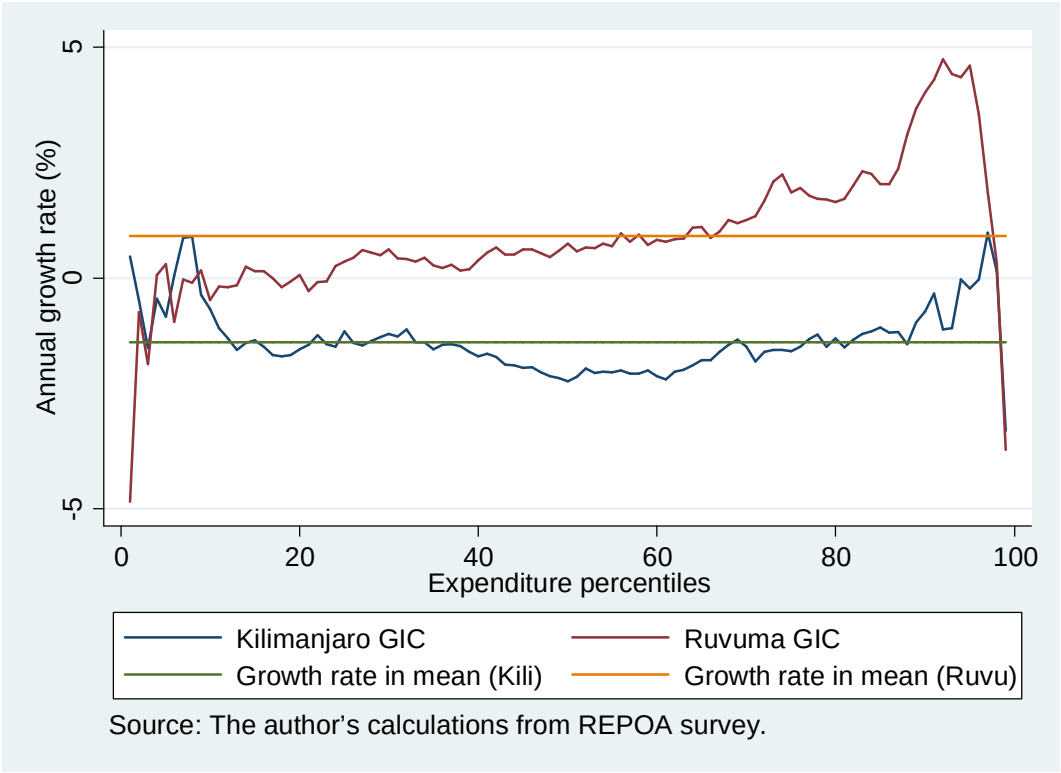
3.7 Results and discussions

This section presents and discusses the results of the consumption and non-consumption Growth Incidence Curves (GICs) and econometric models of the determinants of consumption growth and asset growth. The Growth Incidence Curves and the respective rates of pro-poor growth have been calculated and drawn in Stata using the Stata programme (gicurve) that has been written by Lokshin and Ravallion (2007).

Kilimanjaro GIC results for consumption (see figure 3.2) show that the rate of pro-poor growth for Kilimanjaro was -0.96%. Thus the consumption of the poor declined and hence growth was not pro-poor. The growth rate in mean expenditure of all percentiles is slightly lower than the rate of pro-poor growth. This implies that the consumption of the poor decreased by a slightly lesser amount than that of the non-poor. Overall consumption Gini inequality slightly increased from 0.321 to 0.322 (own calculations).

Ruvuma GIC results for consumption (see figure 3.2) show that the rate of pro-poor growth was 0.05%. Thus the consumption of the poor increased and hence growth was pro-poor in Ruvuma. The rate of pro-poor growth is lower than the growth rate in mean expenditure of all percentiles. This implies that the increase in the consumption of the poor was less than that of the non-poor. Overall consumption Gini inequality slightly increased from 0.34 to 0.347 (own calculations).

Figure 3.2: Kilimanjaro and Ruvuma consumption GIC

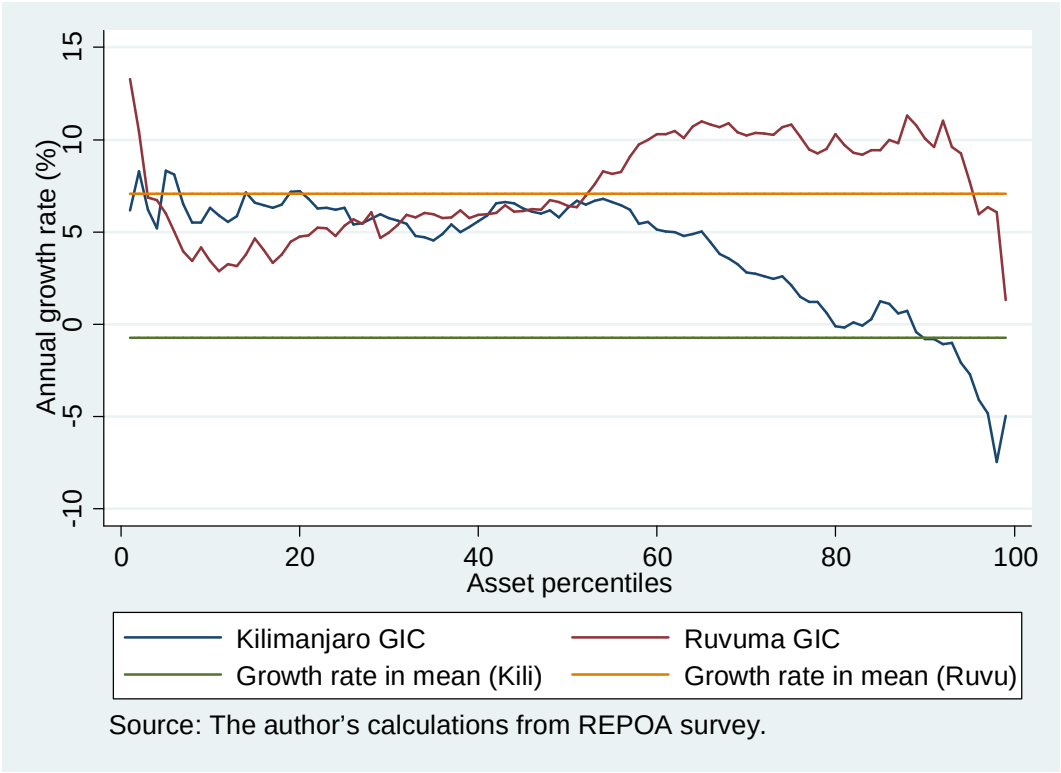


Source: The author's calculations from REPOA survey.

Kilimanjaro GIC results for assets (see figure 3.3) show that the rate of pro-poor asset growth was 6.5%. Thus the assets of the asset poor increased and asset growth was pro-poor. The growth rate in mean asset value for all percentiles is slightly negative and lower than the rate of pro-poor asset growth. This means that the increase in the assets of the asset poor was greater than that of the non-asset poor. Overall Gini inequality in asset ownership decreased from 0.652 to 0.547 (own calculations).

Ruvuma GIC results for assets (see figure 3.3) show that the rate of pro-poor asset growth was 6.06%. Thus asset growth was pro-poor. The growth rate in mean asset value for all percentiles is higher than the rate of pro-poor asset growth. This means that the increase in the assets of the non-asset poor was greater than that of the asset poor. However, overall asset ownership Gini inequality decreased from 0.586 to 0.571 (own calculations).

Figure 3.3: Kilimanjaro and Ruvuma assets GIC



Source: The author's calculations from REPOA survey.

This section now explains the reasons for the pattern of economic growth and consumption poverty reduction in Kilimanjaro and Ruvuma. From the livelihood approach we know that income influences consumption, thus what happens to income will also influence consumption. One of the reasons for the marginal increase in consumption poverty in Kilimanjaro between 2003 and 2009 was the decline in farm incomes. The calculations from the REPOA survey show that the median real adult equivalent farm income fell from 22,329 to 14,688 (TZS) that is by -34.2% between the two periods (or -5.7% per annum). Since real median selling prices of livestock and crops did not fall (see tables 3.10 and 3.11), the main reason for the decline in median farm income was a fall in farm output due to bad weather.

The median real adult equivalent overall income (farm plus non-farm income) rose slightly from 100,000 to 101,013 (TZS), that is it rose by 1% or by 0.2% per annum. This implies that for some people the increase in non-farm income was not able to fully offset the decline in farm income thus resulting in a slight increase in poverty. Christiaensen and Pan (2010) also come to a similar conclusion and they argue that an increase in wage income was instrumental in keeping out of poverty those households whose farm income had declined.

The calculations from REPOA survey show that consumption poverty in Ruvuma fell between 2004 and 2009 because median real adult equivalent income rose from 79,611 to 113,689. In percentage terms this is an increase of 42.8% or by 8.6% per annum. Unlike Kilimanjaro, farm incomes in Ruvuma slightly increased as the real median adult equivalent farm income rose from 43,103 to 44,185 (TZ Shs) that is by 2.5% between the two periods (0.5% per annum). The reason for an increase in farm income was an increase in farm output as a result of good weather. But the real booster of overall income growth was the rise in wage incomes which managed to lift people out of poverty. Wage incomes rose mainly because of increased agricultural employment caused by good weather. Christiaensen and Pan (2010) come to a similar conclusion by arguing that an increase in wage income and farm income was a major contributor towards the increase in income.

From table 3.10 below we can see the regional median real selling prices of livestock in Kilimanjaro in 2003 and 2009 and in Ruvuma in 2004 and 2009. In Kilimanjaro all these prices have not fallen but they have slightly increased. In Ruvuma all these prices have increased.

Table 3.10: Regional median real selling prices of livestock in Kilimanjaro (2003 and 2009) and in Ruvuma (2004 and 2009)

	Kilimanjaro			**Ruvuma**		
Selling price	2003	Real 2009	Nominal 2009	2004	Real 2009	Nominal 2009
Ox	72,500	100,685	200,000	80,000	109,725	200,000
Cattle	100,000	100,685	200,000	82,500	109,725	200,000
Goat/sheep	15,000	15,103	30,000	10,000	13,716	25,000
Pig	35,000	40,274	80,000	18,000	21,945	40,000
Chicken	1,500	2,517	5,000	1,500	2,194	4,000

Source: The author's calculations using REPOA survey.

We now look at the regional median producer crop prices per kilo (see table 3.11). In Kilimanjaro these prices have not fallen but they have slightly increased (with the exception of cassava, groundnuts and onions which are minority crops). For Ruvuma these prices have slightly increased (with the exception of yam, sweet potatoes, sugar cane, tobacco and cashew nuts which have slightly decreased).

Table 3.11: Regional median real crop producer prices per kilo in Kilimanjaro (2003 and 2009) and in Ruvuma (2004 and 2009)

	Kilimanjaro			Ruvuma		
	2003	Real 2009	Nominal 2009	2004	Real 2009	Nominal 2009
Maize	130	181	360	90	137	250
Bean	300	491	975	250	274	500
Coffee	450	671	1,333	350	654	1,192
Banana	73	101	200	73	247	450
Millet	327	420	833	123	137	250
Wheat				150	336	612
Rice	150	239	475	133	165	300
Cassava	100	42	83	70	110	200
Yam	36	101	200	49	41	75
Sweet potatoes	50	126	250	55	41	75
Irish potatoes	80	151	300	81	110	200
Groundnuts	500	378	750	200	165	300
Onion	305	113	225	212	233	425
Tomatoes	150	151	300	78	110	200
Sunflower	136	151	300	108	329	600
Sugar cane				60	55	100
Tobacco				667	433	789
Cashew nuts				450	329	600
Simsim				225	347	633

Source: The author's calculations using REPOA survey.

Per adult equivalent farm incomes in Kilimanjaro fell due to shortage of land and drought which makes it difficult to increase farm output per adult equivalent in a situation of increasing population density and rainfall volatility. The author's calculations from the REPOA survey show that only 33.5% of individuals in households affected by drought had positive (adult equivalent) farm income growth, the respective figure for household not affected by drought was 43.1%.

In 2003, 34.7% of the households experienced drought while in 2009 the figure was 82.2%. Between the two periods the poverty rates of drought stricken households were higher than those of non-drought stricken households, although the poverty rates of drought stricken

households declined by 0.2% between the two periods while those of non-drought stricken households increased by 5.7%. If I look only at 2009 drought shocks the poverty rates of drought affected households increased by 7% while those of households not affected by drought increased by 2.4%. These figures mean that drought adversely affected the households between the two periods and contributed to the negative pro-poor growth rate in the region.

Farm output in Ruvuma increased due to good weather and land availability. The incidence of drought among households in Ruvuma is significantly lower than in Kilimanjaro. The author's calculations from REPOA survey show that in 2004, 4.5% of the households experienced drought while in 2009 the figure was 13.6%. The poverty rates of drought stricken households increased by 16.3% between the two periods while those of non-drought stricken households decreased by 3.2%. These figures mean that drought reduced the positive pro-poor growth rate in the region, but because drought affected a small proportion of households its negative effect was cancelled by the positive pro-poor growth rate of non-drought stricken households which form a huge majority in Ruvuma. Also Ruvuma has more land and has a lower population density than Kilimanjaro thus it was able to absorb its new population and thus maintain and even increase it's per adult equivalent farm incomes.

Another factor that contributed to the negative pro-poor growth rate in the region and led to the marginal increase in poverty was population growth (combined with shortage of land). The author's calculations from the REPOA survey show that in 2009 in Kilimanjaro the poverty rate of households that had an increase in household size was higher (35.5%) than that of households that had a decrease in household size (29.4%). Households that didn't have a change in household size had the lowest poverty rate (25.8%). While in Ruvuma in 2009, the poverty rate of households that had an increase in household size was lower (47.1%) than that of households that had a decrease in household size (53.5%). The poverty rate for households that didn't have a change in household size was 41.9%.

The above means that population growth increases poverty in Kilimanjaro more than it does in Ruvuma. This is because Ruvuma has more land and has a lower population density than Kilimanjaro hence she is able to absorb her new population and thus maintain and even increase her per adult equivalent farm incomes. It is difficult for Kilimanjaro to do this as she has a high population density and less land. However it should be noted that at the aggregate

level freezing household sizes marginally reduces the regional poverty rate in 2009. In Kilimanjaro the poverty rate in 2009 slightly declines from 31.8% to 31.6%; while in Ruvuma (in 2009) it slightly increases from 47.4% to 46.9%.

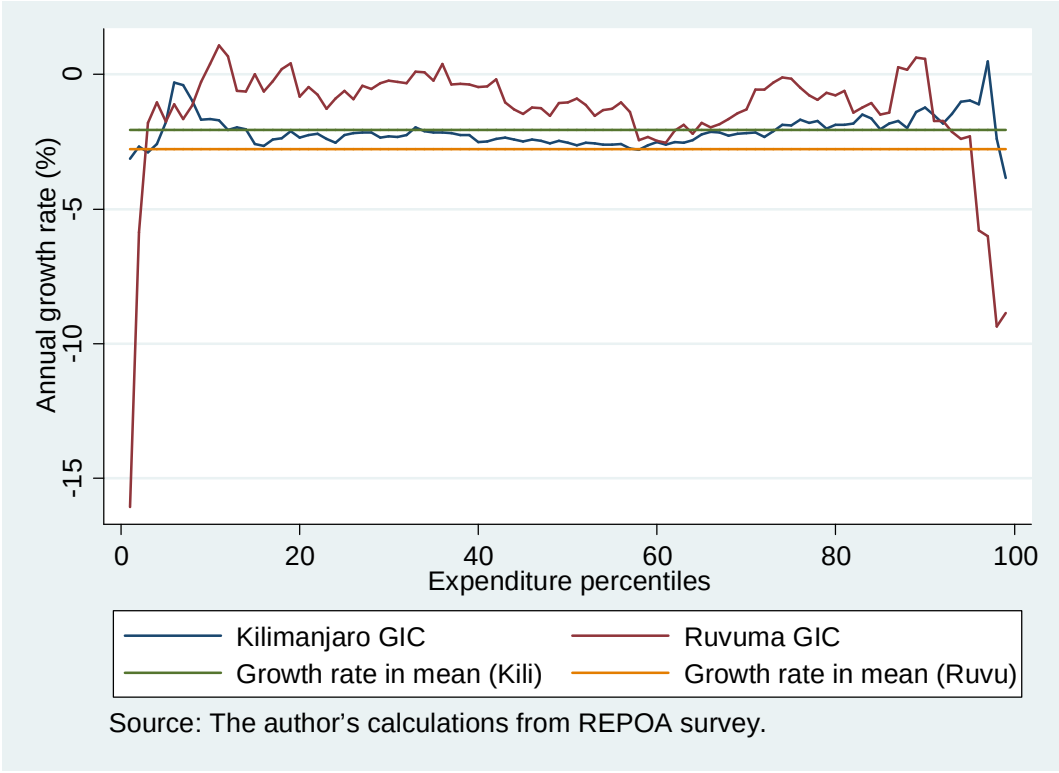
Another reason that GDP growth was accompanied by a marginal increase in poverty between 2003 and 2009 in Kilimanjaro was that during that period GDP growth was accompanied by an increase in food prices as well as overall prices. The author's calculations from the REPOA survey (and also using the price indices of Christiaensen and Pan (2010)) show that in Kilimanjaro, food prices rose by 21.9% per annum compared to overall prices which rose by 16.4% per annum between 2003 and 2009. As a result the poverty rate of net food buyers increased more than that of net food sellers from 22.9% in 2003 to 32.3% in 2009 compared to that of net food sellers which decreased from 34.1% in 2003 to 26.5% in 2009. Since 77% (in 2003) and 91.5% (in 2009) of individuals in Kilimanjaro were net food buyers, the overall effect of food inflation was an erosion of the purchasing power of households in Kilimanjaro and thus causing them to remain in poverty. Hence GDP growth was accompanied by a marginal increase in poverty.

In Kilimanjaro, the aggregate consumption welfare of the poor among net food buyers deteriorated. The Kilimanjaro consumption GIC for net food buyers (see figure 3.4) show that the rate of pro-poor growth for net food buyers is -2.04% which is lower than the rate of pro-poor growth for net food sellers (-0.01%) (own calculations).

In Ruvuma, between 2004 and 2009 GDP growth has also been accompanied by an increase in food prices as well as overall prices. The author's calculations from REPOA survey (and also using the price indices of Christiaensen and Pan (2010)) show that in Ruvuma, food prices rose by 19.2% per annum and overall prices rose by 16.5% per annum between 2004 and 2009. But there was a decline in poverty. The main reason for this (apart from the increase in household incomes) was that in Ruvuma (unlike in Kilimanjaro), many households are net food sellers and thus they are unlikely to be harmed by food inflation. The poverty rate of net food sellers fell from 52.1% in 2004 to 51.2% in 2009, while that of net food buyers increased from 39.8% to 42.8% during the same period. Since the majority of individuals in Ruvuma were net food sellers 76.3% (in 2004) and 55% (in 2009), the overall effect of food inflation was to lift some households out of poverty. Thus causing GDP growth to be accompanied by poverty reduction.

In Ruvuma, the aggregate consumption welfare of the poor among net food buyers deteriorated. The Ruvuma consumption GIC for net food buyers (see figure 3.4) show that the rate of pro-poor growth for net food buyers is -1% which is lower than the rate of pro-poor growth for net food sellers (-0.62%) (the author's calculations).

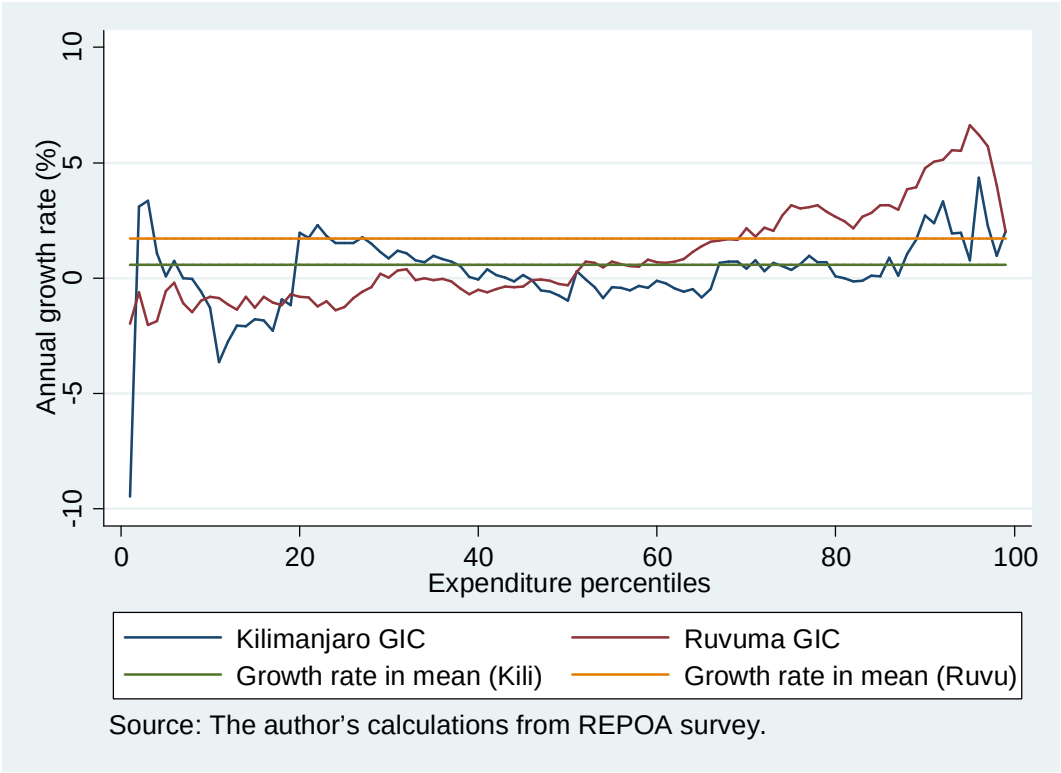
Figure 3.4: Kilimanjaro and Ruvuma Consumption GIC for net food buyers



Source: The author's calculations from REPOA survey.

Kilimanjaro and Ruvuma consumption GIC results for net food sellers (see figure 3.5) show that the rate of pro-poor growth for net food sellers in Kilimanjaro is -0.01% which is slightly higher than the rate of pro-poor growth for net food sellers in Ruvuma (-0.62%). The difference between the rate of pro-poor growth for net food buyers and net food sellers is greater in Kilimanjaro (-2.03%) than in Ruvuma (-0.38%) (own calculations).

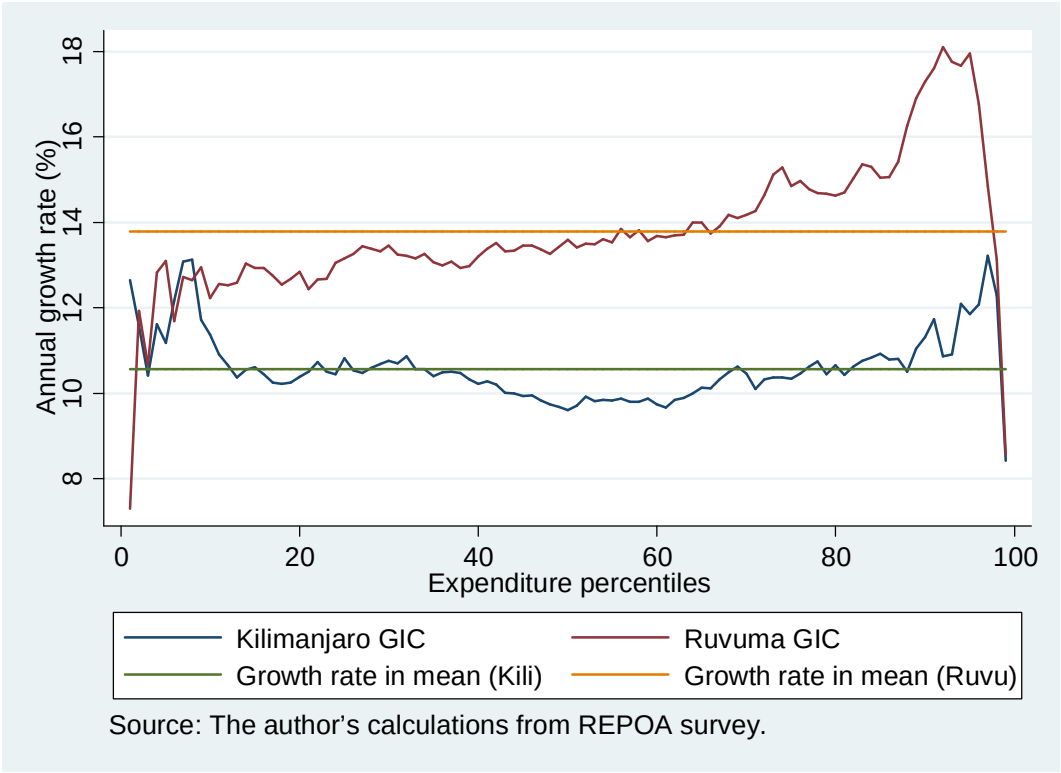
Figure 3.5: Kilimanjaro and Ruvuma consumption GIC for net food sellers



Source: The author's calculations from REPOA survey.

In Kilimanjaro overall inflation also contributed to the marginal poverty increase. While in Ruvuma, overall inflation prevented further reduction of poverty. If I assume there was zero inflation between the respective two periods the rate of pro-poor growth in Kilimanjaro turns from -0.96% to 11.04% while that of Ruvuma increases from 0.05% to 12.82% (the author's calculations). This means that if the rate of inflation was moderate Kilimanjaro region would have enjoyed a positive pro-poor growth rate. And Ruvuma region would have enjoyed a more positive pro-poor growth rate (see figure 3.6 for the respective GICs).

Figure 3.6: Kilimanajro and Ruvuma consumption GIC assuming there is no inflation



Source: The author's calculations from REPOA survey.

Another reason why growth was accompanied by an increase in poverty in Kilimanjaro was the presence of death shocks and the inability of households in this region to cope with the shock of death. The author's calculations from REPOA survey show that in 2003, 25.1% of households had experienced the shock of death between 1998 and 2003 and in 2009, 10.1% of the households had experienced a shock of death between 2004 and 2009. Although the incidence of death had declined, the poverty rate of the households that experienced death increased from 22.7% (in 2003) to 36.8% (in 2009). In Ruvuma, the poverty rate of the households that experienced death increased from 45% (in 2004) to 51% (in 2009). And in 2004, 16.3% of households had experienced the shock of death between 1999 and 2004 and in 2009, 10.6% of the households had experienced a shock of death between 2005 and 2009.

The above means that in Kilimanjaro the rate of pro-poor growth for death affected households was significantly negative than that of non-death affected households and thus death reduced the rate of pro-poor growth in the region. The poverty rate of death affected households in Kilimanjaro increased more than that of Ruvuma although death affected households in Kilimanjaro were less poor than those of Ruvuma. The main reason for this

was the decline in farm incomes in Kilimanjaro which reduced household coping capacity and much higher funeral expenses in Kilimanjaro compared to Ruvuma (Christiaensen and Sarris (2007) observed the same phenomenon of funeral expenses in round 1 and 2 of the survey). Households in Kilimanjaro usually give modern funerals which are more expensive and these funerals are usually attended by relatives who live in other regions. Contributions from relatives and friends usually reduce funeral costs incurred by individual families.

Another significant shock in Kilimanjaro was illness. The calculations from REPOA survey show that in 2003 in Kilimanjaro, 23.8% of the households experienced illness while in 2009 the figure was 16.3%. Between the two periods the poverty rates of illness stricken households were higher than those of non-illness stricken households, although the poverty rates of illness stricken households increased by 5.3% between the two periods while those of non-illness stricken households increased by 5.9%.

In Ruvuma in 2004, 19.5% of the households experienced illness while in 2009 the figure was 25%. In the first period the poverty rates of illness affected households was higher than that of unaffected households but in the last period it was the other way round. The poverty rates of illness affected households declined by 8.7% between the two periods while those of non-affected households slightly decreased by 0.1%. Thus the shock of illness reduced the rate of pro-poor growth in Kilimanjaro while in Ruvuma it improved it.

It seems that households in Ruvuma could cope well with illness. The main reason for this was the decline in farm incomes which reduced household coping capacity in Kilimanjaro and the increase in farm incomes in Ruvuma which improved household coping capacity in Ruvuma. Also medical expenses are much higher in Kilimanjaro than in Ruvuma (Christiaensen and Sarris (2007) observed the same phenomenon of medical expenses in round 1 and 2 of the survey). This is because households in Kilimanjaro are more likely to seek modern health care (sometimes in private hospitals) which is more expensive and also the nature of diseases requires expensive health care. Long term diseases such as cardiovascular diseases and diabetes require long term health care that is usually expensive. Contributions from relatives and friends usually reduce health costs incurred by individual families. However, households in Kilimanjaro obtain benefits from seeking expensive modern health care these benefits are reflected in high life expectancy, low infant mortality and low under five mortality in the Kilimanjaro region.

Malaria and HIV/AIDS were a major cause of illness and death in the first round period in both regions. Death shocks have declined in both regions while illness shocks have declined in Kilimanjaro but they have increased in Ruvuma. The introduction and widespread availability of ARVs has reduced HIV/AIDS related deaths and death shocks in general. Initially HIV/AIDS prevalence rates in Kilimanjaro were higher than in Ruvuma but now they have significantly declined while for Ruvuma they have increased. However the current widespread availability of ARVs means that the impact of HIV/AIDS in Ruvuma is significantly lower than what it was earlier in Kilimanjaro when ARVs were not yet invented.

In both regions improving farm productivity, planting high value crops (while maintaining food security), creating rural jobs via rural economic structural transformation (increasing the size of the rural non-farm sector) and rural infrastructure projects will result in sustainable poverty reduction. Ruvuma has another option of increasing land area under cultivation in the low lands. The lack of regional grid electricity in rural Ruvuma is one of the main reasons hindering rural economic transformation.

Results of consumption growth regressions

This section now discusses the results of consumption growth regressions (see table 3.12). It will only discuss significant results. The choice of variables comes from economic theory (Dercon, 2001; Dercon, 2003; Dercon et al., 2008; 2011). The dependent variable is the real growth of adult equivalent consumption between round 1 and round 3. Poor households are defined as households who have been consumption poor in round 1 and or in round 3.

In both regions the estimated coefficient of lagged adult equivalent consumption is negative for all households and for poor households. Thus households with higher initial consumption have lower consumption growth and vice-versa, ceteris paribus. This shows that there is convergence within each region. In Kilimanjaro households with village leaders have higher consumption growth than other households; this is true for all households and for poor households. In Ruvuma households with village leaders have lower consumption growth but this applies to all households and does not apply to poor households. Households with village leaders are expected to have more social and political capital which can be translated into

higher income and consumption. This is the case in Kilimanjaro but it is not so in Ruvuma. May be in Ruvuma some of the village leaders lost elected office or the costs of being a village leader outweighed the benefits.

In Ruvuma education of household head increases consumption growth for poor households only. In Kilimanjaro this variable is insignificant. A more educated poor household head can get more income via off-farm employment and thus he has higher income growth and higher consumption growth. A more educated poor household head can also easily adopt modern farming techniques and he can easily access market information both of which can improve his income and consumption. In Kilimanjaro poor households with a female head have lower consumption growth than other poor households. Poor female headed households have lower income growth than other poor households as they are usually run without extra income from a male spouse and thus they have lower consumption growth.

In both regions large adult equivalent household size reduces consumption growth for all households and for poor households and thus increases consumption poverty. Larger households have low (per adult equivalent) consumption growth as household resources have to satisfy the consumption of more members. This reduces resources available for investment and thus constraints income growth as well as consumption growth. The percentage of household members aged between 0 and 4 years increases consumption growth for all households in Kilimanjaro but this does not apply to poor households and in Ruvuma its impact is insignificant for all households and for poor households. This is unexpected however the reason might be such households bear children when they are expecting a brighter future and or they receive help from extended family and friends and or they work harder to provide for their new born babies.

In both regions business income increases consumption growth and thus reduces poverty for all households while for poor households its impact is insignificant. An increase in business income increases consumption growth as it increases the household's income and thus enables the household to increase consumption growth. But business income does not boost the consumption growth of the poor. In both regions farm income increases consumption growth for all households and for poor households. An increase in farm income increases household's income and thus enables the household to increase consumption growth.

Growth of adult equivalent household size reduces consumption growth for all households and for poor households in both regions and thus increases poverty. A higher growth of

household size directly reduces (per adult equivalent) consumption growth as household consumption has to be distributed among a higher number of household members. In both regions growth of adult equivalent business income increases consumption growth for all households and for poor households and thus reduces poverty. A higher growth of business income causes a higher growth of household income and thus increases consumption growth. Growth of adult equivalent farm crop income increases consumption growth for all households and for poor households in both regions. A higher growth of farm crop income causes a higher growth of household income and thus increases consumption growth.

Growth of adult equivalent wage income increases consumption growth for all households and for poor households in Ruvuma, while in Kilimanjaro it does so for all households but not for poor households. A higher growth of wage income causes a higher growth of household income and thus increases consumption growth. Growth of adult equivalent other farm income increases consumption growth for all households and for poor households in Ruvuma, while in Kilimanjaro it does so for poor households but not for all households. A higher growth of other farm income causes a higher growth of household income and thus increases consumption growth. Other farm income is income earned from processing animal and farm products such as making flour, meat, vegetable oil and local beer as well as selling livestock.

The value of consumer durables owned per adult equivalent increases consumption growth for all households and for poor households in Ruvuma, while in Kilimanjaro it does so for all households but not for poor households. A higher value of consumer durables owned causes a higher growth of household income and thus increases consumption growth. Consumer durables generate utility and they also represent household wealth. Consumer durables such as beds, sofas, tables, chairs, cupboards, refrigerators and cooking stoves improve household health and hygiene and thus improve household productivity. Some such as radios, mobile phones and television improve communication and access to market information. Others such as bicycles and motor cycles improve household transport. Sometimes consumer durables can be sold for cash or they can be used as collateral for microloans.

Households with electricity in Kilimanjaro have higher consumption growth than other households; this is true for all households and for poor households. Access to electricity improves farm and non-farm income (via agro-processing, lighting of retail outlets and saving time used to fetch for firewood) and thus enables households to increase their

consumption growth. Electricity is used for consumption and production activities such as cooking, lighting and agro-processing. It increases productivity of agricultural households and also helps diversifying economic activities towards non-farm business i.e. some rural retail outlets use electricity for lighting and refrigeration.

Households in Kilimanjaro with access to own or public tap water have higher consumption growth than other households; this is true for all households and for poor households. In Ruvuma this variable is insignificant for all households and for poor households. Access to tap water improves farm and non-farm income (via irrigation and saving time used to fetch for water) and thus enables households to increase their consumption growth. Water is an important input in production and consumption. It is used for drinking by humans and livestock, for domestic cooking, for personal and household hygiene, for irrigation and for agro-processing. Tap water not only simplifies the availability of water but it is also available during droughts. Tap water is also healthier and safer and thus enables households to avoid water related illnesses and the medical expenses and loss of labour time that is associated with such sickness.

In Kilimanjaro households in villages with tarmac or gravel road have higher consumption growth than other households; this is true for all households and for poor households. In Ruvuma poor households that live in villages with tarmac or gravel road have lower consumption growth than other poor households. The results in Kilimanjaro are as expected but those in Ruvuma are unexpected. Households in villages with good road infrastructure have lower transport costs and lower transaction costs and thus are more productive and have higher income and consumption growth.

Good roads facilitate the movement of goods and services as well as inputs i.e. farm output, agricultural inputs (fertilisers and pesticides), extension services and farm labour. Thus they lower transport costs, transaction costs and production costs and thus boost farm income and consumption growth. Good roads also support more commercialised agriculture, agro-processing, non-farm business, access to education, health and public administration facilities. May be with time poor households in Ruvuma will also feel the benefits of good roads. In Ruvuma poor households in villages with markets have higher consumption growth than other poor households. Poor households in villages with markets have better market access than other poor households which in turn improve their income and consumption

growth. Better market access can mean a ready market for their farm output, easier availability of farm inputs, lower market transaction costs and better job opportunities.

In Kilimanjaro households in Rombo district have lower consumption growth; this applies to all households and to poor households. This implies that geographical and locational factors in Rombo such as low rainfall have reduced consumption growth in that district. In Ruvuma households in Tunduru and Namtumbo districts have lower consumption growth; this applies to all households and to poor households. This implies that geographical and locational factors in these two districts such as low rainfall have reduced consumption growth in these districts.

A shock of drought (2003-2004) reduces consumption growth for poor households in Kilimanjaro. A shock of drought reduces farm output and thus reduces farm income and consumption growth. In Ruvuma the shock of death of external financial supporter increases consumption growth for all households and for poor households. This shock can actually increase household wealth via inheritance and thus boost consumption growth. Shocks of heavy rains or floods (1999-2004), unexpected decline in cereal prices and loss of livestock (2005-2009) increases consumption growth for all households but not for poor households. The reason that such shocks have unexpected signs is because they affect prosperous farmers who already have higher consumption growth. In addition, heavy rains can sometimes help certain farmers e.g. rice farmers.

Table 3.12: Results for determinants of real consumption growth in Kilimanjaro and Ruvuma

	Kilimanjaro		Ruvuma	
	Real consumption growth		Real consumption growth	
VARIABLES	Overall	The poor	Overall	The poor
Ln of adult equivalent	-0.918***	-1.263***	-0.954***	-1.240***
Consumption lagged	(-24.75)	(-26.08)	(-18.21)	(-27.78)
Has a village leader	0.0738**	0.123**	-0.0906**	-0.000268
	(2.019)	(2.283)	(-2.018)	(-0.00520)
Ln head age	0.0299	0.0664	-0.0191	0.0928
	(0.415)	(0.745)	(-0.239)	(1.092)
Ln head education	0.0379	0.00976	0.0558	0.0802*
	(1.173)	(0.219)	(1.382)	(1.785)

Female head	0.0166	-0.107*	0.0304	0.00944
	(0.282)	(-1.683)	(0.379)	(0.0906)
Ln of adult equivalent	-0.582***	-0.385***	-0.367***	-0.302***
household size	(-11.87)	(-5.676)	(-6.720)	(-4.657)
Ln percentage aged (0-4)	0.0389***	0.0172	0.00525	0.0209
	(3.011)	(1.124)	(0.355)	(1.324)
Migrated before 2003	-0.00356	0.0232		
	(-0.0982)	(0.478)		
Ln of adult equivalent	0.0457***	0.0298	0.0333**	0.0162
business income	(3.021)	(1.280)	(2.169)	(0.938)
Ln of adult equivalent farm	0.0769***	0.0470*	0.139***	0.111***
income	(4.360)	(1.894)	(6.273)	(4.318)
Growth of adult equivalent	-0.653***	-0.405***	-0.536***	-0.478***
household size	(-12.21)	(-5.627)	(-6.640)	(-5.241)
Growth of adult equivalent	0.0437***	0.0501**	0.0358***	0.0391**
business income	(3.304)	(2.426)	(2.686)	(2.531)
Growth of adult equivalent	0.0403***	0.0394**	0.111***	0.0818***
farm income	(3.407)	(2.432)	(8.311)	(4.886)
Growth of adult equivalent	0.0297***	0.0139	0.0504***	0.0544***
wage income	(3.842)	(1.543)	(5.823)	(5.980)
Growth of adult equivalent	0.00797	0.0213**	0.0204**	0.0214**
other farm income	(1.183)	(2.148)	(2.105)	(2.059)
Member of Saccos	-0.0459	-0.0241	-0.00665	-0.100
	(-0.933)	(-0.432)	(-0.0950)	(-1.464)
Ln of value of consumer	0.0553***	0.0301	0.103***	0.0939***
durables owned per adult	(3.015)	(1.210)	(4.280)	(3.738)
equivalent				
Has electricity	0.184***	0.165*		
	(3.164)	(1.823)		
Has access to own or	0.0904**	0.0883*	0.00709	-0.00881
public tap water	(2.328)	(1.840)	(0.155)	(-0.165)
Village has tarmac or	0.0806**	0.119***	-0.0838	-0.140**
gravel road	(2.282)	(2.861)	(-1.546)	(-2.310)
Village has market	0.0170	-0.0382	0.0735	0.0915*
	(0.426)	(-0.786)	(1.557)	(1.683)
Rombo district	-0.200***	-0.154***		
	(-4.047)	(-2.624)		
Moshi Rural district	-0.0239	0.0361		
	(-0.544)	(0.604)		
Tunduru district			-0.356***	-0.345***
			(-6.276)	(-5.689)
Namtumbo district			-0.159**	-0.157*
			(-1.975)	(-1.831)

Heavy rains or floods (1999-2004)			0.247** (2.019)	0.300 (1.478)
Drought (2003-2004)	0.00914 (0.256)	-0.0999** (-2.179)		
Major harvest losses (2004-2009)	0.0611 (1.181)	0.100 (1.444)		
Unexpected decline in cereal prices (2005-2009)			0.101** (2.032)	0.0127 (0.219)
Loss of livestock (2005-2009)			0.232*** (3.845)	0.128 (1.640)
Death of external supporter (2005-2009)			0.238*** (3.104)	0.244** (2.581)
Constant	5.066*** (13.33)	6.333*** (12.65)	4.576*** (11.41)	5.421*** (13.08)
Observations	765	326	670	450
Adjusted R-squared	0.589	0.806	0.567	0.713
F test	48.19***	51.14***	29.18***	56.76***

T-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Source: The author's calculations.

Results of asset growth regressions

This section now discusses the results of asset growth regressions (see table 3.13). It will only discuss significant results. The choice of variables comes from economic theory (Dercon, 2001; Carter and May, 2001; Carter and Barrett, 2006; Quisumbing and Baulch, 2009). The dependent variable is the real growth of adult equivalent asset value between round 1 and round 3. Poor households are defined as households who have been asset poor in round 1 and or in round 3.

In both regions the estimated coefficient of lagged adult equivalent asset value is negative for all households and for poor households. Thus households with higher initial asset value have lower asset growth and vice-versa, ceteris paribus. This shows that there is convergence within each region. In both Kilimanjaro and Ruvuma the age of the household head increases asset growth for all households but not for poor households. The older a household head becomes the more experienced he is in his occupation (farm and or non-farm) and hence he is more productive and he has higher asset growth. Also older household heads have higher

asset growth as they have been accumulating assets for a longer time period (compared to younger household heads).

In Ruvuma the education of the household head increases asset growth for all households and for poor households. In Kilimanjaro this variables is insignificant. A more educated household head can get more income via off-farm employment and thus he has higher income growth and higher asset growth. A more educated household head can also easily adopt modern farming techniques and he can easily access market information both of which can improve his income and asset accumulation.

In Ruvuma poor households with a female head have higher asset growth than other poor households. This is unexpected as poor female headed households are expected to have lower income (and lower asset growth) due to lack of additional income from a male spouse. The reason might be that a poor female head of household might receive more assistance from friends and relatives and thus accumulate more assets and or the poor female head is more likely to spend family income on productive activities that increase asset accumulation (compared to a poor male headed household).

Large adult equivalent household size reduces asset growth for all households and for poor households in Ruvuma, while in Kilimanjaro it does so for all households but not for poor households. Larger households have low (per adult equivalent) asset growth as household resources have to satisfy the consumption of more members. This reduces resources available for investment and thus constraints income growth as well as asset growth.

In Kilimanjaro business income increases asset growth and thus reduces asset poverty; this is true for all households but not for poor households. In Ruvuma its impact is insignificant. Higher business income increases household's income and thus increases asset accumulation and asset growth. In Ruvuma, farm crop income increases asset growth for all households and for poor households while in Kilimanjaro it does so for all households but not for poor households. Higher farm crop income increases household's income and thus increases asset accumulation and asset growth.

Growth of adult equivalent household size reduces asset growth for all households and for poor households in both regions. A higher growth of household size directly reduces (per adult equivalent) asset growth as household assets are spread among a higher number of household members. In both regions growth of adult equivalent business income increases

asset growth and thus reduces asset poverty; this applies for all households but not for poor households. A higher growth of business income causes a higher growth of household income and thus increases asset accumulation and asset growth.

Growth of adult equivalent farm crop income increases asset growth for all households and for poor households in Ruvuma, while in Kilimanjaro it does so for all households but not for poor households. A higher growth of farm crop income causes a higher growth of household income and thus increases asset accumulation and asset growth. In Ruvuma, growth of adult equivalent wage income increases asset growth for all households but not for poor households. In Kilimanjaro its impact is insignificant. A higher growth of wage income causes a higher growth of household income and thus increases asset accumulation and asset growth.

Growth of adult equivalent other farm income increases asset growth for all households and for poor households in Ruvuma, while in Kilimanjaro its impact is insignificant. A higher growth of other farm income causes a higher growth of household income and thus increases asset accumulation and asset growth. Other farm income is income earned from processing animal and farm products such as making flour, meat, vegetable oil and local beer as well as selling livestock.

Households with electricity in Kilimanjaro have higher asset growth; this is true for all households and for poor households. Access to electricity improves farm and non-farm income (via agro-processing, lighting of retail outlets and saving time used to fetch for firewood) and thus enables households to increase their asset growth. Households in Ruvuma with access to own or public tap water have lower asset growth; this is true for all households but not for poor households. This is unexpected as access to tap water is expected to improve farm and non-farm income (via irrigation and saving time used to fetch for water) and thus improve asset growth. May be with time households in Ruvuma will feel the benefits of access to tap water.

In Kilimanjaro households in villages with tarmac or gravel road have higher asset growth than other households; this is true for all households but not for poor households. Households in villages with good road infrastructure have lower transport costs and lower transaction costs and thus are more productive and have higher income and asset growth. In Ruvuma poor households that live in villages with markets have higher asset growth than other poor

households. Poor households in villages with markets have better market access than other poor households which in turn improve their income and asset growth.

In Kilimanjaro, households in Moshi rural district have higher asset growth; this is true for all households but not for poor households. This implies that geographical and locational factors in Moshi rural district have increased asset growth in that district. In Ruvuma, households in Tunduru district have lower asset growth; this is true for all households and for poor households. This implies that geographical and locational factors in Tunduru district such as low rainfall have reduced asset growth in this district. In Kilimanjaro the shock of death (2003-2004) reduces asset growth for all households but not for poor households. Such a shock reduces income and thus reduces asset accumulation and asset growth.

Table 3.13: Results for determinants of real asset growth in Kilimanjaro and Ruvuma

	Kilimanjaro		Ruvuma	
	Real asset growth		Real asset growth	
VARIABLES	Overall	The poor	Overall	The poor
Ln of adult equivalent asset	-0.745***	-1.188***	-0.573***	-0.827***
value lagged	(-20.49)	(-11.19)	(-15.09)	(-15.25)
Has a village leader	0.0394	-0.247	0.0472	0.114
	(0.484)	(-1.152)	(0.607)	(1.187)
Ln head age	0.308**	0.0595	0.252**	0.0927
	(2.051)	(0.140)	(2.037)	(0.584)
Ln head education	0.0436	-0.228	0.148**	0.158**
	(0.643)	(-1.410)	(2.280)	(2.199)
Female head	0.0840	-0.220	0.235	0.397**
	(0.796)	(-0.569)	(1.539)	(2.031)
Ln of adult equivalent	-0.549***	-0.551	-0.338***	-0.360***
household size	(-5.900)	(-1.470)	(-3.599)	(-2.885)
Migrated before 2003	0.0587	0.0670		
	(0.741)	(0.289)		
Ln of adult equivalent	0.0983***	-0.0787	0.0403	-0.00585
business income	(3.686)	(-0.816)	(1.420)	(-0.149)
Ln of adult equivalent farm	0.111***	-0.0609	0.165***	0.158***
income	(3.395)	(-0.662)	(4.136)	(2.797)
Growth of adult equivalent	-0.838***	-0.786**	-0.930***	-1.026***
household size	(-8.708)	(-2.019)	(-8.135)	(-7.649)
Growth of adult equivalent	0.104***	-0.0441	0.0743***	0.0316
business income	(4.741)	(-0.420)	(3.164)	(0.991)

Growth of adult equivalent	0.104***	0.0179	0.103***	0.0979***
farm income	(4.748)	(0.279)	(3.953)	(2.928)
Growth of adult equivalent	0.0123	-0.0485	0.0458***	0.0311
wage income	(0.887)	(-1.007)	(3.166)	(1.612)
Growth of adult equivalent	0.0168	0.0462	0.0481**	0.0651***
other farm income	(1.211)	(1.112)	(2.501)	(2.709)
Member of Saccos	0.136	0.0964	0.113	0.189
	(1.200)	(0.281)	(1.180)	(1.627)
Has electricity	0.276***	0.872**		
	(3.083)	(2.557)		
Has access to own or	0.0684	-0.0390	-0.131*	-0.152
public tap water	(0.821)	(-0.196)	(-1.702)	(-1.565)
Village has tarmac or	0.122*	0.244	0.0428	0.0171
gravel road	(1.674)	(1.034)	(0.434)	(0.142)
Village has market	0.119	0.384	0.126	0.168*
	(1.436)	(1.234)	(1.534)	(1.682)
Rombo district	0.103	-0.0603		
	(1.110)	(-0.214)		
Moshi Rural district	0.168**	-0.203		
	(1.991)	(-0.667)		
Tunduru district			-0.495***	-0.500***
			(-4.946)	(-4.413)
Namtumbo district			-0.0773	-0.0818
			(-0.566)	(-0.484)
Death (2003-2004)	-0.439**	-0.449		
	(-2.477)	(-1.331)		
Unexpected decline in	-0.171	0.158		
cereal prices (2004-2009)	(-1.186)	(0.277)		
Drought (2005-2009)			0.139	0.191
			(1.242)	(1.449)
Illness (2005-2009)			-0.0299	-0.0876
			(-0.360)	(-0.906)
Constant	3.866***	7.711***	1.877***	3.504***
	(5.455)	(4.676)	(3.663)	(5.542)
Observations	767	161	671	461
Adjusted R-squared	0.509	0.491	0.410	0.518
F test	27.47***	11.87***	19.17***	23.56***

T-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Source: The author's calculations.

Testing for the existence of poverty traps

This part tests whether consumption or asset poverty traps exists among households in the two regions. Sometimes it is customary after estimating consumption and or asset growth regressions to test for the presence of poverty traps as this further enriches the analysis. An asset poverty trap exists when there are households with an equilibrium asset level below the asset poverty line (Carter and Barrett, 2006). Similarly a consumption poverty trap exists when there are households with an equilibrium consumption level below the consumption poverty line. This means there are multiple equilibria in asset levels where by some households will escape poverty while others will remain in poverty (See Appendix B for more details on testing for the existence of poverty traps). If lagged higher order polynomial (square, cubed and fourth power) values of assets (and consumption) are statistically significant this indicates the presence of multiple equilibria. The results show that in both regions consumption and asset poverty traps do not exist (see table 3.14). The lagged higher order polynomial values of assets and consumption are not statistically significant as shown by the F-test ($\beta_2=\beta_3=\beta_4=0$).

Table 3.14: Kilimanjaro and Ruvuma consumption and asset growth results for testing the presence of poverty traps

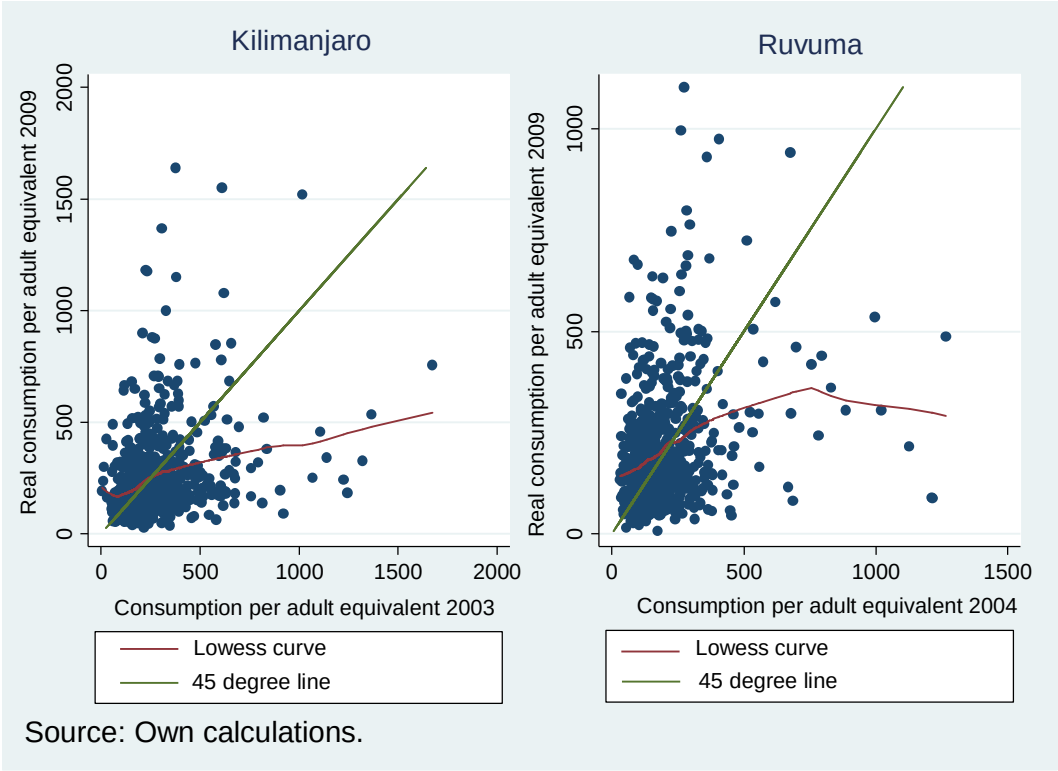
VARIABLES	Kilimanjaro		Ruvuma	
	Real consumption growth	Real asset growth	Real consumption growth	Real asset growth
Ln of adult equivalent	-0.740		-7.061	
Consumption lagged	(-0.225)		(-0.296)	
Ln of adult equivalent	-0.213		1.218	
Consumption lagged squared	(-0.185)		(0.175)	
Ln of adult equivalent	0.0444		-0.0917	
Consumption lagged cubed	(0.263)		(-0.103)	
Ln of adult equivalent	-0.00275		0.00169	
Consumption lagged fourth	(-0.307)		(0.0398)	
Ln of adult equivalent asset		-2.133		-1.888
value lagged		(-0.982)		(-0.956)
Ln of adult equivalent asset		0.358		0.320
value lagged squared		(0.634)		(0.501)
Ln of adult equivalent asset		-0.0349		-0.0321
value lagged cubed		(-0.552)		(-0.367)
Ln of adult equivalent asset		0.00108		0.00114
value lagged fourth		(0.419)		(0.264)
Constant	5.640*	5.633*	15.00	3.821*

	(1.708)	(1.860)	(0.496)	(1.694)
F-test ($\beta_1=\beta_2=\beta_3=\beta_4=0$)	195.06***	118.09***	97.85***	57.21***
(P-value)	0.0000	0.0000	0.0000	0.0000
F-test ($\beta_2=\beta_3=\beta_4=0$)	1.23	1.84	1.35	0.60
(P-value)	(0.2974)	(0.1376)	(0.2573)	(0.6126)
Observations	765	767	670	671
Adjusted R-squared	0.591	0.514	0.570	0.412
F test	51.10***	27.90***	28.00***	17.04***

T-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Other independent variables similar to the ones used in the preceding respective linear models have been included but not reported. Source: The author's calculations.

Non-parametric results of Lowess curve further confirm the above findings. The Lowess curves for consumption cross the 45 degree line once and from above indicating the presence of one stable equilibrium which is not a consumption poverty trap (see figure 3.7).

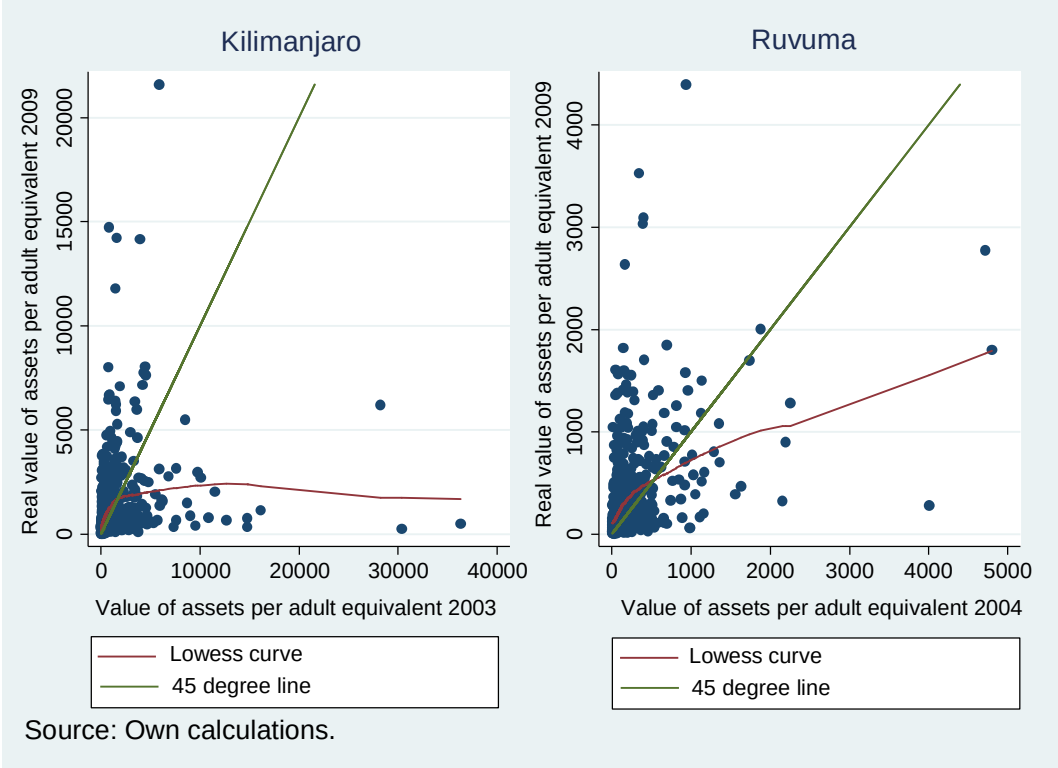
Figure 3.7: Kilimanjaro and Ruvuma Lowess curves for consumption



Source: Own calculations.

The Lowess curves for assets also cross the 45 degree line once and from above indicating the presence of one stable equilibrium which is not an asset poverty trap (see figure 3.8).

Figure 3.8: Kilimanjaro and Ruvuma Lowess curves for assets



Source: Own calculations.

3.8 Conclusion

This chapter analyzed the impact of economic growth on poverty reduction in Kilimanjaro and Ruvuma regions. The author tested two hypotheses: 1) growth of farm crop income and growth of non-farm business income increases the consumption growth and asset growth of the poor; 2) growth of farm crop income has more impact on the consumption growth of the poor than growth of non-farm business income.

Analysis using REPOA panel data survey show that in Kilimanjaro between 2003 and 2009, GDP growth has been accompanied by a marginal increase in consumption poverty from 26.3% to 31.8%. Consumption growth was not pro-poor and the rate of pro-poor growth was -0.96%, and consumption Gini inequality slightly increased. Asset growth was pro-poor and the rate of pro-poor asset growth was 6.5% and Gini inequality in asset ownership declined.

Analysis shows that in Ruvuma between 2004 and 2009, GDP growth has been accompanied by a marginal reduction in consumption poverty from 49.3% to 47.4%. Consumption growth was pro-poor and the rate of pro-poor growth was 0.05% and consumption Gini inequality

slightly increased. Asset growth was also pro-poor and the rate of pro-poor asset growth was 6.06%, Gini inequality in asset ownership declined.

Analysis shows that one of the reasons that growth was more pro-poor in Ruvuma than in Kilimanjaro was the effect of food prices inflation. Many households in Ruvuma are surplus food producers thus food inflation was unlikely to harm them. While many households in Kilimanjaro are net buyers of food thus food inflation reduced their purchasing power and thus kept them in poverty.

These findings reflect those of Datt and Ravallion (1998) who argue that higher food prices increased absolute poverty in India and that many poor were likely to be net food buyers. However, they also found that higher food prices did not affect relative poverty. The findings are also in line with those of Ravallion (1990) who argue that in Bangladesh an increase in food prices was likely to harm the poor (who were likely to be net food buyers) in the short run although in the long run the effect was likely to be neutral.

Analysis shows that other reasons for less pro-poor growth in Kilimanjaro were the decline in adult equivalent farm output and income due to drought and population pressure on limited land. Ruvuma experienced improvement in adult equivalent farm output and income due to good weather and land availability (which eased population pressure). Also the increase in non-farm incomes (mainly wages of agricultural workers) was higher in Ruvuma than in Kilimanjaro due to better agricultural conditions in Ruvuma region. Both regions experienced death and illness shocks but the coping capacity of households in Kilimanjaro was hindered by expensive medical and funeral costs and lower farm incomes (although the poverty rates of death and illness affected households were much higher in Ruvuma).

Analysis using REPOA survey data shows that in both regions growth of adult equivalent business income and growth of adult equivalent farm crop income increases consumption growth for all households and for poor households and thus reduces poverty. In Kilimanjaro, growth of (non-farm) business income has more impact on the consumption growth of the poor than growth of farm crop income. While in Ruvuma, growth of farm crop income has more impact on the consumption growth of the poor than growth of (non-farm) business income.

In Ruvuma, growth of adult equivalent wage income increases consumption growth for all households and for poor households while in Kilimanjaro it does so for all households but not

for poor households. In Ruvuma, growth of adult equivalent other farm income increases consumption growth for all households and for poor households while in Kilimanjaro it does so for poor households but not for all households. In both regions growth of adult equivalent household size reduces consumption growth for all households and for poor households and thus increases poverty.

In both regions, growth of adult equivalent business income increases asset growth for all households but not for poor households. In Ruvuma growth of adult equivalent farm crop income increases asset growth for all households and for poor households while in Kilimanjaro it does so for all households but not for poor households.

Thus in Kilimanjaro, both growth of farm crop income and growth of non-farm business income have no impact on asset growth of the poor. While in Ruvuma growth of farm crop income improves asset growth of the poor and growth of non-farm business income has no impact on asset growth of the poor. In Ruvuma growth of adult equivalent wage income increases asset growth for all households but not for poor households while in Kilimanjaro its impact is insignificant. In Ruvuma growth of adult equivalent other farm income increases asset growth for all households and for poor households while in Kilimanjaro its impact is insignificant. In both regions there were no multiple equilibria poverty traps for consumption or assets. Also in each of those cases the existing one stable equilibrium was not a poverty trap.

The National Strategy for Growth and Reduction of Poverty (NSGRP) has been unsuccessful in rural Kilimanjaro where consumption poverty has increased although asset poverty has decreased. The NSGRP has had limited success in rural Ruvuma where consumption poverty has marginally declined and asset poverty has declined. In spite of the above, rural Ruvuma is much poorer than rural Kilimanjaro as far as consumption and asset poverty is concerned. In future survey rounds it might be better to also include urban households and see whether they behave similarly to rural households. In both regions improving farm productivity, planting high value crops (while maintaining food security), creating rural jobs via rural economic structural transformation (increasing the size of the rural non-farm sector) and rural infrastructure projects will result in sustainable poverty reduction. Ruvuma has another option of increasing land area under cultivation in the low lands.

CHAPTER 4 : VULNERABILITY TO POVERTY AND ITS DETERMINANTS IN KILIMANJARO AND RUVUMA

4.1 Introduction

Before the introduction of the National Strategy for Growth and Reduction of Poverty many people in the rural areas of Kilimanjaro and Ruvuma were vulnerable to poverty. Previous study of earlier two rounds of the REPOA survey by Christiaensen and Sarris (2007) showed that 31.7% (in 2004) and 66.6% (in 2005) of the households in Kilimanjaro and Ruvuma respectively were vulnerable to consumption poverty. Thus we are interested to know whether or not vulnerability to consumption poverty has declined in the new third round of year 2009.

We also want to widen the scope of investigation by not only investigating the determinants of vulnerability to consumption poverty but by also investigating the determinants of vulnerability to asset poverty. Estimating vulnerability to consumption poverty as well as vulnerability to asset poverty is important as it will not only give us a better picture of vulnerability but it will also enable us to investigate if there is a link between vulnerability to consumption poverty and vulnerability to asset poverty.

Factors that are expected to reduce vulnerability to poverty in rural Kilimanjaro and Ruvuma include education of household head, farm crop income, business income, land ownership, ownership of livestock, access to electricity, access to tap water, access to tarmac or gravel road and having household members who are migrants. While factors that are expected to increase vulnerability include larger household size, and shocks such as drought and death of a household member.

For this chapter the research objective is: To investigate the determinants of household vulnerability to poverty in the rural areas of Kilimanjaro and Ruvuma regions. The research question is: What are the determinants of vulnerability to (consumption and asset) poverty? The chapter begins with a section on literature review, then sections on theoretical framework, econometric model, data, results and discussion, evolution of vulnerability in the two regions, and then conclusion.

4.2 Literature review

This section reviews studies which analyse vulnerability to poverty. Many of these studies analyse vulnerability to consumption poverty and few analyse vulnerability to asset poverty. The concept of vulnerability to poverty has been documented since Jalan and Ravallion (1998), however the literature on vulnerability to poverty started to flourish after the 2000/1 World Development report (World Bank, 2001).

Hoddinot and Quisumbing (2003) gave a comprehensive review of the concept and measurement of vulnerability to poverty. They list three quantitative measures of vulnerability to poverty 1) Vulnerability as Expected Poverty (VEP) 2) Vulnerability as Low Expected Utility (VEU) 3) Vulnerability as Uninsured Exposure to Risk (VER). VEP calculates an ex-ante aggregate measure of vulnerability based on the probability of being poor in the future. VEU is an ex-ante utilitarian aggregate measure of vulnerability based on the difference between utility gained from certainty-equivalent consumption (the consumption level where by the household is not considered to be vulnerable) and the expected utility of consumption (Ligon and Schechter, 2003). VEU is not popular as it requires the specification of the utility function as well as the coefficient of risk aversion. VER does not calculate an aggregate measure of vulnerability but instead it is an ex-post assessment based on calculating the welfare loss caused by a negative consumption shock.

Dercon et al. (2005) did a study on vulnerability and shocks in rural Ethiopia. They use a panel data set of 15 villages. They found that the most common shock was drought, which affected at least half of all households. Other important shocks were pests, input price increase and output price decline shocks. Their regression analysis showed that assets (livestock, land and education of head of household), social networks (having relatives in village authorities) increased consumption per capita in the next period while higher household size, drought, illness and high dependency ratio reduced it. Out of all shocks variables drought and illness were the only ones that were statistically significant. However his study did not estimate the proportion of the population that was vulnerable to poverty.

Christiaensen and Subbarao (2004) did a study on risk and vulnerability to poverty in rural Kenya. They used a pseudo panel data that was created out of two repeated cross section survey data and information on shocks. They measured vulnerability to poverty as expected poverty and found that 26% of the households in rural Kenya were vulnerable to poverty. Rainfall volatility was the main source of consumption variability in arid areas while for non-

arid areas it was malaria. Livestock didn't help households to insure their consumption against covariant shocks although small livestock (sheep/goat) was helpful in the case of idiosyncratic shocks. Availability of electricity, access to markets and literacy helped households to cope with consumption shocks.

Christiaensen and Subbarao (2004) found that non-farm employment increased the mean consumption level and reduced consumption variability. In non-arid areas, a larger household size and a higher dependency ratio reduced the mean consumption level, but the later (as expected) increased consumption variance while the former (surprisingly) increased it. The explanation they gave for the surprising result was that a large household size has large amounts of labour which it can use in difficult times to reduce consumption variance. They also found that policies that increase market access as well as adult literacy and reduce malaria were important in reducing vulnerability to poverty. They argue that effective anti-poverty policies should focus on both the mean and variance of consumption i.e. the poverty level as well as vulnerability to poverty. The authors have improved our understanding of the determinants of vulnerability to poverty however; their study would have been improved by using genuine panel data.

Calvo and Dercon (2005) criticised VEP, VEU and VER measures of vulnerability that they overlook important issues concerning vulnerability. VEP assumes risk sensitivity has no impact on vulnerability, VEU will allow good welfare outcomes to mask bad welfare outcomes and VER is an ex-post measurement that does not take into account the probabilities of shocks occurring. They introduced their own ex-ante measure of vulnerability. They defined vulnerability as the magnitude (likelihood and severity) of the threat of future poverty. Their measure assumes that there is uncertainty and that the future has different states of the world with different welfare outcomes. However, they admit that it might be difficult to empirically operationalize their measure of vulnerability.

Witt and Waibel (2009) did a study of vulnerability to poverty in rural Cameroon. They used a method of Lower Partial Moments (LPMs) to measure vulnerability as downside risk of household income. They argue that combining LPMs with the VEP method will incorporate risk averseness (without using an arbitrary risk coefficient) into the VEP method and thus address Ligon and Schechter (2003) critique that VEP does not take into account risk as it implicitly assumes risk neutrality. They used the general portfolio theory (Markowitz, 1952) to estimate the stochastic distribution of household farm income which they defined as a

function of the distributions of its individual components and the subjective probabilities of different states of the world.

The data of Witt and Waibel (2009) consisted of 238 households which consisted of four livelihood groups; fishermen, rice, millet and sorghum farmers. Their study found that fishermen were the least vulnerable, followed by sorghum, millet farmers, rice farmers were the most vulnerable. However when applying the mean portfolio income as a moving target in the calculation of Lower Partial Moments fishermen face a higher risk (than millet and rice farmers) of not being able to maintain their mean portfolio income. They also found that in general the vulnerability rate was more than the poverty rate. Their study is highly informative and innovative despite the small sample size, however, the LPMs method generates results where by vulnerability rate is higher than the poverty rate.

Foster et al. (2010) criticised vulnerability as expected poverty measures that they generate indicators whereby the poor are a subset of the vulnerable. This is because such measures include the poor as well as those living on the poverty line. Thus the percentage of individuals who are vulnerable will always be greater than the percentage of individuals who are poor. They also criticise methods that link the inability to smooth consumption (independent of an external poverty line) with vulnerability to poverty arguing that standard deviations around an individual's consumption path might not be a good indicator of vulnerability. It is not accurate to equalise a poor person's consumption variability with that of a rich person as a poor person's consumption variability might hit an irreversible low level (Christiaensen and Subbarao, 2004).

Foster et al. (2010) go on to create a new measure of vulnerability to poverty based on a conceptual framework of decision making under uncertainty. In their framework vulnerability is linked with uncertainty in the future outcomes of income (or other indicators such as consumption). They argue that a good measure of vulnerability has the following characteristics 1) It has to be an ex-ante measure, that tells us about possible deprivations in the future 2) It has to focus on downside risk i.e. it should look at consumption shortfalls from a given threshold 3) It has to be individual specific, since individuals are heterogeneous and may respond differently to the same level of risk. Their measure uses a reference line which is a hybrid of an individual's current standard of living and the poverty line. A person will be vulnerable to poverty if his future income or consumption is below the reference line.

Celidoni (2011) did a study to check which vulnerability index was better. She used household data from Italy, Germany and the UK. She compared vulnerability indices of (Dutta et al. 2011; Foster, Greer and Thorbecke (after Foster et al. 1984); Calvo and Dercon, 2005; Pritchett et al. 2000; Chaudhuri, 2003). She found that the Dutta et al. (2011) (also referred as Foster et al. 2010) measure of vulnerability performed better than other indices. However, one criticism of the Foster et al. (2010) index is that it is not possible to assign probabilities to different states of nature when there is complete uncertainty. Also different future states of nature might need different poverty lines (and reference lines).

With respect to Tanzania, a number of studies have been done. Christiaensen and Sarris (2007) did a study on vulnerability to poverty among small scale cash crop growers in the regions of Ruvuma and Kilimanjaro. They looked at the possibility of the use of market based instruments such as commodity price and rainfall insurance as a means of combatting climatic risks in the two regions. Their study used a two round panel data (collected by REPOA); round one had 957 households for Kilimanjaro (November 2003) and 892 households for Ruvuma (February 2004) and round two had 915 households for Kilimanjaro (November 2004) and 837 households for Ruvuma (February 2005).

They found that rural households live in risky environments and around two thirds of households have experienced a major shock. Important shocks for both regions were death and illness (mainly Malaria) while drought was relevant for Kilimanjaro. Households coped with shocks through using own cash savings and help from family and friends as there was no formal insurance schemes. Ex-ante coping strategies involved income and crop diversification. Declining cash crop prices caused households in Kilimanjaro to switch from coffee to bananas while those of Ruvuma to plant more cash crops (coffee and cashew nuts).

Their analysis of vulnerability to poverty found that households in Kilimanjaro were significantly less vulnerable to poverty (and also less poor) than households in Ruvuma. The vulnerability index (and poverty rate) was 0.31 (0.41) for Kilimanjaro and 0.6 (0.63) for Ruvuma. Land size, crop productivity, consumer durables and Saccos membership, were found to reduce vulnerability to poverty in the two regions. They also found that there was substantial demand for cash crop price insurance and rainfall based insurance however households' lack of cash might hinder the actual implementation of such schemes. They suggested that public subsidies will have to be produced for such schemes to take off.

Christiaensen and Pan (2010) did a study on poverty evolution and the input voucher program in Kilimanjaro and Ruvuma regions. Their study included a new third round of panel data (collected by REPOA) that was a continuation of the panel data that was used by Christiaensen and Sarris (2007). This new panel data was collected in 2009. They found that poverty has risen in Kilimanjaro while it has declined in Ruvuma (from round 1 to round 3). They also found that crop productivity has declined in Kilimanjaro while in Ruvuma it has increased. They argued that drought, low coffee prices and high input prices were the reason for poverty increase in Kilimanjaro.

They found that the input voucher program increased the use of inorganic fertilizer and improved seeds. They also found that social connections (like being in the village voucher committee) increase the probability of receiving input vouchers. They argue that there was no clear evidence that input vouchers increased agricultural productivity.

However the above studies did not analyse asset based vulnerability to poverty as well as its relationship to consumption based vulnerability to poverty. Echevin (2011) is one of the few studies which analyses vulnerability to asset poverty. His study analyses vulnerability to asset poverty in nine Sub-Sahara African countries and Haiti, using a pseudo panel data. He argues that vulnerability to asset poverty is a good proxy for vulnerability to consumption poverty.

The above literature review leads us to test the following research hypotheses: 1) individuals that are vulnerable to asset poverty are also vulnerable to consumption poverty; 2) the poverty rate is higher than mean vulnerability.

The original contribution of this chapter is: 1) it uses panel data to analyse vulnerability to asset poverty and its determinants in the spirit of Christiaensen and Subbarao (2004); 2) it looks at a wider range of determinants of vulnerability to asset poverty than Echevin (2011); 3) it analyses uninvestigated determinants of vulnerability to consumption poverty and asset poverty i.e. infrastructure variables.

4.3 Theoretical framework

Vulnerability to poverty is defined as expected poverty; the probability that an individual or a household will be poor in the future (Chaudhuri et al, 2002; Chaudhuri, 2003; Hoddinott and Quisumbing, 2003).

Poverty is "a human condition characterized by sustained or chronic deprivation of the resources, capabilities, choices, security and power necessary for the enjoyment of an adequate standard of living and other civil, cultural, economic, political and social rights." [1]

Vulnerability to poverty is an ex ante measure of well-being while current poverty is an ex post measure of wellbeing. Vulnerability to poverty takes into account the stochasticity of poverty. If there is no risk and the future is certain then poverty equals vulnerability to poverty (Chaudhuri, 2003).

Risk is defined as a potentially harmful event that is likely to adversely affect the welfare of a household when it occurs (Chaudhuri et al, 2002). A shock is defined as an adverse event that leads to a loss of household welfare. A shock is a manifestation (actual occurrence) of a risk. If a household is fully insured, risk is no longer a problem as an occurrence of a shock will not affect its welfare (Dercon, 2000) (Dercon et al, 2005).

The risk chain is usually employed to explain the theoretical framework of vulnerability to poverty. The risk chain shows how households living in risky environments use their assets to generate income which they use to consume and or save. These households also use their incomes and assets to manage risk and thus reduce vulnerability to poverty (Hoddinott and Quisumbing, 2003).

A typical household in rural Tanzania can have personal assets (land, house, livestock education, money and social networks), can have access to community infrastructure (markets, schools, hospital and roads) and can have access to environmental resources (forests, water, fisheries, fertile soil and good climate). Household can alter their asset portfolio depending on their preferences. Some of the assets can be used to generate income (agricultural land) while some of them can be a store of value (money or livestock). Once income has been generated it is used for consumption, a part of it can be used for savings. However this household is vulnerable to poverty as it lives in a risky and uncertain environment with a probability of a shock occurring being greater than zero (Hoddinott and Quisumbing, 2003; RAWG, 2004).

An occurrence of shock will reduce the welfare of the household. Thus the household has to adopt ex-ante risk management strategies that will reduce the likelihood of a shock occurring. In case a shock cannot be avoided the household will adopt ex-post risk management

[1] UN Economic and Social Council, Committee on Economic, Social and Cultural Rights (2001).

strategies to minimize or completely neutralize the impact of the shock on household welfare (Alderman and Paxson, 1992; Dercon, 2000; Holzmann, 2001). Risks can be idiosyncratic or covariate. Covariate risks affect every person in the community, while idiosyncratic risks affect only individuals (Dercon, 2000).

Since the household exists in a society it is affected by institutions as well as policies Hoddinott and Quisumbing (2003). These institutions and policies can increase or reduce vulnerability to poverty. Institutions such as markets, agricultural cooperatives and SACCOs can facilitate income generation and thus reduce vulnerability. Pro-poor government policies such as cash transfers, social protection, provision of social services and infrastructure (health, education, water, roads) can also reduce vulnerability to poverty.

Anti-poor government policies such as bad regulation, over-taxation, corruption and human rights violation usually increase vulnerability to poverty. Institutions and policies also affect risk management strategies, household assets and other household characteristics (such as the level of human capital). Institutions and policies can also directly affect risks. I.e. a campaign to destroy mosquito habitats will reduce the risk of contracting malaria.

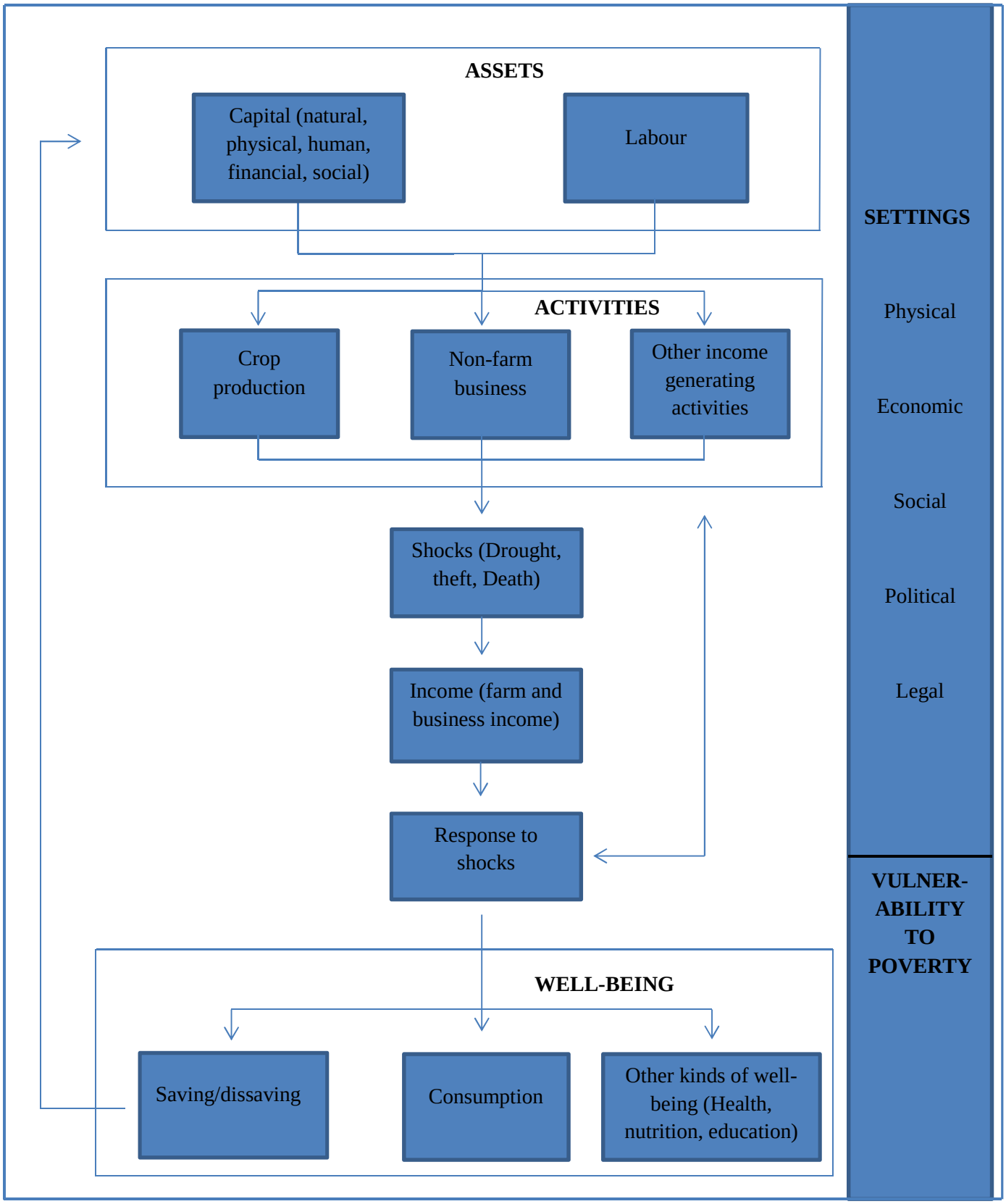
Figure 4.1, shows the vulnerability framework (of settings, assets, activities and well-being) adopted (but slightly modified) from Hoddinott and Quisumbing (2003), Dercon (2001) and Chaudhuri (2003). The macro environment within which the household exists is called settings. The settings are grouped into physical settings (the natural environment such as soil fertility and the climate), economic settings (institutions and policies that affect the generation of income from assets), social settings (traditions that influence human relations), political settings (the processes that generate rules and regulations) and legal settings (the rules and regulations that govern the society).

A household owns assets or capital which is grouped into natural capital (land), physical capital (house, livestock, farming tools and simple agro-processing machinery), human capital (education, health), financial capital (money and financial debts) and social capital (social networks).

The household undertake activities using their assets within the settings. Activities include crop production (food or cash crop production), non-farm business and other income generating activities such as employment and remittances. The household faces risk and experience shocks (drought, theft and death). The household responds to risk and shocks in

an ex-ante or ex-post manner. The interaction of settings, assets, activities and shocks determines the income and well-being of the household as well as its vulnerability to poverty (Hoddinott and Quisumbing, 2003; Dercon, 2001; Chaudhuri, 2003).

Figure 4.1: Settings, assets, activities and wellbeing



Source: Adopted from Hoddinot and Quisumbing (2003), Dercon (2001) and Chaudhuri (2003).

Vulnerability to poverty model

The vulnerability to poverty model assumes that: (a) Individuals have rational expectations; they are forward looking and do not make systematic errors. (b) Households maximize inter-temporal expected utility subject to an inter-temporal budget constraint. (c) Households have a positive discount rate and thus they prefer to consume now rather than in the future. (d) Households' have instantaneous concave utility functions and their marginal utility of consumption is convex. (e) Households have a precautionary savings motive since marginal utility of consumption is convex. (f) Marginal propensity to consume out of permanent income is greater than 0 but less than 1. (g) Households are risk averse. (h) Households' positive discount rates (impatience) prevents overaccumulation of assets. (i) Individuals can save and de-save assets and goods. (j) Vulnerability to poverty cannot be observed directly. (k) There is a stochastic probability distribution of consumption. (l) The probability distribution of consumption is log normal; hence it is entirely captured by the mean and variance. Thus to estimate vulnerability you need to estimate the mean and variance of future consumption (Chaudhuri, 2003; Deaton, 1992; Alderman and Paxson, 1992; Dercon, 2000; Skoufias, 2003).

Vulnerability (V_{ht}) is defined as the probability that consumption in the next period (C_{t+1}) will be less than an ex ante defined poverty line L:

$$V_{ht} = \Pr(C_{h,t+1} \leq L)$$

Assuming that the probability distribution of consumption can be estimated efficiently, we can calculate a vulnerability index at time t for household h by using a FGT formula:

$$V_{h,t,v} = F(Y) \int_{\underline{C}_t}^{L} (L - C_t)^v \frac{f(C_{h,t})}{F(L)} \, dC_t$$

The formula for the poverty index can be represented as:

$$P_{ht} = \frac{u(L) - u(C_{ht})}{|u(L)|}$$

L is a predetermined poverty line, C_{ht} is the consumption level of household h at time t and $u(.)$ is an increasing function representing household utility.

$$u(C) = L^{\propto} - (\max\{0, L - C\})^{\propto}$$

$\propto$ takes only integer values.

The above poverty index reduces to the famous Foster-Greere-Thorbecke (1984) family of poverty measures:

$$P_{\propto,ht} = (max\left\{0, \frac{L - C_{ht}}{L}\right\})^{\propto}$$

When $\propto = 0$, the poverty index becomes a binary indicator of whether or not a household is poor. When $\propto = 1$, the poverty index becomes the poverty gap ratio and when $\propto = 2$, it becomes the poverty gap squared.

The formula for vulnerability can be presented as:

$$V_{\propto,h,t} = E[P_{\propto,h,t+1}(C_{h,t+1})|F(C_{h,t+1})]$$

$$= \int (max\left\{0, \frac{L - C_{h,t+1}}{L}\right\})^{\propto} dF\,(C_{h,t+1})$$

$$F(L)\int_{\underline{C}}^{L} (\frac{L - C_{h,t+1}}{L})^{\propto} \frac{f(C_{h,t+1})}{F(L)} dC_{h,t+1}$$

Where by $f(C_{h,t+1})$ is the density function and $F(C_{h,t+1})$ is the cumulative distribution function (Chaudhuri, 2003).

In economic terminology, variance of the error term is interpreted as the inter-temporal variance (volatility) of log consumption. Different households have different variances of future consumption. Thus the error term is heteroskedastic (Chaudhuri, 2003). We need to use a flexible heteroskedastic consumption function to incorporate and correct heteroskedasticity (Christiaensen and Subbarao 2004).

Vulnerability to asset poverty

Poverty is a multidimensional phenomenon hence analyzing vulnerability to non-consumption poverty will give us a clearer picture of vulnerability to poverty. Dercon (2001) set the stage for this idea by arguing that we can analyse vulnerability to non-consumtpion poverty just as we analyze vulnerability to consumption (or income) poverty. One of the candidates he proposed was vulnerability to asset poverty. For a more recent study on vulnerability to asset poverty refer to Echevin (2011) who analyses vulnerability to asset poverty in nine Sub-Sahara African countries and Haiti, using pseudo panel data.

4.4 Econometric Model

This section presents the econometric model used to analyze vulnerability to poverty. The econometric model of vulnerability to poverty follows (Christiaensen and Subbarao, 2004; Just and Pope, 1979; Hoddinott and Quisumbing, 2003; Makoka, 2008) and is represented by:

$$\ln C_{hjt} = X_{hjt-1}\beta + S_{hjt}\alpha + S_{hjt}\emptyset' X'_{hjt-1} + \omega_{hj} + e_{hjt}$$

$$= X_{hjt-1}\beta + S_{hjt}\alpha + S_{hjt}\emptyset' X'_{hjt-1} + \omega_{hj} + k^{\frac{1}{2}}(X_{hjt-1};\delta)^{*}\,\varepsilon_{hjt}$$

Where by $\varepsilon_{hjt} \sim N(0, \sigma_{\varepsilon}^2)$

The conditional mean and variance can be expressed as follows:

$$E(\ln C_{hjt} | X_{hjt-1}) = X_{hjt-1}\beta + E(S_{hjt})[\alpha + \emptyset' X'_{hjt-1}] + E(\omega_{hj}) \quad (1)$$

$$V(\ln C_{hjt} | X_{hjt-1}) = [\alpha + \emptyset' X'_{hjt-1}]' V(S_{hjt})[\alpha + \emptyset' X'_{hjt-1}] + \sigma_{\omega}^2 + k(X_{hjt-1};\delta)^{*}\sigma_{\varepsilon}^2 \quad (2)$$

Ln C_{hjt} is ln of real household expenditure in 2009. X represents other independent variables (in period t-1) that affect vulnerability to poverty such as household size, access to tap water, gender, age and education of the household head.

The consumption function has been specified into a flexible heteroskedastic form. The advantage of the above heteroskedastic specification is: (a) it allows the variance of the disturbance term of consumption to vary across households depending on the variance of household shocks, household characteristics and their locality and differential effect of the shock on the household. (b) It allows shocks to affect various households in different ways. (c) It allows the marginal effects of the independent variables on the ex-ante mean to have a different sign compared to the marginal effect of the independent variable on the variance of future consumption (Just and Pope, 1979; Christiaensen and Subarao, 2004; Makoka, 2008).

The above equations (1 and 2) can be used to estimate the exante mean and variance of a household's future consumption (Christiaensen and Subbarao, 2004). The estimation of the regression coefficients $\beta, \alpha, \emptyset$ and δ require a three step heteroskedastic correction procedure (also known as Feasible Generalised Least Squares method) proposed by Judge et al. (1988). We can predict the household mean and variance of future consumption using all of the above independent variables. Assuming there is log-normality we can then estimate household vulnerability to poverty two time periods ahead. The log-normality assumption allows the entire distribution of consumption to be captured by its mean and variance (Christiaensen and Subbarao, 2004; Chaudhuri, 2003; Makoka, 2008).

Note that when estimating household vulnerability to asset poverty, Ln C_{hjt} is replaced by Ln A_{hjt}, which is the ln of real household assets in 2009.

4.5 Data

Data has been obtained from the REPOA rural vulnerability household panel survey for Kilimanjaro and Ruvuma regions. The survey was conducted by REPOA in three rounds; in Kilimanjaro in November 2003, November 2004 and November 2009 and in Ruvuma in February 2004, February 2005 and April 2009. The same households were traced and interviewed. In Kilimanjaro, 957 households were interviewed in the first round, in the second round 915 and in the third round 793; the corresponding figures for Ruvuma were 892, 837 and 691 households respectively.

The analysis will look at the first and third rounds of the survey (the 2004/5 and 2009 rounds). It should be noted that the National Strategy For Growth and Reduction of Poverty I (NSGRP I) was implemented between 2005 and 2010, thus by analyzing this period we

would be able to look at the short run impact of NSGRP I on vulnerability to poverty at the regional level.

In Ruvuma 36 villages from 4 districts (Songea rural, Tunduru, Mbinga and Namtumbo) were included in the survey. Songea Urban district was excluded as it is an entirely urban district. In Kilimanjaro 45 villages from six districts (Rombo, Mwanga, Same, Moshi rural, Hai and Siha) were included in the survey. Moshi urban district was excluded because it is an entirely urban district.

All of the interviewed households are small scale farmers; some of them grow cash crops (like coffee or cashew nuts) and some of them don't. Large scale farms (whether private or public) were excluded. A household member was defined as someone who usually eats and lives in the household. The questions were answered by the household head or the most knowledgeable household member.

The survey consumption data uses a seven-day recall module on food, beverages, and tobacco; a one-month recall module on non-durable goods and frequently purchased services including housing expenditures, personal care, transportation, communication and health expenditure; and a one-year recall module on durable goods and services, as well as education and non-consumption expenditures. Household non-consumption expenditure includes items such as taxes, social security contributions, funeral contributions as well as gifts given to other people.

Household aggregate consumption is obtained by adding consumption items purchased by the household, consumption items produced by the household and consumption items received as gifts. Regional median prices that are obtained from the survey are used to value gifts and own produced consumption items. However, aggregate consumption excludes expenditures on water, postage, rent, health care, education, durables and non-consumption expenditure.

Household aggregate assets are obtained by adding the value of production assets, the value of consumer durables, the value of livestock, the value of the house and its compound (that is the value of the house plus the value of the land surrounding the house), and the value of another house and its compound if the household has one extra house. The asset poor are those whose value of assets is below the asset poverty line. The asset poverty line equals the consumption poverty line. We take this concept of asset poverty line from Haveman and Wolff (2004) and Sierminska (2012). Haveman and Wolff (2004) set the asset poverty line at

25% of the consumption poverty line. Haveman and Wolff (2004) defined assets as net worth of households i.e. marketable assets minus debts. Sierminska (2012) set the asset poverty line at 50% of the consumption poverty line. Sierminska (2012) considered assets to be financial assets. Another type of asset poverty line is that of Carter and May (2001), who define asset poverty line as the minimum amount of assets required to produce a livelihood above the consumption poverty line. We build upon these definitions and set the asset poverty line to equal the consumption poverty line. In Kilimanjaro in 2003 the annual consumption poverty line was 148,000 TZS per adult equivalent and in 2009 it was 293,987 TZS per adult equivalent. In Ruvuma in 2004 the annual consumption poverty line was 151,200 TZS per adult equivalent and in 2009 it was 275,599 TZS per adult equivalent.

For round 1, the author uses the data that was cleaned and aggregated by Christiaensen and Sarris (2007), with the exception of net food sellers, per capita education and other variables which have been calculated by the author. For round 2, the author uses shocks data (like drought, illness and death) which has been calculated by the author. For round 3, the author has cleaned and aggregated the raw data himself; this includes the data on assets, consumption, shocks, median crop prices, household size and the remaining variables. The only data that is used in round 3 that was cleaned and aggregated by Christiaensen and Pan (2010) is household income data: this is data on adult equivalent household income, wages, business income, other non-farm income, farm (crop) income and other farm income.

As a result of the above reasons the author's round 3 estimates will differ to those of Christiaensen and Pan (2010). For comparison reasons the poverty lines used by the author for the two regions is the continuation of the round 1 poverty lines that were used by Christiaensen and Sarris (2007) adjusted by the round 3 price indices of Christiaensen and Pan (2010). The above leads to one notable difference that the author's consumption poverty estimates will show that in round 3 Ruvuma is poorer than Kilimanjaro. While the estimates of Christiaensen and Pan (2010) (who uses different poverty lines) will show that in round 3 Kilimanjaro is poorer than Ruvuma.

For more detailed information about the REPOA panel survey and its characteristics refer to Christiaensen and Sarris (2007) and Christiaensen and Pan (2010). The descriptive statistics of the variables used in the ex-ante mean and ex-ante variance models of consumption and assets are in Appendix C (see tables C1 and C2).

4.6 Results and discussion

This section presents and discusses the results of the econometric models of the determinants of ex-ante mean and variance of consumption and of assets. These econometric models are then used to estimate the levels of vulnerability to (consumption and asset) poverty.

Vulnerability to consumption poverty

This section now discusses the results of the determinants of ex-ante mean and ex-ante variance of future consumption (see table 4.1) that are used to estimate vulnerability to consumption poverty (see figures 4.2 and 4.3). The choice of independent variables is guided by economic theory (Dercon, 2001; Chaudhuri, 2003; Hoddinott and Quisumbing, 2003). Only statistically significant results are discussed.

In Kilimanjaro having a village leader in the household increases ex-ante mean consumption and thus reduces vulnerability. While in Ruvuma it reduces ex-ante mean consumption and thus increases vulnerability. Households with village leaders are expected to have more social and political capital which can be translated into higher income and consumption. This is the case in Kilimanjaro but it is not so in Ruvuma. May be in Ruvuma some of the village leaders lost elected office or the costs of being a village leader outweighed the benefits.

In both regions the education of household head increases ex-ante mean consumption and thus reduces vulnerability. The more educated a household head is the more income he has and thus the less vulnerable his household is. A more educated household head can easily adopt modern farming techniques, he can easily access market information and he can engage in more lucrative off-farm employment.

Households with a female head have lower ex-ante variance of consumption and are thus less vulnerable to consumption poverty in Kilimanjaro, while in Ruvuma this variable is not statistically significant. The result in Kilimanjaro is unexpected as literature findings show that female headed households usually have lower income. The reason might be that friends and relatives are more likely to assist a household with a female head when such a household is in difficult times and thus reduce the variance of consumption and or the female head is more likely to spend on household consumption during difficult times (such as buying food for the children).

In both regions large adult equivalent household size reduces ex-ante mean consumption and thus increases vulnerability. Large households are more vulnerable as household

consumption has to be distributed among many members (Christiaensen and Subbarao, 2004). In Kilimanjaro the percentage of household members aged between 0 and 4 years increases ex-ante mean of consumption and thus reduces vulnerability but it also increases the variance of consumption and thus increases vulnerability. In Ruvuma its impact is insignificant. The reason might be such households bear children when they are expecting a brighter future and or they receive help from extended family but when they have children it becomes difficult to smooth consumption especially in difficult times.

In Kilimanjaro households with migrants have higher ex-ante mean of consumption and thus have lower vulnerability. This is because migrants send remittances to their original households. Adult equivalent business income increases the variance of consumption in Kilimanjaro while in Ruvuma this result is insignificant. In Kilimanjaro a higher business income might be associated with a higher fluctuation of income i.e. may be due to fluctuating business profits. And thus it increases ex-ante variance of consumption.

Adult equivalent farm (crop) income increases ex-ante mean consumption in Kilimanjaro and thus reduces vulnerability. While in Ruvuma it increases the variance of consumption and thus increases vulnerability. In Kilimanjaro, a higher farm income increases household's income and thus enables the household to have higher consumption. In Ruvuma a higher farm income might be associated with a higher fluctuation of income i.e. may be due to fluctuating crop prices. And thus it increases ex-ante variance of consumption.

Households in Kilimanjaro that have a Saccos member have lower ex-ante variance of consumption and are thus less vulnerable to poverty. In Ruvuma this variable is insignificant. Households with SACCOS members are less vulnerable as they can save and borrow money from their SACCOS and use the money to smooth consumption. In both regions households that hire farm labourers have higher ex-ante mean consumption and thus are less vulnerable. Hiring farm labourers increases labour supply and thus increases income and consumption and hence reduces vulnerability. Hiring farm labour also indicates more commercialisation of farms and hence more profitable farming.

Land owned per adult equivalent increases the ex-ante variance of consumption in Kilimanjaro and thus increases vulnerability. In Ruvuma it decreases the ex-ante variance of consumption and thus reduces vulnerability. In Kilimanjaro higher land ownership hinders consumption smoothing may be due to fluctuating rainfall which makes land more productive in good times (when there are also good rains) and less productive in bad times (when there

are also bad rains). Thus the more land owned the larger the fluctuations in income and consumption between good and bad periods (due to fluctuations in land productivity). In Ruvuma higher land ownership contributes to consumption smoothing due to more stable rainfall. Another reason might be that in Kilimanjaro it is more difficult to sell land (and smooth consumption) than in Ruvuma due to shortage of land in Kilimanjaro.

The value of medium livestock owned per adult equivalent increases ex-ante mean consumption in Kilimanjaro and thus reduce vulnerability. In Ruvuma this variable is insignificant. The more medium livestock (goats, pigs and sheep) a household owns the more income it can get from selling them (or their products such as meat and milk) and thus the higher its consumption.

In both regions the value of consumer durables owned per adult equivalent increases ex-ante mean consumption and thus reduces vulnerability. The more consumer durables a household own the more income it has and thus the higher its consumption. Consumer durables generate utility and they also represent household wealth. They can be sold for cash or they can be used as collateral for microloans. Some consumer durables such as beds, sofas, tables, chairs, cupboards, refrigerators and cooking stoves improve household health and hygiene and thus improve household productivity and income.

Households with electricity in Kilimanjaro have higher ex-ante mean of consumption and thus have lower vulnerability. Access to electricity improves farm and non-farm income (via agro-processing, lighting of retail outlets and saving time used to fetch for firewood) and thus enables households to have higher ex-ante mean of consumption. Households in Kilimanjaro with access to own or public tap water have higher ex-ante mean of consumption and thus have lower vulnerability. In Ruvuma this variable is insignificant. Access to tap water improves farm and non-farm income (via irrigation and saving time used to fetch for water) and thus increase ex-ante mean of consumption.

In Kilimanjaro households in villages with tarmac or gravel road have higher ex-ante mean of consumption and thus have lower vulnerability. In Ruvuma this variable is insignificant. Households in villages with good road infrastructure have lower transport costs and lower transaction costs and thus are more productive and have higher income and higher ex-ante mean of consumption.

In Kilimanjaro households in Rombo, Mwanga, Same and Moshi rural districts have lower ex-ante mean consumption and are thus more vulnerable to consumption poverty. Households in Rombo, Mwanga, Same and Moshi rural districts have characteristics that reduce mean consumption and increase vulnerability such characteristics might be caused by low volume of rainfall and or low soil fertility. The district with the lowest ex-ante mean consumption is Rombo, followed by Same followed by Mwanga and then Moshi rural. Households in Same also have lower ex-ante variance of consumption.

In Ruvuma households in Tunduru district have lower ex-ante mean consumption and are thus more vulnerable to consumption poverty. While households in Mbinga district have higher ex-ante mean consumption and are thus less vulnerable to consumption poverty. Households in Tunduru district have characteristics that reduce mean consumption and increase vulnerability such characteristics might be caused by low volume of rainfall and or low soil fertility.

A shock of theft (2004-2009) reduces the ex-ante variance of consumption in Kilimanjaro and thus reduces vulnerability. In Ruvuma shocks of unexpected decline in cash crop prices (2005-2009) and loss of livestock (2005-2009) increases the ex-ante mean consumption and thus reduces vulnerability. And a shock of major harvest losses (2005-2009) reduces the ex-ante variance of consumption and thus reduces vulnerability. The reason that such shocks have unexpected signs is because they affect prosperous farmers who already have higher ex-ante mean of consumption or lower ex-ante variance of consumption.

In Ruvuma a shock of drought (2005-2009) reduces the ex-ante mean of consumption and thus increases vulnerability but it also reduces the ex-ante variance of consumption and thus decreases vulnerability. A shock of drought reduces farm output and thus reduces farm income and ex-ante mean of consumption. But it also reduces the variance of consumption may be drought hit families receive help from family and friends and or they receive government food relief which enables them to smooth their consumption.

Table 4.1: GLS results of the determinants of vulnerability to consumption poverty in Kilimanjaro and Ruvuma

VARIABLES	Kilimanjaro		Ruvuma	
	Ln ex-ante Mean	Ln ex-ante Variance	Ln ex-ante Mean	Ln ex-ante Variance
Has a village leader	0.0825**	0.218	-0.0943**	-0.312
	(2.004)	(1.025)	(-1.973)	(-1.595)
Ln head age	0.0926	0.682	-0.0622	0.548
	(1.086)	(1.547)	(-0.695)	(1.494)
Ln head education	0.0771**	0.179	0.0872**	0.112
	(2.374)	(1.066)	(2.076)	(0.653)
Female head	0.0394	-0.755**	-0.0235	-0.0680
	(0.660)	(-2.447)	(-0.232)	(-0.164)
Ln of adult equivalent	-0.277***	-0.246	-0.212***	-0.224
household size	(-5.382)	(-0.925)	(-3.740)	(-0.968)
Ln percentage aged (0-4)	0.0295**	0.169**	-0.00745	-0.0677
	(2.141)	(2.374)	(-0.481)	(-1.066)
Migrated before 2003	0.118***	0.180		
	(3.034)	(0.896)		
Ln of adult equivalent	-0.00480	0.108*	0.0134	0.0714
business income	(-0.412)	(1.792)	(1.000)	(1.302)
Ln of adult equivalent	0.0352**	-0.0978	0.0184	0.482***
farm income	(2.218)	(-1.191)	(0.793)	(5.081)
Member of Saccos	-0.0633	-0.715***	-0.0108	0.108
	(-1.259)	(-2.753)	(-0.147)	(0.362)
Hires farm labour	0.114***	-0.166	0.145***	-0.180
	(2.631)	(-0.741)	(2.702)	(-0.817)
Ln of land owned per	0.0427	1.056**	0.0675	-0.313*
adult equivalent	(0.506)	(2.416)	(1.588)	(-1.797)
Ln of value of big livestock	0.0133	-0.0866	0.0246	-0.0555
owned per adult equivalent	(1.245)	(-1.572)	(1.347)	(-0.744)
Ln of value of medium	0.0267*	-0.0452	0.00261	0.0946
livestock owned per adult equivalent	(1.932)	(-0.634)	(0.140)	(1.244)
Ln of value of consumer	0.0555***	-0.0477	0.0953***	-0.0258
durables owned per adult equivalent	(2.644)	(-0.440)	(4.094)	(-0.271)
Has electricity	0.120**	0.325		
	(1.990)	(1.042)		
Has access to own or	0.103**	0.163	0.0342	0.104
public tap water	(2.439)	(0.748)	(0.684)	(0.507)
Village has tarmac or	0.0905**	-0.159	-0.0349	0.0716

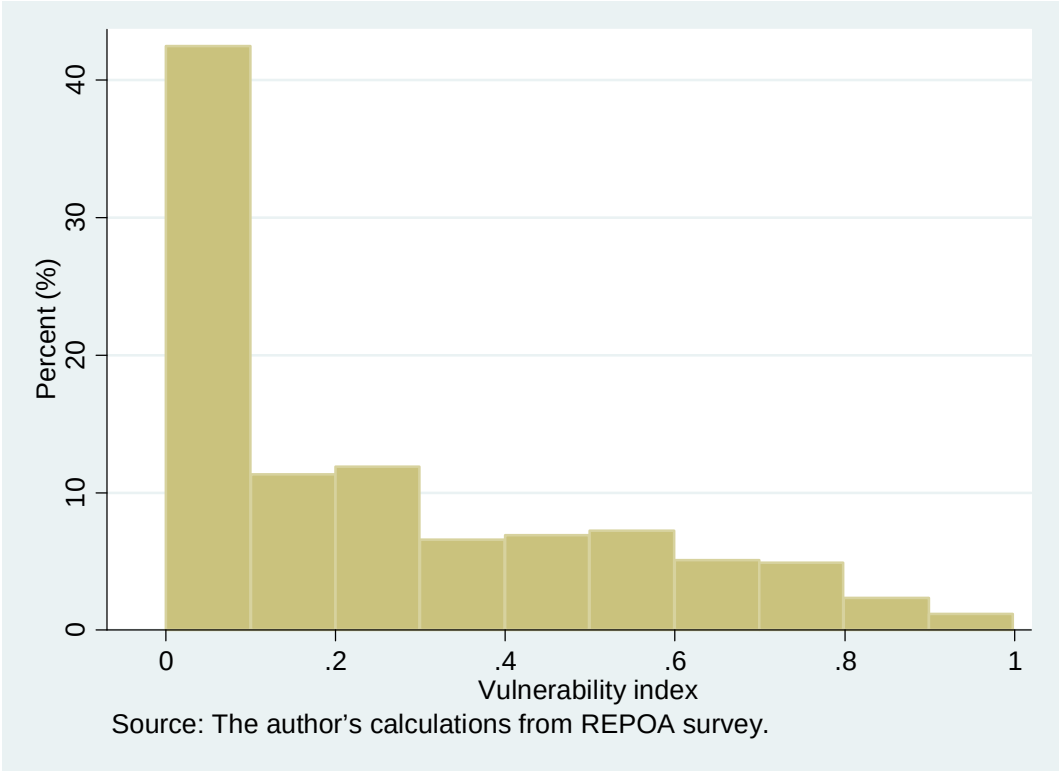
gravel road	(2.230)	(-0.759)	(-0.559)	(0.280)
Village has market	-0.0145	-0.0792	0.0575	0.00160
	(-0.326)	(-0.344)	(1.096)	(0.00743)
Rombo district	-0.352***	-0.0232		
	(-5.093)	(-0.0650)		
Mwanga district	-0.161*	0.151		
	(-1.736)	(0.315)		
Same district	-0.164**	-0.685*		
	(-2.101)	(-1.699)		
Moshi Rural district	-0.139**	-0.228		
	(-2.443)	(-0.774)		
Songea rural district			0.0636	0.194
			(0.586)	(0.438)
Tunduru district			-0.264***	0.151
			(-3.120)	(0.437)
Mbinga district			0.151*	0.0285
			(1.697)	(0.0783)
Theft (2004-2009)	0.0724	-0.997***		
	(1.309)	(-3.487)		
Death (2004-2009)	-0.0862	0.264		
	(-1.494)	(0.887)		
Drought (2005-2009)			-0.171***	-0.568**
			(-3.072)	(-2.493)
Unexpected decline in cash			0.208***	0.0414
crop prices (2005-2009)			(3.786)	(0.184)
Major harvest losses			0.0793	-0.608***
(2005-2009)			(1.461)	(-2.738)
Loss of livestock			0.243***	0.0277
(2005-2009)			(3.827)	(0.107)
Constant	4.700***	-5.162***	4.982***	-5.968***
	(12.62)	(-2.682)	(13.28)	(-3.888)
Observations	768	768	673	673
R-squared	0.250	0.082	0.292	0.090
Adjusted R-squared	0.225	0.0510	0.266	0.0561
F test	9.887***	2.648***	11.13***	2.663***

T-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: The author's calculations.

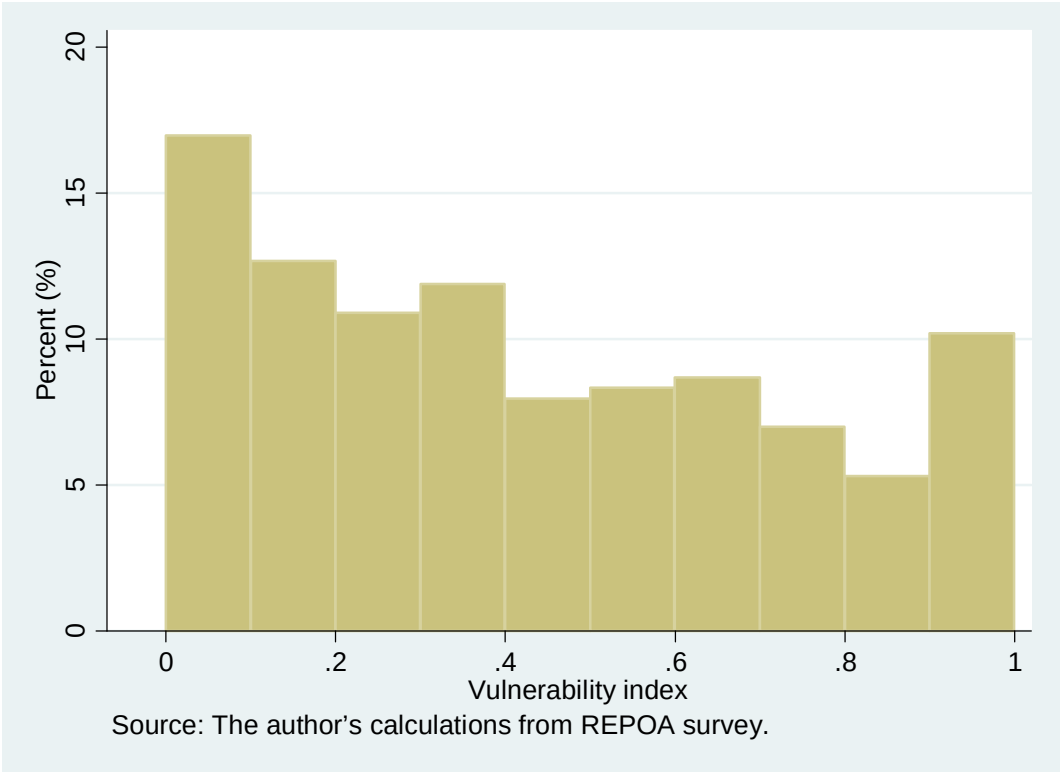
When the probability of consumption shortfall is 0.5 or more, 20.2% of individuals in Kilimanjaro are vulnerable to consumption poverty (see figure 4.1).

Figure 4.2: Kilimanjaro histogram of vulnerability to consumption poverty



When the probability of consumption shortfall is greater than 0.5, 39.6% of individuals in Ruvuma are vulnerable to consumption poverty (see figure 4.2).

Figure 4.3: Ruvuma histogram of vulnerability to consumption poverty



Source: The author's calculations from REPOA survey.

Vulnerability to asset poverty

This section now discusses the results of the determinants of ex-ante mean and ex-ante variance of future asset value (see table 4.2) that are used to estimate vulnerability to asset poverty (see figures 4.4 and 4.5). The choice of independent variables is guided by economic theory (Dercon, 2001; Chaudhuri, 2003; Hoddinott and Quisumbing, 2003). Only statistically significant results are discussed.

In Kilimanjaro households with village leaders have higher ex-ante variance of asset value and are thus more vulnerable to asset poverty while in Ruvuma they have a lower ex-ante variance of asset value and are thus less vulnerable to asset poverty. Households with village leaders are expected to have more social and political capital which can be translated into lower asset fluctuation. This is the case in Ruvuma but it is not so in Kilimanjaro. May be in Kilimanjaro the costs and benefits of being a village leader increase asset fluctuation i.e. village leaders might sell assets (e.g. livestock) so as to pay for election expenses.

The age of household head increases ex-ante mean of asset value in Kilimanjaro and thus decreases vulnerability to asset poverty. Older household heads have higher mean of asset value as they have been accumulating assets for a longer time period (compared to younger household heads). Households in Ruvuma with a female head have higher ex-ante mean of asset value and a lower ex-ante variance of asset value and are thus less vulnerable to asset poverty. In Kilimanjaro this variable is insignificant. This is unexpected as female headed households are expected to have lower income and thus fewer assets (and or higher asset fluctuation) due to lack of additional income from a male spouse.

The reason might be that in Ruvuma a female head of household is more likely to spend family income on productive activities that increase asset accumulation (compared to a male headed household). Also friends and relatives are more likely to assist a household with a female head when such a household is in difficult times and thus reduce asset fluctuation and also increase asset accumulation. Also the female head is more likely to smooth assets by avoiding luxurious spending in good times and by spending on household necessities during difficult times (such as buying food for the children).

A higher percentage of household members aged between zero and four years decreases the ex-ante variance of asset value in Ruvuma and thus decreases vulnerability. The reason might be that such households with young babies receive help from friends and family which in turn reduces asset fluctuation and or households bear children when they are expecting a brighter future with less asset fluctuation. In Kilimanjaro households with migrants have higher ex-ante mean of asset value and are thus less vulnerable. This is because migrants send remittances to their original households.

Business income increases ex-ante variance of asset value in Ruvuma and thus increases vulnerability to asset poverty. A higher business income might be associated with a higher fluctuation of income and assets i.e. may be due to fluctuating business profits between good and bad times. And thus it increases ex-ante variance of asset value. Households in Ruvuma that have a Saccos member have lower ex-ante variance of asset value and are thus less vulnerable to asset poverty. In Kilimanjaro this variable is insignificant. Households with SACCOS members are less vulnerable as they can save and borrow money from their SACCOS and use the money to accumulate assets or to smooth their assets.

The number of coffee trees owned increase the ex-ante mean of asset value and thus reduces vulnerability to asset poverty in both regions. A higher number of coffee trees owned

increases farm income (especially during coffee price booms) and enables households to accumulate more assets and thus increase the mean asset value. In Ruvuma the number of coffee trees owned also increases ex-ante variance of asset value. This might be caused by fluctuation of coffee prices which in turn cause fluctuation of farm income and assets. In Ruvuma the number of cashew nut trees owned increase the ex-ante mean of asset value and thus reduces vulnerability to asset poverty. A higher number of cashew nut trees owned increases farm income and enables households to accumulate more assets and thus increase the mean asset value.

Land owned per adult equivalent increases the ex-ante variance of asset value in Kilimanjaro and thus increases vulnerability to asset poverty. In Ruvuma this variable is insignificant. In Kilimanjaro higher land ownership might be associated with higher fluctuation of income and assets due to fluctuating land productivity that is related to fluctuating rainfall. Thus the more land owned the larger the fluctuations in income and assets between good and bad periods. Also in Kilimanjaro it might be difficult to buy and sell land (and hence reduce asset fluctuation) due to shortage of land.

The value of big livestock owned increases ex-ante mean asset value in Ruvuma and thus reduce vulnerability to asset poverty. In Kilimanjaro the value of big livestock owned reduces ex-ante variance of asset value and thus reduce vulnerability to asset poverty. The more big livestock (cattle) a household owns the wealthier it is and also the more income it can get from selling them (and or their products such as meat and milk) and thus the higher its ex-ante mean of asset value. Also since big livestock generate income they can also reduce fluctuation of assets.

In both regions the value of consumer durables owned increases ex-ante mean asset value and thus reduces vulnerability to asset poverty. In Kilimanjaro it also reduces the ex-ante variance of asset value. The more consumer durables a household own the more wealthy it is and thus the higher its asset value. Consumer durables generate utility and they can also generate income and thus increase household assets. They can be sold for cash or they can be used as collateral for microloans. Some consumer durables such as beds, sofas, tables, chairs, cupboards, refrigerators and cooking stoves improve household health and hygiene and thus improve household productivity and income. Also since consumer durables generate income they can also reduce fluctuation of assets.

Households with access to electricity have higher ex-ante mean of asset value and are thus less vulnerable to asset poverty in Kilimanjaro. Access to electricity improves farm and non-farm income (via agro-processing, lighting of retail outlets and saving time used to fetch for firewood) and thus enables households to have higher ex-ante mean of asset value. In Kilimanjaro households in villages with markets have higher ex-ante mean of asset value and lower ex-ante variance of asset value and are thus less vulnerable to asset poverty. In Ruvuma such households have higher ex-ante variance of asset value and are thus more vulnerable to asset poverty.

Households in villages with markets have better market access than other households in Kilimanjaro which in turn improve their income and asset accumulation and also enable them to reduce asset fluctuation. Better market access can mean a ready market for their farm output, easier availability of farm inputs, lower market transaction costs and better job opportunities. The result in Ruvuma is unexpected the reason might be that in Ruvuma markets are less integrated and thus they increase asset fluctuation i.e. in good years prices of assets and returns from assets are high and in bad years they are low. In the future this effect is likely to disappear as road construction improves market integration.

In Kilimanjaro households in Same and Rombo districts have lower ex-ante mean of asset value and are thus more vulnerable to asset poverty. While households in Mwanga and Moshi rural districts have higher ex-ante variance of asset value and are thus more vulnerable to asset poverty. Such characteristics might be caused by geographical factors such as low volume of rainfall in Same and Rombo districts and rainfall volatility in Mwanga and Moshi rural districts. In Ruvuma households in Songea rural district have higher ex-ante variance of asset value and are thus more vulnerable to asset poverty. While in Tunduru district they have lower mean of asset value and are thus more vulnerable to asset poverty. Such characteristics might be caused by geographical factors such as rainfall volatility in Songea rural district and low volume of rainfall in Tunduru district.

Shocks of death (2003-2004) and drought (2004-2009) lowers ex-ante mean asset value in Kilimanjaro and thus increases vulnerability to asset poverty. A shock of death reduces mean asset value as the household loses the deceased's income and it has to divert income to pay for funeral expenses. A shock of drought reduces farm output and thus reduces farm income and ex-ante mean of asset value. A shock of major harvest losses (1998-2003) reduces the variance of asset value in Kilimanjaro and thus reduces vulnerability to asset poverty. The

reason that such a shock in Kilimanjaro has an unexpected sign is because it affected prosperous farmers who already have lower ex-ante variance of asset value.

In Ruvuma households that experienced major harvest losses (1999-2004) have higher ex-ante variance of asset value and are thus more vulnerable. This is because such shocks reduce income and increase asset fluctuation. A shock of unexpected decline in cash crop prices (1999-2004) reduces ex-ante variance of asset value and thus reduces vulnerability. The reason that such a shock in Ruvuma has an unexpected sign is because it affected prosperous farmers who already have lower ex-ante variance of asset value.

Table 4.2: GLS results of the determinants of vulnerability to asset poverty in Kilimanjaro and Ruvuma

	Kilimanjaro		Ruvuma	
VARIABLES	Ln ex-ante Mean	Ln ex-ante Variance	Ln ex-ante Mean	Ln ex-ante Variance
Has a village leader	0.0927	0.466**	-0.0777	-0.453**
	(1.158)	(2.059)	(-1.036)	(-2.208)
Ln head age	0.361**	0.221	0.228	-0.250
	(2.403)	(0.521)	(1.585)	(-0.636)
Ln head education	-0.00257	-0.166	0.0729	-0.145
	(-0.0403)	(-0.923)	(1.056)	(-0.770)
Female head	0.106	-0.342	0.341**	-0.906**
	(0.938)	(-1.076)	(2.207)	(-2.145)
Ln of adult equivalent	-0.147	-0.213	0.0240	-0.0368
household size	(-1.594)	(-0.814)	(0.253)	(-0.142)
Ln percentage aged (0-4)	0.00613	0.0822	-0.0243	-0.153**
	(0.251)	(1.191)	(-1.004)	(-2.321)
Migrated before 2003	0.288***	0.297		
	(4.064)	(1.486)		
Ln of adult equivalent	0.00428	-0.0109	9.08e-05	0.0973*
business income	(0.235)	(-0.212)	(0.00431)	(1.687)
Ln of adult equivalent	0.0332	-0.0478	-0.0305	-0.0732
farm income	(1.177)	(-0.600)	(-0.744)	(-0.653)
Member of Saccos	0.0400	0.322	0.0784	-1.006***
	(0.385)	(1.097)	(0.880)	(-4.129)
Ln number of	0.0606***	0.0479	0.0415**	0.0845*
coffee trees	(4.263)	(1.192)	(2.304)	(1.716)
Ln number of			0.0650*	-0.00736
cashew nut trees			(1.895)	(-0.0784)

Ln of land owned per	0.180	0.842*	0.104	0.102
adult equivalent	(1.136)	(1.879)	(1.429)	(0.513)
Ln of value of big livestock	-0.000967	-0.128**	0.0921***	-0.0619
owned per adult equivalent	(-0.0489)	(-2.287)	(3.522)	(-0.865)
Ln of value of medium	0.0113	-0.109	0.0352	0.0317
livestock owned per adult	(0.462)	(-1.573)	(1.204)	(0.396)
equivalent				
Ln of value of consumer	0.232***	-0.222**	0.367***	0.0872
durables owned per adult	(6.192)	(-2.098)	(9.461)	(0.821)
equivalent				
Has electricity	0.198*	0.413		
	(1.953)	(1.444)		
Has access to own or	0.104	0.259	-0.00580	0.00242
public tap water	(1.334)	(1.176)	(-0.0712)	(0.0109)
Village has tarmac or	0.115	-0.0762	-0.0506	-0.389
gravel road	(1.635)	(-0.384)	(-0.507)	(-1.425)
Village has market	0.134*	-0.409*	0.0423	0.377*
	(1.728)	(-1.858)	(0.517)	(1.684)
Rombo district	-0.215*	0.202		
	(-1.924)	(0.642)		
Mwanga district	-0.178	0.929**		
	(-1.106)	(2.041)		
Same district	-0.482***	0.535		
	(-2.824)	(1.107)		
Moshi Rural district	0.0599	0.479*		
	(0.622)	(1.761)		
Songea rural district			0.120	1.761***
			(0.619)	(3.327)
Tunduru district			-0.720***	0.278
			(-3.701)	(0.522)
Mbinga district			0.141	0.256
			(0.901)	(0.599)
Major harvest losses	-0.0695	-0.869**		
(1998-2003)	(-0.537)	(-2.375)		
Decline in cash crop			-0.132	-0.785**
prices (1999-2004)			(-0.968)	(-2.109)
Major harvest losses			0.0916	1.322***
(1999-2004)			(0.494)	(2.607)
Major harvest losses	-0.181	-0.0693		
(2003-2004)	(-1.013)	(-0.137)		
Death (2003-2004)	-0.432**	0.275		
	(-2.520)	(0.567)		
Drought (2004-2009)	-0.229**	0.0198		

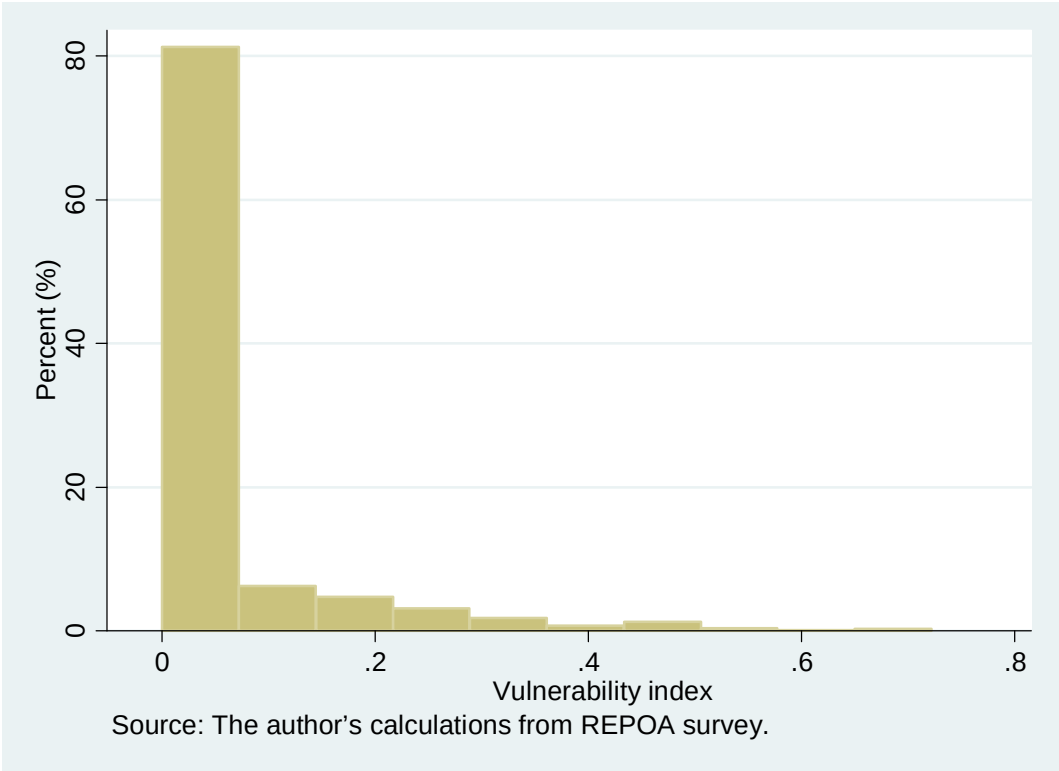
	(-2.512)	(0.0768)		
Drought (2005-2009)			0.110	0.371
			(1.063)	(1.313)
Constant	3.930***	-1.461	2.975***	-0.335
	(5.916)	(-0.778)	(4.910)	(-0.202)
Observations	793	793	691	691
R-squared	0.282	0.062	0.340	0.080
Adjusted R-squared	0.257	0.0292	0.316	0.0465
F test	11.14***	1.881***	14.28***	2.402***

T-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: The author's calculations.

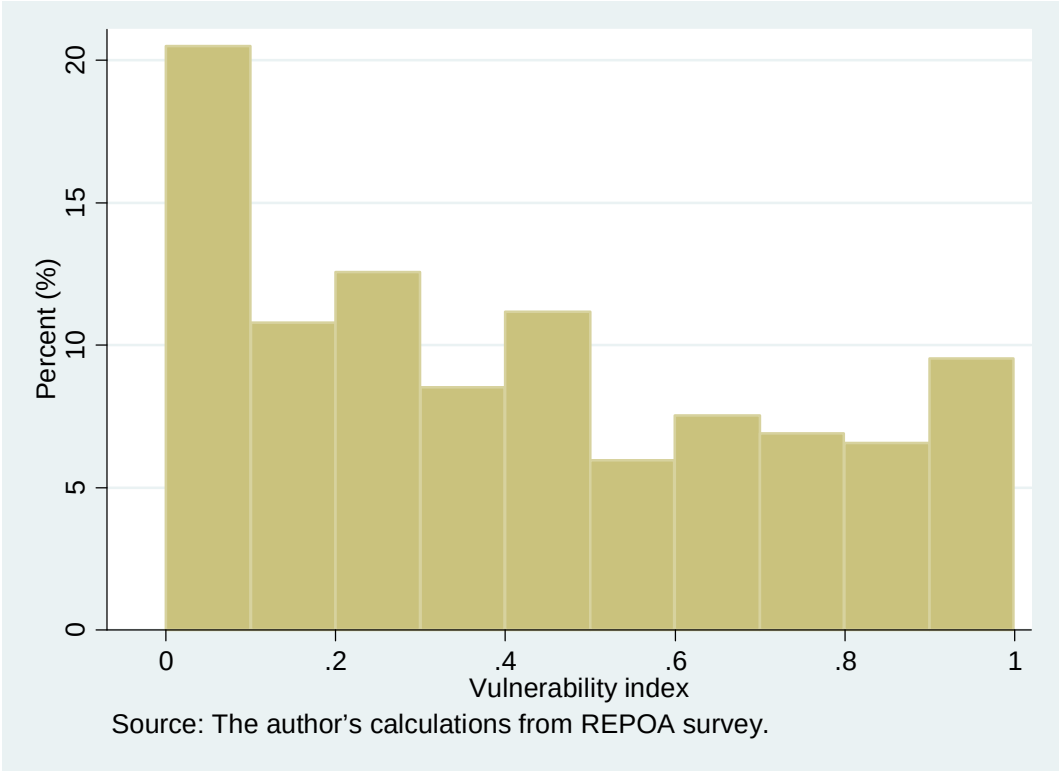
When the probability of asset shortfall is 0.5 or more, 0.8% of individuals in Kilimanjaro are vulnerable to asset poverty (see figure 4.3).

Figure 4.4: Kilimanjaro histogram of vulnerability to asset poverty



When the probability of asset shortfall is greater than 0.5, 36.3% of individuals in Ruvuma are vulnerable to asset poverty (see figure 4.4).

Figure 4.5: Ruvuma histogram of vulnerability to asset poverty



Source: The author's calculations from REPOA survey.

4.7 Evolution of vulnerability to poverty in Kilimanjaro and Ruvuma

This section looks at the evolution of vulnerability to poverty in the two regions. Calculations show that vulnerability to poverty has declined in the two regions since the earlier two rounds of Christiaensen and Sarris (2007).

The previous study of earlier two rounds of the REPOA survey by Christiaensen and Sarris (2007) showed that in 2003, 31.7% of the households in Kilimanjaro were vulnerable to consumption poverty in 2004 and in 2004, 66.6% of the households in Ruvuma were vulnerability to consumption poverty in 2005.

Calculations by this study show that in 2003, 21.1% of the households in Kilimanjaro were vulnerable to consumption poverty in 2009 and in 2004, 44.4% of the households in Ruvuma were vulnerable to consumption poverty in 2009. Here the author uses the vulnerability

threshold (of 0.4) that was used by Christiaensen and Sarris (2007) and looks at the household level as they did. Thus vulnerability to consumption poverty has fallen from 31.7% and 66.6% to 21.1% and 44.4% in Kilimanjaro and Ruvuma respectively.

Mean vulnerability to consumption poverty (at the household level) has also declined in all districts of the two regions from the earlier rounds of Christiaensen and Sarris (2007) to the last round of the author's estimates (see table 4.3). This means that vulnerability to poverty has declined in all districts of the two regions. Note that estimates of mean vulnerability are independent of vulnerability thresholds.

In the earlier rounds the least vulnerable district in Kilimanjaro was Hai and the most vulnerable was Same. In the last round the least vulnerable district was still Hai and the most vulnerable was Rombo. In Kilimanjaro the ranking of the three least vulnerable districts has not changed although vulnerability has declined in all districts.

In Ruvuma the least vulnerable district in the earlier rounds was Mbinga and the most vulnerable was Tunduru. In the last round the least vulnerable was still Mbinga and the most vulnerable was still Tunduru. In fact in Ruvuma the ranking of vulnerability among the districts has not changed although vulnerability has declined in all districts.

Table 4.3: Evolution of mean vulnerability to consumption poverty at the district level in Kilimanjaro and Ruvuma

Mean Vulnerability to Consumption Poverty					
Kilimanjaro			**Ruvuma**		
District	**2004**	**2009**	**District**	**2005**	**2009**
Rombo	45%	38%	Songea rural	55%	36%
Mwanga	40%	24%	Tunduru	77%	68%
Same	55%	35%	Mbinga	51%	26%
Moshi rural	22%	15%	Namtumbo	64%	41%
Hai	16%	6%			
Overall	31%	21%	Overall	60%	40%

Source: The author's calculations and Christiaensen and Sarris (2007).

The author's calculations show that in Kilimanjaro vulnerability to consumption poverty and vulnerability to asset poverty is lower than in Ruvuma (see table 4.4). In fact vulnerability to asset poverty is very low in Kilimanjaro.

In Kilimanjaro vulnerability to consumption poverty is higher than vulnerability to asset poverty in all districts. The rankings from the least vulnerable to the most vulnerable district change when comparing the two kinds of vulnerability. Rombo district which is the most vulnerable to consumption poverty becomes one of the districts least vulnerable to asset poverty.

In Ruvuma vulnerability to consumption poverty is higher than vulnerability to asset poverty in all districts except Tunduru. The rankings from the least vulnerable to the most vulnerable district are similar when comparing the two kinds of vulnerability.

Table 4.4: Vulnerability to consumption poverty and asset poverty at the district level in Kilimanjaro and Ruvuma

Kilimanjaro			**Ruvuma**		
	Vulnerability to			**Vulnerability to**	
District	**Consumption Poverty**	**Asset Poverty**	**District**	**Consumption Poverty**	**Asset Poverty**
Rombo	42.6%	0%	Songea rural	33.5%	25%
Mwanga	22.4%	2.4%	Tunduru	76.9%	80.2%
Same	31.6%	5.7%	Mbinga	21.3%	17.1%
Moshi rural	11.2%	0%	Namtumbo	46.5%	39.9%
Hai	3.9%	0%			
Overall	20.2%	0.8%	Overall	39.6%	36.3%

Source: The author's calculations.

Calculations show that mean vulnerability to consumption poverty is lower than the consumption poverty rate in both regions (see table 4.5). This also applies to all districts with the exception of Rombo in Kilimanjaro and Tunduru in Ruvuma.

Mean vulnerability is expected to be similar to the poverty rate in a normal year, if mean vulnerability is less than the poverty rate then the year is a bad year (Chaudhuri et al 2002; Christiaensen and Sarris, 2007).

In Kilimanjaro and Ruvuma the consumption poverty rate was higher than mean vulnerability to consumption poverty by 25.4% and 10.2% respectively. Thus the year 2009 was worse for Kilimanjaro than for Ruvuma.

Within Kilimanjaro region, the consumption poverty rate was higher than mean vulnerability to consumption poverty by 73.4% (in Hai), 62.1% (in Moshi rural), 25% (in Mwanga), 6.7% (in Same) and it was marginally lower by 0.6% in Rombo. Thus the year 2009 was quite bad for Hai and Moshi rural while it was marginally better for Rombo (which usually is poorer and more vulnerable).

Within Ruvuma region, the consumption poverty rate was higher than mean vulnerability to consumption poverty by 24.5% (in Songea rural), 21.3% (in Mbinga), 21.2% (in Namtumbo) and it was slightly lower by 9% in Tunduru. Thus the year 2009 was bad for Songea rural, Mbinga and Namtumbo while it was slightly better for Tunduru (which is usually poorer and more vulnerable).

Table 4.5: Comparison of Mean vulnerability to Consumption poverty and the consumption poverty rate at the district level in Kilimanjaro and Ruvuma

Mean Vulnerability and Consumption Poverty in 2009					
Kilimanjaro			**Ruvuma**		
District	**Mean Vulnerability**	**Poverty rate**	**District**	**Mean Vulnerability**	**Poverty rate**
Rombo	42.8%	42.5%	Songea rural	39.1%	48.7%
Mwanga	29.9%	37.3%	Tunduru	71.2%	64.7%
Same	40.7%	43.4%	Mbinga	29.6%	35.9%
Moshi rural	18.4%	29.9%	Namtumbo	46.2%	56%
Hai	7.7%	13.4%			
Overall	25.4%	31.8%	Overall	43%	47.4%

Source: The author's calculations.

The author's calculations show that mean vulnerability to asset poverty is lower than the asset poverty rate in both regions (see table 4.6). This also applies to all districts with the exception of Mwanga in Kilimanjaro and Tunduru in Ruvuma.

In Kilimanjaro and Ruvuma the asset poverty rate was higher than mean vulnerability to asset poverty by 143.4% and 17.1% respectively. Thus the year 2009 was worse for Kilimanjaro than for Ruvuma.

Within Kilimanjaro region, the asset poverty rate was higher than mean vulnerability to asset poverty by 3450% (in Hai), 483.6% (in Moshi rural), 206.7% (in Rombo), 67.1% (in Same) and it was lower by 36.3% (in Mwanga). Thus the year 2009 was bad for Hai while it was good for Mwanga.

Within Ruvuma region, the asset poverty rate was higher than mean vulnerability to asset poverty by 41.4% (in Mbinga), 36.1% (in Songea rural), 12% (in Namtumbo) and it was lower by 4.8% in Tunduru. Thus the year 2009 was bad for Mbinga and Songea rural while it was slightly better for Tunduru.

Table 4.6: Comparison of Mean vulnerability to Asset poverty and the asset poverty rate at the district level in Kilimanjaro and Ruvuma

Mean Vulnerability and Asset Poverty in 2009					
Kilimanjaro			**Ruvuma**		
District	**Mean Vulnerability**	**Poverty rate**	**District**	**Mean Vulnerability**	**Poverty rate**
Rombo	3.6%	10.9%	Songea rural	37.8%	51.4%
Mwanga	7.6%	4.9%	Tunduru	73.3%	69.7%
Same	24.5%	41%	Mbinga	26%	36.7%
Moshi rural	1.2%	7.1%	Namtumbo	45%	50.3%
Hai	0.1%	4.3%			
Overall	4.7%	11.5%	Overall	41.5%	48.6%

Source: The author's calculations.

The calculations show that for the last round (2009) Kilimanjaro had a higher percentage of non-vulnerable and non-poor households (65.1%) than Ruvuma (43%) while it had a lower percentage of vulnerable and poor households (8%) compared to 23.2% in Ruvuma (see table 4.7). In Kilimanjaro 20.1% of the households that were not vulnerable were poor and 6.9% of the households that were vulnerable were not poor. The corresponding figures for Ruvuma were 20.9% and 12.9% respectively.

The calculations show that for the first round (2003 in Kilimanjaro and 2004 in Ruvuma) Kilimanjaro had a higher percentage of non-vulnerable and non-poor households (71.9%) than Ruvuma (44.3%) while it had a lower percentage of vulnerable and poor households (7.4%) compared to 24.9% in Ruvuma (see table 4.7). In Kilimanjaro 13.3% of the households that were not vulnerable were poor and 7.5% of the households that were vulnerable were not poor. The corresponding figures for Ruvuma were 19.5% and 11.2% respectively.

Table 4.7: Cross-tabulations of vulnerability to consumption poverty and consumption poverty in Kilimanjaro and Ruvuma

Vulnerable to Consumption Poverty 2003/2004	Consumption Poor			
	Kilimanjaro (2009)		Ruvuma (2009)	
	No	Yes	No	Yes
No	65.1%	20.1%	43%	20.9%
Yes	6.9%	8%	12.9%	23.2%
	Consumption Poor			
	Kilimanjaro (2003)		Ruvuma (2004)	
	No	Yes	No	Yes
No	71.9%	13.3%	44.3%	19.5%
Yes	7.5%	7.4%	11.2%	24.9%

Source: The author's calculations.

The calculations show that for the last round (2009) Kilimanjaro had a higher percentage of non-vulnerable and non-poor households (89.7%) than Ruvuma (43.8%) while it had a lower percentage of vulnerable and poor households (0.4%) compared to 26.5% in Ruvuma (see table 4.8). In Kilimanjaro 9.6% of the households that were not vulnerable were poor and 0.3% of the households that were vulnerable were not poor. The corresponding figures for Ruvuma were 20% and 9.7% respectively.

The calculations show that for the first round (2003 in Kilimanjaro and 2004 in Ruvuma) Kilimanjaro had a higher percentage of non-vulnerable and non-poor households (83.3%) than Ruvuma (38.3%) while it had a lower percentage of vulnerable and poor households

(0.4%) compared to 30.5% in Ruvuma (see table 4.8). In Kilimanjaro 16% of the households that were not vulnerable were poor and 0.3% of the households that were vulnerable were not poor. The corresponding figures for Ruvuma were 25.5% and 5.7% respectively.

Table 4.8: Cross-tabulations of vulnerability to asset poverty and asset poverty in Kilimanjaro and Ruvuma

Vulnerable to Asset Poverty 2003/2004	Asset Poor			
	Kilimanjaro (2009)		Ruvuma (2009)	
	No	Yes	No	Yes
No	89.7%	9.6%	43.8%	20%
Yes	0.3%	0.4%	9.7%	26.5%
	Asset Poor			
	Kilimanjaro (2003)		Ruvuma (2004)	
	No	Yes	No	Yes
No	83.3%	16%	38.3%	25.5%
Yes	0.3%	0.4%	5.7%	30.5%

Source: The author's calculations.

The cross tabulations of the two types of vulnerability show that the percentage of people who are vulnerable to both consumption poverty and asset poverty is higher in Ruvuma (27.5%) than in Kilimanjaro (0.6%) (see table 4.9).

Table 4.9: Cross tabulations of the two types of vulnerability to poverty in Kilimanjaro and Ruvuma

Vulnerable to consumption poverty	Vulnerable to asset poverty			
	Kilimanjaro		Ruvuma	
	No	Yes	No	Yes
No	79.6%	0.3%	52.1%	8.3%
Yes	19.6%	0.6%	12.1%	27.5%

Source: The author's calculations.

The calculations also show that in Kilimanjaro, 68.6% of individuals who are vulnerable to asset poverty are also vulnerable to consumption poverty (see table 4.10). Thus the majority of people who are vulnerable to asset poverty are also vulnerable to consumption poverty. And 2.8% of individuals who are vulnerable to consumption poverty are also vulnerable to asset poverty (see table 4.10). Thus only a minority of people who are vulnerable to consumption poverty are also vulnerable to asset poverty.

The calculations also show that in Ruvuma, 76.7% of individuals who are vulnerable to asset poverty are also vulnerable to consumption poverty (see table 4.10). Thus the majority of people who are vulnerable to asset poverty are also vulnerable to consumption poverty. And 69.4% of individuals who are vulnerable to consumption poverty are also vulnerable to asset poverty (see table 4.10). Thus the majority of people who are vulnerable to consumption poverty are also vulnerable to asset poverty.

Table 4.10: Cross tabulation of individuals who are vulnerable to one type of poverty and also vulnerable to another type of poverty in Kilimanjaro and Ruvuma

	If Vulnerable to asset poverty	
Vulnerable to consumption poverty	Kilimanjaro	Ruvuma
No	31.4%	23.3%
Yes	68.6%	76.7%
	If Vulnerable to consumption poverty	
	Kilimanjaro	Ruvuma
Vulnerable to asset poverty		
No	97.2%	30.6%
Yes	2.8%	69.4%

Source: The author's calculations.

Vulnerability by selected household characteristics

This part looks at vulnerability by selected household characteristics. I start with vulnerability to consumption poverty (see table 4.11). In Kilimanjaro female headed households are less vulnerable than male headed households. In Ruvuma it is the other way round. Households in Kilimanjaro with a head over 60 years old are less vulnerable than those with a head under 60 years old. In Ruvuma the reverse is true. In both regions households with a head who has at

least completed primary education are less vulnerable than their counterparts. In both regions households with access to various types of infrastructure such as electricity, tap water, tarmac or gravel road, and a village market are less vulnerable than those without access. Note that the consumption poverty rates by the selected household characteristics have increased in Kilimanjaro reflecting the overall trend of increase in poverty in that region. While in Ruvuma there has been a mixed pattern with consumption poverty increasing for some household characteristics and decreasing for other household characteristics.

Table 4.11: Kilimanjaro and Ruvuma vulnerability to consumption poverty by selected household characteristics

VARIABLES	Percentage of population	Poverty rate 2003/2004	Poverty rate 2009	Mean vulnerability	Vulnerability rate
		Kilimanjaro			
Male head	90.2	26.9	31.7	26.0	20.9
Female head	9.8	20.7	32.9	20.2	13.6
Head age over 60	31.8	20.1	24.9	19.1	11.3
Head age under 60	68.2	29.1	34.9	28.3	24.4
Head has at least primary education	63.7	24.8	32.9	24.3	18.5
Head has under primary education	36.3	28.8	30.0	27.4	23.1
Has a village political elite	28.6	25.8	27.0	21.9	17.1
Has no village political elite	71.4	26.5	33.6	26.7	21.4
Has electricity	15.4	7.3	14.8	5.0	1.1
Has no electricity	84.6	29.7	34.9	29.1	23.6
Has access to own or public tap water	62.2	24.0	30.6	21.7	16.2
Has no access to own or public tap water	37.8	30.0	33.8	31.7	27.0
Village has tarmac or gravel road	47.4	20.6	27.3	19.6	13.6
Village has no tarmac or gravel road	52.6	31.3	35.8	30.5	26.0
Village has market	33.1	15.2	20.5	16.2	12.0
Village has no market	66.9	31.7	37.3	30.0	24.2
		Ruvuma			
Male head	94.3	49.4	47.1	42.5	38.9
Female head	5.7	48.0	51.8	50.2	49.9
Head age over 60	13.3	52.1	46.0	49.9	53.3
Head age under 60	86.7	48.9	47.6	42.0	37.5
Head has at least primary education	69.1	41.8	44.9	37.6	31.9
Head has under	30.9	66.0	53.7	55.7	57.5

primary education					
Has a village political elite	30.4	42.3	49.2	43.4	40.8
Has no village political elite	69.6	52.3	46.7	42.8	39.1
Has access to own or public tap water	32.9	42.0	50.4	39.6	31.8
Has no access to own or public tap water	67.1	52.9	46.0	44.7	43.5
Village has tarmac or gravel road	40.8	39.8	44.1	36.4	30.7
Village has no tarmac or gravel road	59.2	55.8	49.7	47.6	45.8
Village has market	34.5	46.7	44.8	35.9	27.7
Village has no market	65.5	50.7	48.8	46.8	45.9

Source: Own calculations.

This part looks at vulnerability to asset poverty by selected household characteristics (see table 4.12). In both regions female headed households are less vulnerable than male headed households. Households in Kilimanjaro with a head over 60 years old are less vulnerable than those with a head under 60 years old. In Ruvuma the same is true for mean vulnerability but it is the opposite for vulnerability rate. In Kilimanjaro households with a head who has at least completed primary education are slightly more vulnerable than their counterparts. In Ruvuma the opposite is true. In both regions households with access to various types of infrastructure such as electricity, tap water, tarmac or gravel road, and a village market are less vulnerable than those without access. Note that the asset poverty rates by the selected household characteristics have decreased in both regions reflecting the overall pattern of decrease in asset poverty in the two regions.

Table 4.12: Kilimanjaro and Ruvuma vulnerability to asset poverty by selected household characteristics

VARIABLES	Percentage of population	Poverty rate 2003/2004	Poverty rate 2009	Mean vulnerability	Vulnerability rate
		Kilimanjaro			
Male head	90.2	20.0	12.2	5.0	0.9
Female head	9.8	12.3	5.9	2.0	0.0
Head age over 60	31.8	14.7	9.9	2.5	0.0
Head age under 60	68.2	21.4	12.2	5.8	1.2
Head has at least	63.7	19.2	11.4	5.2	1.0

primary education					
Head has under primary education	36.3	19.4	11.7	3.9	0.5
Has a village political elite	28.6	20.3	11.3	5.3	0.5
Has no village political elite	71.4	18.9	11.6	4.5	1.0
Has electricity	15.4	2.9	0.0	0.1	0.0
Has no electricity	84.6	22.3	13.6	5.6	1.0
Has access to own or public tap water	62.2	12.9	7.7	2.7	0.0
Has no access to own or public tap water	37.8	29.9	17.8	8.1	2.2
Village has tarmac or gravel road	47.4	13.7	7.7	1.5	0.0
Village has no tarmac or gravel road	52.6	24.3	14.9	7.6	1.6
Village has market	33.1	12.3	8.2	0.5	0.0
Village has no market	66.9	22.7	13.1	6.8	1.2
		Ruvuma			
Male head	94.3	61.2	49.1	41.7	36.6
Female head	5.7	61.0	41.7	38.8	30.9
Head age over 60	13.3	49.9	45.1	41.3	41.8
Head age under 60	86.7	63.0	49.1	41.6	35.5
Head has at least primary education	69.1	59.0	45.6	37.8	31.5
Head has under primary education	30.9	66.1	56.0	50.1	47.3
Has a village political elite	30.4	55.0	44.3	36.7	30.8
Has no village political elite	69.6	63.9	50.4	43.6	38.6
Has access to own or public tap water	32.9	59.2	49.4	39.5	34.0
Has no access to own or public tap water	67.1	62.2	48.3	42.5	37.4
Village has tarmac or gravel road	40.8	53.3	39.8	32.5	22.9
Village has no tarmac or gravel road	59.2	66.7	54.7	47.8	45.6
Village has market	34.5	61.6	45.7	37.6	28.7
Village has no market	65.5	61.0	50.1	43.6	40.3

Source: Own calculations.

Testing for the presence of consumption and asset smoothing

This part tests whether consumption or asset smoothing exists among households in the two regions. Sometimes it is customary after estimating vulnerability levels to test for the presence of consumption and or asset smoothing. Households that are able to smooth consumption and or assets are usually less vulnerable. Consumption smoothing occurs when

households try to protect their consumption levels from income fluctuations. Perfect consumption smoothing occurs when changes in income do not affect consumption (Skoufias, 2003; 2007). The same applies for perfect asset smoothing. (See Appendix C for more details on consumption smoothing). The results show that in both regions growth of household income affects consumption growth and asset growth (see table 4.13). This means there is partial consumption smoothing and partial asset smoothing. The estimated coefficients of growth of adult equivalent household income are statistically significant and greater for Ruvuma than for Kilimanjaro. This means that households in Kilimanjaro can smooth their consumption and assets more than those in Ruvuma. In Kilimanjaro assets are smoothed more than consumption. While in Ruvuma consumption is slightly more smoothed than assets.

Table 4.13: Kilimanjaro and Ruvuma results of consumption and asset smoothing

	Kilimanjaro		Ruvuma	
VARIABLES	Real consumption growth	Real asset growth	Real consumption growth	Real asset growth
Growth of adult equivalent	0.0994***	0.0501*	0.180***	0.184***
household income	(5.956)	(1.804)	(8.724)	(5.461)
Growth of adult equivalent	-0.598***	-0.882***	-0.449***	-0.840***
household size	(-10.86)	(-7.790)	(-5.458)	(-7.124)
Head age under 30	0.0181	0.267	0.0343	0.0961
	(0.125)	(0.997)	(0.423)	(0.885)
Head age over 60	-0.119**	-0.160	0.0723	0.176
	(-2.066)	(-1.364)	(0.886)	(1.275)
Head has at least	-0.0876	-0.151	-0.0524	0.139
primary education	(-1.589)	(-1.282)	(-0.793)	(1.354)
Female head	0.104	0.325**	0.0798	0.396**
	(1.374)	(2.110)	(0.772)	(2.205)
Constant	-0.0223	0.361	0.0877	-0.0130
	(-0.176)	(1.277)	(0.765)	(-0.0569)
Observations	767	769	673	674
Adjusted R-squared	0.292	0.204	0.255	0.225
F test	6.952***	4.349***	5.140***	5.222***

T-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Village dummies included but not reported. Source: The author's calculations.

Testing for the presence of community risk sharing

This part tests whether community risk sharing exists among households of the same community or village in the two regions. Usually it is customary to test for community risk sharing after testing for consumption smoothing. Community risk sharing occurs when there are informal risk sharing arrangements among households of the same community/village (Skoufias, 2003) i.e. helping one another during difficult times. Community risk sharing is one of the ways in which households can reduce vulnerability. Empirically community risk sharing occurs when growth of community income increases growth of individual household consumption (Skoufias, 2003; 2007). The same applies for assets. (See Appendix C for more details). The results show that in both regions growth of adult equivalent community income does not affect household consumption growth (see table 4.14). In Kilimanjaro it does not affect household asset growth while in Ruvuma it negatively affects household asset growth. This means that there is no risk sharing among households of the same community (or village) in both regions as far as consumption and assets are concerned. Note that lack of evidence of community risk sharing does not mean it does not exist it might mean that the exiting informal arrangements are weak or ineffective.

Table 4.14: Kilimanjaro and Ruvuma results of community risk sharing

VARIABLES	Kilimanjaro		Ruvuma	
	Real consumption growth	Real asset growth	Real consumption growth	Real asset growth
Growth of adult equivalent household income	0.0994***	0.0501*	0.180***	0.184***
	(5.956)	(1.804)	(8.724)	(5.461)
Growth of adult equivalent community income	0.546	-1.080	0.0368	-1.160***
	(0.579)	(-0.773)	(0.109)	(-3.128)
Growth of adult equivalent household size	-0.598***	-0.882***	-0.449***	-0.840***
	(-10.86)	(-7.790)	(-5.458)	(-7.124)
Head age under 30	0.0181	0.267	0.0343	0.0961
	(0.125)	(0.997)	(0.423)	(0.885)
Head age over 60	-0.119**	-0.160	0.0723	0.176
	(-2.066)	(-1.364)	(0.886)	(1.275)
Head has at least primary education	-0.0876	-0.151	-0.0524	0.139
	(-1.589)	(-1.282)	(-0.793)	(1.354)
Female head	0.104	0.325**	0.0798	0.396**
	(1.374)	(2.110)	(0.772)	(2.205)
Constant	-0.505	1.316	0.0892	-0.0593
	(-0.640)	(1.240)	(0.736)	(-0.246)

Observations	767	769	673	674
Adjusted R-squared	0.292	0.204	0.255	0.225
F test	6.952***	4.349***	5.140***	5.222***

T-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Village dummies included but not reported. Source: The author's calculations.

4.8 Conclusion

This chapter analysed the determinants of vulnerability to consumption poverty and asset poverty. The author tested two hypotheses: 1) individuals that are vulnerable to asset poverty are also vulnerable to consumption poverty; 2) the poverty rate is higher than mean vulnerability. Calculations from REPOA survey data show that 20.2% of individuals in Kilimanjaro and 39.6% of individuals in Ruvuma are vulnerable to consumption poverty. And 0.8% of individuals in Kilimanjaro and 36.3% of individuals in Ruvuma are vulnerable to asset poverty.

Calculations show that in Kilimanjaro, the majority of people who are vulnerable to asset poverty are also vulnerable to consumption poverty. Only a minority of people who are vulnerable to consumption poverty are also vulnerable to asset poverty. In Ruvuma, the majority of people who are vulnerable to asset poverty are also vulnerable to consumption poverty. And the majority of people who are vulnerable to consumption poverty are also vulnerable to asset poverty.

Thus in both regions individuals that are vulnerable to asset poverty are also likely to be vulnerable to consumption poverty. The findings in Ruvuma reflect those of Echevin (2011) who using pseudo panel data found that in Ghana vulnerability to asset poverty was a good proxy for vulnerability to consumption poverty. That is the percentage of households vulnerable to asset poverty was roughly similar to that of households vulnerable to consumption poverty. But since he used pseudo panel data he was not able to conclude that the same households that were vulnerable to asset poverty were likely to be vulnerable to consumption poverty.

In both regions the consumption poverty rate was higher than mean vulnerability to consumption poverty, and the asset poverty rate was also higher than mean vulnerability to asset poverty. Thus the year 2009 was a bad year for both regions. Cross tabulations show

that the percentage of people who are vulnerable to both consumption poverty and asset poverty is higher in Ruvuma than in Kilimanjaro. Calculations from REPOA survey data show that in Kilimanjaro farm crop income, having a SACCOs member, access to electricity, access to tap water and living in a village with tarmac or gravel road reduced vulnerability to consumption poverty and households with migrants were less vulnerable to consumption poverty.

In Ruvuma land owned per adult equivalent reduced vulnerability to consumption poverty. In both regions education of household head reduces vulnerability to consumption poverty while large adult equivalent household size increases vulnerability. In Kilimanjaro having a village leader in the household reduces vulnerability to consumption poverty while in Ruvuma it increases vulnerability to consumption poverty. In both regions the value of consumer durables owned per adult equivalent reduces vulnerability to consumption poverty.

In Kilimanjaro age of household head, value of big livestock owned per adult equivalent and a higher number of coffee trees reduce vulnerability to asset poverty and households with migrants were less vulnerable to asset poverty. In Ruvuma the value of big livestock owned and a higher number of cashew nut trees reduced vulnerability to asset poverty. A higher number of coffee trees had a mixed impact on vulnerability to asset poverty. In Kilimanjaro households with a village leader are more vulnerable to asset poverty while in Ruvuma they are less vulnerable to asset poverty. In both regions the value of consumer durables owned reduces vulnerability to asset poverty.

Analysis of vulnerability by household characteristics show that in both regions households with access to various types of infrastructure such as electricity, tap water, tarmac or gravel road, and a village market were less vulnerable to both consumption and asset poverty than those without access. Results show that there is partial consumption smoothing and partial asset smoothing. Households in Kilimanjaro can smooth their consumption and assets more than those in Ruvuma. And in Kilimanjaro assets are smoothed more than consumption. While in Ruvuma consumption is slightly more smoothed than assets. Community risk sharing among households of the same village was ineffective.

As far as vulnerability to consumption poverty is concerned the National Strategy for Growth and Reduction of Poverty (NSGRP) has so far been successful in rural Kilimanjaro and Ruvuma where vulnerability to consumption poverty has decreased. However the levels of vulnerability are still high especially in rural Ruvuma. In future survey rounds it might be

better to also include urban households and see whether their vulnerability levels are similar to those of rural households.

CHAPTER 5 : CONCLUSION

This thesis analyzed the impact of foreign aid on national economic growth, the impact of economic growth on poverty reduction in Kilimanjaro and Ruvuma regions and the determinants of vulnerability to consumption and asset poverty in the two regions. The thesis has attempted to answer the following research questions 1) Does foreign aid improve economic growth? 2) What factors make poverty reduction more responsive to economic growth? 3) What are the determinants of vulnerability to consumption and asset poverty?

The analysis of the impact of foreign aid on national economic growth shows that foreign aid (ODA) has a positive impact on real GDP per capita. These results reflect those of cross country studies like Collier and Dehn (2001) and Burnside and Dollar (2000) which found that aid is good for growth. Results also show that gross fixed capital formation that is not financed by aid and exports have a positive impact on real GDP per capita. Aid boosts exports in the current period although in the following years it slightly reduce exports. Note that this reduces exports as a share of GDP and not the amount or volume of exports. Nkusu (2004) has argued that if there are idle resources and if aid is invested wisely (i.e. in infrastructure), aid will not necessarily reduce exports and cause a Dutch disease.

Results show that foreign aid slightly reduces gross fixed capital formation that is not financed by aid (% of GDP). This means that foreign aid slightly crowds out investment that is not financed by aid. Note that this refers to a reduction of its share of GDP and not a reduction of the amount or level of such investment. War with Uganda reduced the short run growth of real GDP per capita and the growth of exports (% of GDP). While post 1996 economic reforms have improved the short run growth of real GDP per capita and have made investment and foreign aid to be more productive.

Thus foreign aid and also good investment climate and export oriented growth strategy is good for growth in Tanzania. This agrees with Tanzania development vision 2025 which aims to make Tanzania a middle income semi-industrialized country via foreign aid, good investment climate and export promotion. However Tanzania might need more time than 2025 to achieve the aim of vision 2025. She also might need more time than 2015 to achieve the Millennium Development Goals.

The analysis of economic growth and poverty reduction in the two regions using REPOA panel data survey show that in Kilimanjaro between 2003 and 2009, GDP growth has been accompanied by a marginal increase in consumption poverty from 26.3% to 31.8%. Analysis also shows that consumption growth was not pro-poor and consumption Gini inequality slightly increased. Asset growth was pro-poor and Gini inequality in asset ownership declined. Analysis shows that in Ruvuma between 2004 and 2009, GDP growth has been accompanied by a marginal reduction in consumption poverty from 49.3% to 47.4%. Consumption growth was pro-poor and consumption Gini inequality slightly increased. Asset growth was also pro-poor and Gini inequality in asset ownership declined.

The analysis shows that one of the reasons that growth was more pro-poor in Ruvuma than in Kilimanjaro was the effect of food price inflation. Many households in Ruvuma are surplus food producers thus food inflation was unlikely to harm them. While many households in Kilimanjaro are net buyers of food thus food inflation reduced their purchasing power and thus kept them in poverty. These findings are in line with those of Ravallion (1990) who argue that in Bangladesh an increase in food prices was likely to harm the poor (who were likely to be net food buyers) in the short run although in the long run the effect was likely to be neutral.

Analysis shows that other reasons for less pro-poor growth in Kilimanjaro were the decline in adult equivalent farm output and income due to drought and population pressure on limited land. Ruvuma experienced improvement in adult equivalent farm output and income due to good weather and land availability (which eased population pressure). Also the increase in non-farm incomes (mainly wages of agricultural workers) was higher in Ruvuma than in Kilimanjaro due to better agricultural conditions in Ruvuma region.

Analysis using REPOA survey data shows that in both regions growth of adult equivalent business income and growth of adult equivalent farm crop income increases consumption growth for all households and for poor households and thus reduces poverty. In Kilimanjaro, growth of (non-farm) business income has more impact on the consumption growth of the poor than growth of farm crop income. While in Ruvuma, growth of farm crop income has more impact on the consumption growth of the poor than growth of (non-farm) business income.

In both regions, growth of adult equivalent business income increases asset growth for all households but not for poor households. In Ruvuma growth of adult equivalent farm crop

income increases asset growth for all households and for poor households while in Kilimanjaro it does so for all households but not for poor households. Thus in Kilimanjaro, both growth of farm crop income and growth of non-farm business income have no impact on asset growth of the poor. While in Ruvuma growth of farm crop income improves asset growth of the poor and growth of non-farm business income has no impact on asset growth of the poor. In both regions there were no multiple equilibria poverty traps for consumption or assets. Also in each of those cases the existing one stable equilibrium was not a poverty trap.

As far as consumption poverty is concerned the National Strategy for Growth and Reduction of Poverty (NSGRP) has been unsuccessful in rural Kilimanjaro where consumption poverty has increased and it has had limited success in rural Ruvuma where consumption poverty has marginally declined. The NSGRP has been accompanied by a reduction in asset poverty in the rural areas of both regions and can thus be regarded as successful in this area. In spite of the above, rural Ruvuma is much poorer than rural Kilimanjaro as far as consumption and asset poverty is concerned. In both regions improving farm productivity, planting high value crops (while maintaining food security), creating rural jobs via rural economic structural transformation (increasing the size of the rural non-farm sector) and rural infrastructure projects will result in sustainable poverty reduction. Ruvuma has another option of increasing land area under cultivation in the low lands.

The analysis of vulnerability to poverty in the two regions using REPOA survey data shows that 20.2% of individuals in Kilimanjaro and 39.6% of individuals in Ruvuma are vulnerable to consumption poverty. And 0.8% of individuals in Kilimanjaro and 36.3% of individuals in Ruvuma are vulnerable to asset poverty. Calculations show that in both regions, the majority of people who are vulnerable to asset poverty are also vulnerable to consumption poverty. Thus in both regions individuals that are vulnerable to asset poverty are also likely to be vulnerable to consumption poverty. The findings in Ruvuma reflect those of Echevin (2011) who using pseudo panel data found that in Ghana vulnerability to asset poverty was a good proxy for vulnerability to consumption poverty. That is the percentage of households vulnerable to asset poverty was roughly similar to that of households vulnerable to consumption poverty.

In both regions the consumption poverty rate was higher than mean vulnerability to consumption poverty, and the asset poverty rate was also higher than mean vulnerability to asset poverty. Thus the year 2009 was a bad year for both regions. Cross tabulations show

that the percentage of people who are vulnerable to both consumption poverty and asset poverty is higher in Ruvuma than in Kilimanjaro. Calculations show that in Kilimanjaro farm crop income, having a SACCOs member, access to electricity, access to tap water and living in a village with tarmac or gravel road reduced vulnerability to consumption poverty and households with migrants were less vulnerable to consumption poverty.

In Ruvuma land owned per adult equivalent reduced vulnerability to consumption poverty. In both regions education of household head reduces vulnerability to consumption poverty while large adult equivalent household size increases vulnerability. In Kilimanjaro having a village leader in the household reduces vulnerability to consumption poverty while in Ruvuma it increases vulnerability to consumption poverty.

In Kilimanjaro age of household head, value of big livestock owned per adult equivalent and a higher number of coffee trees reduce vulnerability to asset poverty and households with migrants were less vulnerable to asset poverty. In Ruvuma the value of big livestock owned and a higher number of cashew nut trees reduced vulnerability to asset poverty. In Kilimanjaro households with a village leader are more vulnerable to asset poverty while in Ruvuma they are less vulnerable to asset poverty.

Analysis of vulnerability by household characteristics show that in both regions households with access to various types of infrastructure such as electricity, tap water, tarmac or gravel road, and a village market were less vulnerable to both consumption and asset poverty than those without access. Results show that there is partial consumption smoothing and partial asset smoothing. Households in Kilimanjaro can smooth their consumption and assets more than those in Ruvuma. And in Kilimanjaro assets are smoothed more than consumption. While in Ruvuma consumption is slightly more smoothed than assets. Community risk sharing among households of the same village was ineffective.

As far as vulnerability to consumption poverty is concerned the National Strategy for Growth and Reduction of Poverty (NSGRP) has so far been successful in rural Kilimanjaro and Ruvuma where vulnerability to consumption poverty has decreased. However the levels of vulnerability are still high especially in rural Ruvuma. In future survey rounds it might be better to also include urban households and see whether they behave similarly to rural households.

The findings in Kilimanjaro and Ruvuma have some implications for foreign aid. The survey period in the two regions has been accompanied by huge aid inflows at the national level. Thus more foreign aid has to be directed at activities that increase the consumption growth of the poor so as to make aid more pro-poor and thus achieve the MDG 1 objective of halving income poverty. Such activities include increasing access to rural piped water supply and electricity, and building rural tarmac or gravel roads. They also include improving rural farm income via increasing agricultural productivity, and strengthening rural business environment so as to promote rural business income.

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APPENDIX A

Unit root tests (Augmented Dickey Fuller)

The Augmented Dickey Fuller (ADF) tests shows that all the variables have unit roots and are integrated of the first order I(1) (see tables A1).

Table A 1: Results of Augmented Dickey Fuller (ADF) tests.

Variable	ADF Test in levels	ADF Test in First Difference	Number of lags
Ln Real GDP per Capita	1.025	-5.009***	0
Ln foreign aid (% of GDP)	-1.525	-8.164***	0
Ln GFCF (not financed by aid) (% of GDP)	-1.784	-6.785***	0
Ln Exports (% of GDP)	-1.246	-6.546***	0
***P<0.01, ** p< 0.05 and * P<0.1.			

Source: The author's calculations.

Lag and Trace tests.

The optimal lag tests show that the optimal lag length is either three lags or one lag (see table A2). I choose one lag as the HQIC and SBIC lag tests are the most reliable. The Johansen cointegration trace test (for a VECM with one lag and four dummies) shows that there is one cointegrating vector (see table A3).

Table A 2: Results of optimal lag tests

Lag	LL	LR	df	p-value	FPE	AIC	HQIC	SBIC
0	29.6035				7.90E-06	-0.400146	-0.105509	0.379521
1	212.142	365.08	16	0	7.80E-09	-7.33925	-6.80891*	-5.93585*
2	230.623	36.961	16	0.002	7.30E-09	-7.44262	-6.67656	-5.41548
3	248.518	35.79*	16	0.003	7.2e-09*	-7.52157*	-6.5198	-4.8707
4	261.364	25.692	16	0.059	9.30E-09	-7.39016	-6.15268	-4.11556

Source: The author's calculations.

Table A 3: Results of Johansen test for cointegration.

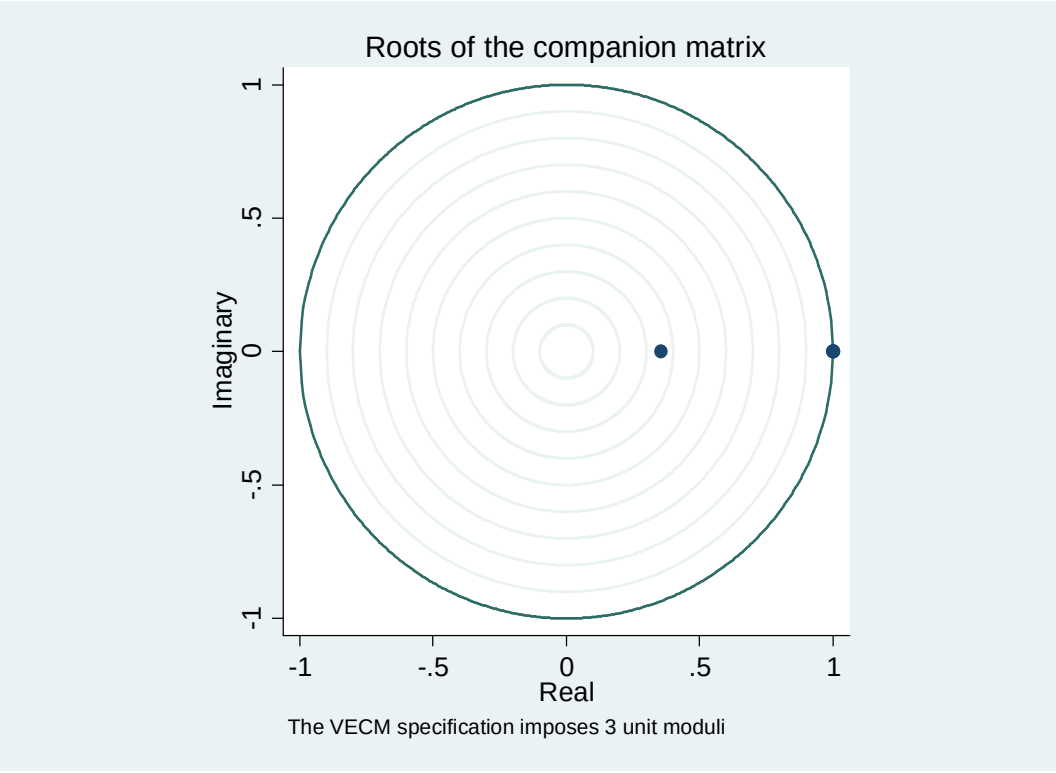
Maximum rank	Eigenvalue	Trace statistic	5% critical value
0	-	59.0839	47.21
1	0.447	28.8712*	29.68
2	0.26168	13.399	15.41
3	0.22768	0.2229	3.76

Source: The author's calculations.

VECM diagnostics

VECM diagnostics show that the estimates are stable and there is no autocorrelation (see figure A1 and table A4).

Figure A 1: VECM stability test results



Source: The author's calculations.

Table A 4: Results of LM test for autocorrelation.

Lag	Chi2	Degrees of freedom	Probability>chi2
1	10.6430	16	0.83097
2	19.9259	16	0.22358
H0: No autocorrelation at lag order			

Source: The author's calculations.

Table A 5: Results of Jarque-Bera test for normality.

Equation	Chi2	Degrees of freedom	Probability>chi2
DLn Real GDP per Capita	73.58800	2	0.00000
DLn Foreign aid (% of GDP)	2.14200	2	0.34269
DLn GFCF (not financed by aid) (% of GDP)	0.35700	2	0.83650
DLn Exports (% of GDP)	0.54200	2	0.76263
ALL	76.62900	8	0.00000
H0: Residuals are normally distributed			

Source: The author's calculations.

Table A 6: Orthogonalized Impulse Response Functions of aid (in table form)

Step	Ln Real GDP per Capita	Ln GFCF (not financed by aid) (% of GDP)	Ln Exports (% of GDP)	Ln foreign aid (% of GDP)
0	0.000000	-0.030946	0.001382	0.222460
1	0.000071	-0.036599	-0.000817	0.219410
2	0.000097	-0.038608	-0.001598	0.218327
3	0.000106	-0.039322	-0.001876	0.217942
4	0.000109	-0.039575	-0.001975	0.217805
5	0.000110	-0.039665	-0.002010	0.217756
6	0.000110	-0.039697	-0.002022	0.217739
7	0.000111	-0.039708	-0.002026	0.217733
8	0.000111	-0.039713	-0.002028	0.217731
9	0.000111	-0.039714	-0.002029	0.217730
10	0.000111	-0.039714	-0.002029	0.217730

Source: The author's calculations.

Table A 7: Forecast Error Variance Decompositions (FEVDs) of aid (in table form)

Step	Ln Real GDP per Capita	Ln GFCF (not financed by aid) (% of GDP)	Ln Exports (% of GDP)	Ln foreign aid (% of GDP)
0	0.000000	0.000000	0.000000	0.000000
1	0.000000	0.051283	0.000091	0.999903
2	7.10E-06	0.090238	0.000064	0.983374
3	0.000014	0.123463	0.000087	0.968985
4	0.000018	0.149478	0.000110	0.959065
5	0.000021	0.169731	0.000129	0.952331
6	0.000023	0.185758	0.000142	0.947620
7	0.000025	0.198697	0.000152	0.944195
8	0.000026	0.209343	0.000160	0.941612
9	0.000027	0.218249	0.000166	0.939600
10	0.000028	0.225807	0.000171	0.937992

Source: The author's calculations.

Table A 8: Orthogonalized Impulse Response Functions of aid (in table form): when ln foreign aid (% of GDP) is ordered first in the VECM and ln real GDP per capita is ordered last

Step	Ln Real GDP per Capita	Ln GFCF (not financed by aid) (% of GDP)	Ln Exports (% of GDP)	Ln foreign aid (% of GDP)
0	0.000187	-0.030788	0.001387	0.222471
1	0.000256	-0.036275	-0.000748	0.219510
2	0.000280	-0.038225	-0.001506	0.218459
3	0.000289	-0.038917	-0.001775	0.218085
4	0.000292	-0.039164	-0.001871	0.217952
5	0.000293	-0.039251	-0.001905	0.217905
6	0.000294	-0.039282	-0.001917	0.217888
7	0.000294	-0.039293	-0.001921	0.217882
8	0.000294	-0.039297	-0.001923	0.217880
9	0.000294	-0.039298	-0.001923	0.217880
10	0.000294	-0.039299	-0.001924	0.217879

Source: The author's calculations.

Table A 9: Forecast Error Variance Decompositions (FEVDs) of aid (in table form): when ln foreign aid (% of GDP) is ordered first in the VECM and ln real GDP per capita is ordered last

Step	Ln Real GDP per Capita	Ln GFCF (not financed by aid) (% of GDP)	Ln Exports (% of GDP)	Ln foreign aid (% of GDP)
0	0.000000	0.000000	0.000000	0.000000
1	0.000097	0.050760	0.000092	1.000000
2	0.000140	0.088927	0.000062	0.983866
3	0.000168	0.121415	0.000080	0.969696
4	0.000185	0.146832	0.000101	0.959906
5	0.000197	0.166611	0.000117	0.953255
6	0.000205	0.182261	0.000129	0.948602
7	0.000211	0.194894	0.000138	0.945218
8	0.000215	0.205289	0.000145	0.942666
9	0.000219	0.213985	0.000150	0.940679
10	0.000222	0.221365	0.000155	0.939090

Source: The author's calculations.

Table A 10: Descriptive statistics of the variables used in the VECM model

Variable	Mean	Standard Deviation	Min	Max
Ln Real GDP per Capita	12.512	0.174	12.160	12.992
Ln foreign aid (% of GDP)	2.315	0.559	1.193	3.367
Ln GFCF (not financed by aid) (% of GDP)	2.733	0.316	2.084	3.469
Ln Exports (% of GDP)	2.881	0.404	1.914	3.440
Dummy 1966 (D1966)	0.019	0.139	0.000	1.000
Dummy Post War (DPW)	0.058	0.235	0.000	1.000
Dummy 1987-88 (D1987-88)	0.038	0.194	0.000	1.000
Dummy Post 1996 (DP1996)	0.327	0.474	0.000	1.000

Source: The author's calculations.

A note on growth accelerations

The author's calculations of growth accelerations (as shown in figure 2.2 in chapter 2) are defined according to Hausman et al. (2004):

1) $g_{t,t+n} \geq 3.5$

2 $\Delta g_t = g_{t,t+n} - g_{t-n,t} \geq 2$

3) $y_{t+n} \geq max\{y_i\},\ i \leq t$

Where by; $g_{t,\ t+n}$ is the least squares growth rate between period t and t+n. It is obtained by regressing ln of real GDP per capita (y) on a constant (k) and time (t) for each period between t and t+n:

$(ln(y_{t+i}) = k + (\hat{g}_{t,t+n})t, i = 0,..,n$.

In my case I looked at 10 year periods and thus n=9. The first condition states that average real GDP per capita growth must be at least 3.5% per annum. The second condition states that the change in the average real GDP per capita growth from one 10 year period to another must be greater than 2%. The last condition states that real GDP per capita at the end of the 10 year period must be greater than real GDP per capita in all previous years.

APPENDIX B

Table B 1: Kilimanjaro descriptive statistics of the variables used in the consumption and asset growth models

Variable (Kilimanjaro)	Mean	Standard Deviation	Min	Max
Real consumption growth	-0.095	0.710	-2.336	3.412
Real asset growth	0.211	1.263	-4.859	4.194
Ln of adult equivalent Consumption lagged	5.405	0.614	1.860	7.514
Ln of adult equivalent asset value lagged	6.145	1.283	1.579	10.501
Growth of adult equivalent household size	0.278	0.426	-1.373	2.134
Growth of adult equivalent business income	-0.639	2.064	-7.036	7.331
Growth of adult equivalent farm income	-0.417	1.867	-6.520	7.077
Growth of adult equivalent wage income	0.810	2.369	-5.904	7.892
Growth of adult equivalent other farm income	-0.056	2.626	-7.798	9.141
Drought (2003-2004)	0.398	0.490	0.000	1.000
Unexpected decline in cereal prices (2004-2009)	0.058	0.234	0.000	1.000
Major harvest losses (2004-2009)	0.111	0.314	0.000	1.000

Source: The author's calculations from REPOA survey.

Table B 2: Ruvuma descriptive statistics of the variables used in the consumption and asset growth models

Variable (Ruvuma)	Mean	Std. Dev.	Min	Max
Real consumption growth	0.012	0.758	-3.117	2.242
Real asset growth	0.309	1.127	-2.901	4.438
Ln of adult equivalent Consumption lagged	5.093	0.621	3.328	8.186
Ln of adult equivalent asset value lagged	4.791	1.117	1.358	8.891
Growth of adult equivalent household size	0.181	0.347	-1.557	2.512
Growth of adult equivalent business income	-0.257	2.162	-7.868	5.647

Growth of adult equivalent farm income	-0.063	1.581	-5.562	8.559
Growth of adult equivalent wage income	0.966	2.377	-5.344	7.343
Growth of adult equivalent other farm income	-0.089	2.019	-5.846	9.933
Namtumbo district	0.105	0.307	0.000	1.000
Heavy rains or floods (1999-2004)	0.025	0.155	0.000	1.000
Unexpected decline in cereal prices (2005-2009)	0.194	0.396	0.000	1.000
Illness (2005-2009)	0.252	0.434	0.000	1.000
Death of external financial supporter (2005-2009)	0.069	0.254	0.000	1.000

Source: The author's calculations from REPOA survey.

Table B 3: Results of Wu-Hausman test of endogeneity for ln of adult equivalent consumption lagged (consumption growth model)

	Consumption growth model			
	Kilimanjaro		Ruvuma	
	Overall	The poor	Overall	The poor
Wu-Hausman F statistic	0.39	1.27	0.85	0.01
P-value	0.532	0.261	0.356	0.928

Source: The author's calculations.

Table B 4: Results of Variance Inflation Factor (VIF) and Tolerance (1/VIF) tests for multicollinearity (consumption growth model)

Consumption growth model					
Kilimanjaro			**Ruvuma**		
Variable	**VIF**	**1/VIF**	**Variable**	**VIF**	**1/VIF**
Ln of adult equivalent business income	2.41	0.42	Ln of adult equivalent business income	2.45	0.41
Growth of adult equivalent business income	2.30	0.44	Growth of adult equivalent business income	2.11	0.47
Ln of adult equivalent Consumption lagged	1.89	0.53	Ln of adult equivalent Consumption lagged	1.80	0.56
Ln of adult equivalent farm income	1.88	0.53	Ln of adult equivalent household size	1.77	0.57
Ln of adult equivalent household size	1.81	0.55	Village has tarmac or gravel road	1.74	0.57
Ln of value of consumer	1.64	0.61	Namtumbo district	1.62	0.62

durables owned per adult equivalent					
Growth of adult equivalent farm income	1.59	0.63	Tunduru district	1.62	0.62
Rombo district	1.58	0.63	Ln of value of consumer durables owned per adult equivalent	1.61	0.62
Ln head age	1.56	0.64	Ln head age	1.55	0.64
Moshi Rural district	1.56	0.64	Ln of adult equivalent farm income	1.55	0.65
Ln head education	1.44	0.70	Ln head education	1.46	0.68
Growth of adult equivalent household size	1.43	0.70	Growth of adult equivalent farm income	1.42	0.70
Has electricity	1.39	0.72	Growth of adult equivalent household size	1.37	0.73
Has access to own or public tap water	1.30	0.77	Ln percentage aged (0-4)	1.36	0.74
Ln percentage aged (0-4)	1.27	0.79	Village has market	1.22	0.82
Village has market	1.25	0.80	Female head	1.13	0.89
Female head	1.19	0.84	Growth of adult equivalent other farm income	1.12	0.89
Village has tarmac or gravel road	1.14	0.87	Growth of adult equivalent wage income	1.12	0.90
Growth of adult equivalent other farm income	1.10	0.91	Member of Saccos	1.11	0.90
Has a village leader	1.10	0.91	Loss of livestock (2005-2009)	1.10	0.91
Migrated before 2003	1.09	0.92	Has access to own or public tap water	1.09	0.91
Member of Saccos	1.08	0.93	Has a village leader	1.09	0.92
Drought (2003-2004)	1.08	0.93	Death of external supporter (2005-2009)	1.08	0.93
Growth of adult equivalent wage income	1.06	0.94	Unexpected decline in cereal prices (2005-2009)	1.08	0.93
Major harvest losses	1.05	0.96	Heavy rains or floods	1.06	0.94

(2004-2009)			(1999-2004)		
Mean VIF	1.45		Mean VIF	1.42	

Source: The author's calculations.

Table B 5: Results of Wu-Hausman test of endogeneity for ln of adult equivalent asset value lagged (asset growth model)

	Asset growth model			
	Kilimanjaro		Ruvuma	
	Overall	The poor	Overall	The poor
Wu-Hausman F statistic	0.01	0.08	0.1	0.45
P-value	0.937	0.781	0.748	0.503

Source: The author's calculations.

Table B 6: Results of Variance Inflation Factor (VIF) and Tolerance (1/VIF) tests for multicollinearity (asset growth model)

Asset growth model					
Kilimanjaro			**Ruvuma**		
Variable	**VIF**	**1/VIF**	**Variable**	**VIF**	**1/VIF**
Ln of adult equivalent business income	2.33	0.43	Ln of adult equivalent business income	2.28	0.44
Growth of adult equivalent business income	2.24	0.45	Growth of adult equivalent business income	2.03	0.49
Ln of adult equivalent farm income	1.76	0.57	Village has tarmac or gravel road	1.73	0.58
Ln of adult equivalent household size	1.63	0.61	Namtumbo district	1.66	0.60
Ln of adult equivalent asset value lagged	1.61	0.62	Tunduru district	1.63	0.62
Moshi Rural district	1.61	0.62	Ln of adult equivalent household size	1.57	0.64
Rombo district	1.57	0.63	Ln of adult equivalent farm income	1.48	0.68

Growth of adult equivalent farm income	1.52	0.66	Growth of adult equivalent farm income	1.42	0.70
Ln head age	1.45	0.69	Ln of adult equivalent asset value lagged	1.39	0.72
Growth of adult equivalent household size	1.42	0.71	Ln head education	1.37	0.73
Ln head education	1.42	0.71	Ln head age	1.34	0.75
Has access to own or public tap water	1.32	0.76	Growth of adult equivalent household size	1.33	0.75
Village has market	1.24	0.80	Village has market	1.20	0.83
Has electricity	1.24	0.81	Female head	1.13	0.88
Female head	1.20	0.83	Growth of adult equivalent other farm income	1.12	0.89
Village has tarmac or gravel road	1.14	0.88	Growth of adult equivalent wage income	1.09	0.92
Growth of adult equivalent other farm income	1.12	0.89	Member of Saccos	1.08	0.92
Migrated before 2003	1.09	0.92	Has access to own or public tap water	1.07	0.94
Member of Saccos	1.09	0.92	Has a village leader	1.06	0.94
Has a village leader	1.08	0.93	Drought (2005-2009)	1.03	0.97
Growth of adult equivalent wage income	1.08	0.93	Illness (2005-2009)	1.02	0.98
Unexpected decline in cereal prices (2004-2009)	1.07	0.94	Mean VIF	1.38	
Death (2003-2004)	1.05	0.95		2.28	0.44
Mean VIF	1.40			2.03	0.49

Source: The author's calculations.

Poverty trap test

The consumption growth regression is estimated as before but higher order polynomials of $\ln C_{it-1}$ are included.

$$\ln C_{it} - \ln C_{it-1} = K + \beta_1 \ln C_{it-1} + \beta_2 (\ln C_{it-1})^2 + \beta_3 (\ln C_{it-1})^3 + \beta_4 (\ln C_{it-1})^4$$

$$+ \ln X_{it-1} + \Delta \ln V_i + SH_{it} + \varepsilon_{it}$$

An F – test that cannot reject the null hypothesis H_0: $\beta_1=\beta_2=\beta_3=\beta_4=0$, but rejects the null hypothesis H_0: $\beta_2=\beta_3=\beta_4=0$. Means that the higher polynomials are not statistically significant and thus there are no multiple equilibria consumption poverty traps. Only the first polynomial of $\ln C_{it-1}$ is significant.

The same applies for the assets equation.

$$\ln A_{it} - \ln A_{it-1} = K + \beta_1 \ln A_{it-1} + \beta_2 (\ln A_{it-1})^2 + \beta_3 (\ln A_{it-1})^3 + \beta_4 (\ln A_{it-1})^4$$

$$+ \ln W_{it-1} + \Delta \ln V_i + SO_{it} + \varepsilon_{it}$$

An F –test that cannot reject the null hypothesis H_0: $\beta_1= \beta_2= \beta_3= \beta_4=0$, but rejects the null hypothesis H_0: $\beta_2= \beta_3= \beta_4=0$. Means that the higher polynomials are not statistically significant and thus there are no multiple equilibria asset poverty traps. Only the first polynomial of $\ln A_{it-1}$ is significant. For more information regarding the theory of asset poverty traps see Carter and Barrett (2006).

APPENDIX C

Table C 1: Kilimanjaro descriptive statistics of the variables used in the ex-ante mean and ex-ante variance models of consumption and assets

Variable (Kilimanjaro)	Mean	Standard Deviation	Min	Max
Ln real consumption per adult equivalent 2009	5.301	0.595	3.286	7.402
Ln real asset value per adult equivalent 2009	6.411	1.119	3.096	9.98
Has a village leader	0.261	0.440	0.000	1.000
Ln head age	3.936	0.292	2.996	4.654
Ln head education	1.816	0.638	0.000	2.944
Female head	0.130	0.336	0.000	1.000
Ln of adult equivalent household size	1.389	0.482	-0.329	2.797
Ln percentage aged (0-4)	1.189	1.521	0.000	4.215
Migrated before 2003	0.296	0.457	0.000	1.000
Ln of adult equivalent business income	1.317	1.836	0.000	7.324
Ln of adult equivalent farm income	3.071	1.407	0.000	6.954
Member of Saccos	0.119	0.324	0.000	1.000
Hires farm labour	0.364	0.481	0.000	1.000
Ln number of coffee trees	3.140	2.773	0.000	8.987
Ln of land owned per adult equivalent	0.480	0.321	0.000	2.329
Ln of value of big livestock owned per adult equivalent	2.442	1.970	0.000	8.369
Ln of value of medium livestock owned per adult equivalent	1.810	1.547	0.000	5.975
Ln of value of consumer durables owned per adult equivalent	3.517	1.109	0.404	6.981
Has electricity	0.145	0.353	0.000	1.000
Has access to own or public tap water	0.642	0.480	0.000	1.000
Village has tarmac or gravel road	0.474	0.500	0.000	1.000
Village has market	0.300	0.458	0.000	1.000
Rombo district	0.241	0.428	0.000	1.000
Mwanga district	0.076	0.266	0.000	1.000
Same district	0.113	0.317	0.000	1.000
Moshi Rural district	0.415	0.493	0.000	1.000
Major harvest losses (1998-2003)	0.070	0.255	0.000	1.000
Major harvest losses (2003-2004)	0.043	0.202	0.000	1.000
Death (2003-2004)	0.043	0.202	0.000	1.000
Drought (2004-2009)	0.818	0.386	0.000	1.000

Theft (2004-2009)	0.074	0.263	0.000	1.000
Death (2004-2009)	0.129	0.335	0.000	1.000

Source: The author's calculations from REPOA survey.

Table C 2: Ruvuma descriptive statistics of the variables used in the ex-ante mean and ex-ante variance models of consumption and assets

Variable (Ruvuma)	Mean	Standard Deviation	Min	Max
Ln real consumption per adult equivalent 2009	5.100	0.671	2.038	7.005
Ln real asset value per adult equivalent 2009	5.123	1.151	1.385	8.387
Has a village leader	0.269	0.444	0.000	1.000
Ln head age	3.715	0.315	2.944	4.500
Ln head education	1.810	0.632	0.000	2.708
Female head	0.073	0.260	0.000	1.000
Ln of adult equivalent household size	1.327	0.487	-0.329	2.604
Ln percentage aged (0-4)	1.743	1.614	0.000	4.111
Ln of adult equivalent business income	1.448	1.823	0.000	7.868
Ln of adult equivalent farm income	3.827	1.039	0.000	9.794
Member of Saccos	0.113	0.317	0.000	1.000
Hires farm labour	0.286	0.452	0.000	1.000
Ln number of coffee trees	2.115	3.202	0.000	8.700
Ln number of cashew nut trees	1.716	2.512	0.000	8.517
Ln of land owned per adult equivalent	0.309	0.707	-1.664	3.689
Ln of value of big livestock owned per adult equivalent	0.442	1.250	0.000	6.481
Ln of value of medium livestock owned per adult equivalent	1.473	1.397	0.000	4.922
Ln of value of consumer durables owned per adult equivalent	3.004	1.091	0.000	7.912
Has access to own or public tap water	0.295	0.456	0.000	1.000
Village has tarmac or gravel road	0.378	0.485	0.000	1.000
Village has market	0.305	0.461	0.000	1.000
Songea rural district	0.123	0.329	0.000	1.000
Tunduru district	0.349	0.477	0.000	1.000
Mbinga district	0.423	0.494	0.000	1.000
Decline in cash crop prices (1999-2004)	0.047	0.212	0.000	1.000
Major harvest losses (1999-2004)	0.066	0.249	0.000	1.000

Drought (2005-2009)	0.136	0.343	0.000	1.000
Unexpected decline in cash crop prices (2005-2009)	0.211	0.409	0.000	1.000
Major harvest losses (2005-2009)	0.148	0.355	0.000	1.000
Loss of livestock (2005-2009)	0.132	0.338	0.000	1.000

Source: The author's calculations from REPOA survey.

Table C 3: Results of Wu-Hausman test of endogeneity for ln of adult equivalent farm income (ex-ante mean of consumption model)

	Ex-ante mean of consumption model	
	Kilimanjaro	Ruvuma
Wu-Hausman F statistic	1.8	0.37
P-value	0.18	0.541

Source: The author's calculations.

Table C 4: Results of Variance Inflation Factor (VIF) and Tolerance (1/VIF) tests for multicollinearity (ex-ante mean of consumption model)

Ex-ante mean of consumption model					
Kilimanjaro			**Ruvuma**		
Variable	**VIF**	**1/VIF**	**Variable**	**VIF**	**1/VIF**
Rombo district	2.55	0.39	Mbinga district	4.20	0.24
Moshi Rural district	2.47	0.40	Tunduru district	3.89	0.26
Same district	2.23	0.45	Songea rural district	2.45	0.41
Ln of land owned per adult equivalent	1.83	0.55	Ln of land owned per adult equivalent	1.98	0.50
Ln head age	1.59	0.63	Village has tarmac or gravel road	1.89	0.53
Ln of adult equivalent household size	1.59	0.63	Ln head age	1.73	0.58
Ln head education	1.55	0.65	Ln of value of consumer durables owned per adult equivalent	1.56	0.64
Ln of value of consumer durables owned per adult equivalent	1.54	0.65	Ln of adult equivalent farm income	1.48	0.67

Mwanga district	1.39	0.72	Ln head education	1.47	0.68
Hires farm labour	1.38	0.73	Ln of adult equivalent household size	1.47	0.68
Ln of adult equivalent farm income	1.34	0.75	Hires farm labour	1.45	0.69
Village has market	1.32	0.76	Ln of value of medium livestock owned per adult equivalent	1.38	0.72
Has access to own or public tap water	1.30	0.77	Ln percentage aged (0-4)	1.32	0.76
Village has tarmac or gravel road	1.28	0.78	Loss of livestock (2005-2009)	1.27	0.79
Has electricity	1.28	0.78	Major harvest losses (2005-2009)	1.23	0.81
Ln of value of medium livestock owned per adult equivalent	1.26	0.79	Village has market	1.23	0.81
Female head	1.26	0.79	Ln of value of big livestock owned per adult equivalent	1.22	0.82
Ln percentage aged (0-4)	1.21	0.83	Ln of adult equivalent business income	1.21	0.83
Ln of value of big livestock owned per adult equivalent	1.18	0.84	Has access to own or public tap water	1.17	0.85
Member of Saccos	1.15	0.87	Member of Saccos	1.17	0.85
Has a village leader	1.11	0.90	Female head	1.16	0.86
Ln of adult equivalent business income	1.10	0.91	Drought (2005-2009)	1.16	0.86
Death (2004-2009)	1.07	0.93	Unexpected decline in cash crop prices (2005-2009)	1.15	0.87
Theft (2004-2009)	1.07	0.94	Has a village leader	1.10	0.91
Migrated before 2003	1.03	0.97	Mean VIF	1.64	
Mean VIF	1.44				

Source: The author's calculations.

Table C 5: Results of Wu-Hausman test of endogeneity for ln of adult equivalent farm income (ex-ante mean of asset model)

	Ex-ante mean of asset model	
	Kilimanjaro	Ruvuma
Wu-Hausman F statistic	0.43	0.02
P-value	0.512	0.892

Source: The author's calculations.

Table C 6: Results of Variance Inflation Factor (VIF) and Tolerance (1/VIF) tests for multicollinearity (ex-ante mean of asset model)

Ex-ante mean of asset model					
Kilimanjaro			**Ruvuma**		
Variable	**VIF**	**1/VIF**	**Variable**	**VIF**	**1/VIF**
Rombo district	2.34	0.43	Tunduru district	7.12	0.14
Moshi Rural district	2.11	0.47	Ln number of cashew nut trees	6.25	0.16
Ln of land owned per adult equivalent	1.80	0.55	Mbinga district	5.24	0.19
Ln head age	1.63	0.62	Ln number of coffee trees	3.06	0.33
Ln of value of consumer durables owned per adult equivalent	1.56	0.64	Ln of land owned per adult equivalent	2.09	0.48
Same district	1.56	0.64	Village has tarmac or gravel road	2.01	0.50
Ln of adult equivalent household size	1.51	0.66	Songea rural district	1.75	0.57
Ln head education	1.46	0.69	Ln head age	1.62	0.62
Ln number of coffee trees	1.43	0.70	Ln of adult equivalent household size	1.56	0.64
Mwanga district	1.43	0.70	Ln of adult equivalent farm income	1.45	0.69
Ln of adult equivalent farm income	1.35	0.74	Ln head education	1.44	0.69
Village has market	1.32	0.76	Ln of value of consumer durables owned per adult equivalent	1.42	0.71

Has electricity	1.31	0.76	Ln of value of medium livestock owned per adult equivalent	1.37	0.73
Has access to own or public tap water	1.31	0.76	Ln percentage aged (0-4)	1.26	0.79
Ln of value of medium livestock owned per adult equivalent	1.23	0.82	Ln of value of big livestock owned per adult equivalent	1.22	0.82
Ln percentage aged (0-4)	1.22	0.82	Village has market	1.22	0.82
Female head	1.21	0.83	Female head	1.21	0.83
Village has tarmac or gravel road	1.18	0.85	Has access to own or public tap water	1.20	0.84
Ln of value of big livestock owned per adult equivalent	1.18	0.85	Member of Saccos	1.19	0.84
Ln of adult equivalent business income	1.13	0.89	Ln of adult equivalent business income	1.16	0.86
Drought (2004-2009)	1.10	0.91	Major harvest losses (1999-2004)	1.16	0.86
Major harvest losses (1998-2003)	1.09	0.92	Decline in cash crop prices (1999-2004)	1.14	0.88
Major harvest losses (2003-2004)	1.09	0.92	Has a village leader	1.12	0.89
Member of Saccos	1.08	0.93	Drought (2005-2009)	1.04	0.97
Has a village leader	1.07	0.94	Mean VIF	2.05	
Migrated before 2003	1.06	0.95			
Death (2003-2004)	1.04	0.96			
Mean VIF	1.36				

Source: The author's calculations.

Consumption and asset smoothing test.

$$\Delta \ln c_{htk} = \sum_{tk} \alpha_{tk}(ZD_{tk}) + \theta \Delta \ln y_{htk} + \mu X_{htk} + \Delta \varepsilon_{htk}$$

$\Delta \ln c_{htk}$ is the growth rate of adult equivalent consumption of household h, t is time period, k is community or village. $\Delta \ln y_{htk}$ is the growth rate of adult equivalent household income, X is a vector of household characteristics and $\Delta \varepsilon_{htk}$ is a household specific error term. α, θ and μ are estimated coefficients. ZD_{tk} is a group of dummy variables representing each community or village; it captures covariate shocks at the community or village level. It is assumed that shocks to a household affect household income. If there is perfect consumption smoothing θ equals zero and changes in income do not affect household consumption. For more details see Skoufias (2003).

The same applies for assets.

$$\Delta \ln a_{htk} = \sum_{tk} \alpha_{tk}(ZD_{tk}) + \theta \Delta \ln y_{htk} + \mu X_{htk} + \Delta \varepsilon_{htk}$$

$\Delta \ln a_{htk}$ is the growth rate of adult equivalent asset value of household h, t is time period, k is community or village. $\Delta \ln y_{htk}$ is the growth rate of adult equivalent household income, X is a vector of household characteristics and $\Delta \varepsilon_{htk}$ is a household specific error term. ZD_{tk} is a group of dummy variables representing each community or village; it captures covariate shocks at the community or village level. If there is perfect asset smoothing θ equals zero and changes in income do not affect household assets.

Community risk sharing.

For consumption:

$$\Delta \ln c_{htk} = \omega + \theta \Delta \ln y_{htk} + \varphi \Delta(\overline{\ln y_{kt}}) + \mu X_{htk} + \Delta \varepsilon_{htk}$$

For assets:

$$\Delta \ln a_{htk} = \omega + \theta \Delta \ln y_{htk} + \varphi \Delta(\overline{\ln y_{kt}}) + \mu X_{htk} + \Delta \varepsilon_{htk}$$

$\Delta(\overline{\ln y_{kt}})$ is the growth rate of average community or village income. Every other notation is similar to the above consumption and asset smoothing equations. If $\varphi \neq 0$ then there is risk sharing within communities/villages. For more details see Skoufias (2003).

Sampling weights

Sampling weights have been used in all equations, poverty rate calculations and Growth Incidence Curves (GICs) of Chapter 3 and Chapter 4 that involve the REPOA survey. The sampling weights equal original sampling weights multiplied by attrition correcting weights (Pan and Christiaensen, 2011). Original sampling weights are the inverse of the probability of a household being chosen into the survey in the first round (Christiaensen and Sarris, 2007; Pan and Christiaensen, 2011). I use the same original sampling weights as those used by Christiaensen and Sarris (2007).

Attrition correcting weights are the inverse of the probability of a household remaining in the panel (being interviewed) in the third round (Pan and Christiaensen, 2011). Attrition correcting weights were obtained from attrition probit regressions. The dependent variable of these probit regressions was a dummy variable equal to one if a household was interviewed in round 3 (or if it recorded the outcome variable of interest in round 3) and equal to zero if the household was not interviewed in round 3 (or if it did not record the outcome variable of interest in round 3). The independent variables were socio-economic factors that influenced attrition (Pan and Christiaensen, 2011).

My attrition probits are similar to those of Christiaensen and Pan (2010) and Pan and Christiaensen 2011) with the exception that some independent variables are different and I tailor my attrition probits towards my outcome variables of interest i.e. adult equivalent consumption, asset value in 2009, consumption growth, asset value growth etc.

For more information about REPOA survey original sampling weights refer to Christiaensen and Sarris (2007). For more information about attrition (and attrition correcting weights) in the REPOA survey refer to Christiaensen and Pan (2010) and Pan and Christiaensen (2011). For more general information about correcting for attrition see Baulch and Quisumbing (2011).