

Rural Household Poverty Dynamics in Northern Ethiopia 1997-2000
Analysis of Determinants of Poverty

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Abstract

The incidence of poverty, in spite of a 5 percent increase between 1997 and 2000, has significantly remained the same. There is, however, a moderate but significant decrease in the depth and severity of poverty perhaps pointing to the positive impact of policy reform in the region. Decomposition results indicate that there are significant differences in the geographic distribution of poverty. Moreover, zones with initially highest level of poverty remained so during the period perhaps indicating the presence of a geographic trap to poverty.

The analysis of the dynamics of poverty indicated that the proportion of the people falling into poverty was far higher than those escaping poverty, and people found initially in extreme poverty are found to have difficulty of moving out of poverty. This underlines the chronic nature of poverty in the region and the need for longer-term investments in the poor while supporting those temporarily falling into poverty.

In the analysis of the determinants of poverty, human capital resources such as members with primary and secondary education and households educated heads and with any kind of acquired skills were found to have higher welfare. Increased physical asset endowments, in terms of farm size and livestock holding, are also positively related to improved household welfare. These results underline the importance of enhancing the poor's human and physical endowments in poverty reduction. On the other hand, household labour endowment seems not to have generally contributed to improvement in welfare perhaps underlining the poor functioning of labour markets in the region. This calls for policy measures that attack poverty through increased investment for employment creation to tap on the existing idle labour resource. Households' access to services was not found to have a significant effect on welfare perhaps pointing to the limited effect of these programs on poverty reduction in a remote, socially unstable and fragile environment. Finally, regression results also show the adverse effects of village level variables such as political risk (war) and weather factors underlining the importance of peace and political stability and investments in irrigation in poverty reduction. Better access to markets, through investments in marketing infrastructure may also contribute to poverty reduction, although it may leave poor households vulnerable to external shocks until they are fully integrated into the market.

Key terms: Poverty profile, characteristics of the poor, poverty dynamics, determinants of poverty; northern Ethiopia

1. Introduction

Poverty still poses a major problem in most of the developing world, especially in sub-Saharan Africa. By many accounts, Ethiopia is one of the poorest countries in Sub-Saharan Africa¹. Rural poverty constitutes the major form of poverty in Ethiopia (Fassil, 1993; Demery, 1999).

After years of political instability and economic decline, economic reform programs in Ethiopia started in the late 1980's. The first phase of the reforms program focused on liberalization of food markets (Dercon, 2000; Dercon, 2002). Since 1994, Ethiopia stepped-up on a structural adjustment program sponsored by the World Bank and IMF, focusing on reforms related to exchange rate determination, investment and trade liberalization and removal of fertilizer subsidies. Ethiopia is claimed to have witnessed genuine economic

¹ The average per capita income is \$ 599 in 1999 \$ purchasing power parity terms. Life expectancy at birth is 44 years while adult literacy rate account only for 36.3 percent. Infant and under five mortality rates amount to 107/1000 and 173/1000 respectively while children under 5 who are malnourished account for 48 percent (UNDP, 2000; WDR, 2001).

recovery, as measured by increase in per capita GDP, after 1996 (Dercon, 2000; Dercon, 2001). This improved macroeconomic performance is said to have led to significant reduction in poverty (IMF, 1999; Demery, 1999; Dercon, 2000; Dercon, 2001).

Poverty reduction policies in Ethiopia have focused on strategies to enhance agricultural productivity of the smallholder sector, the main stay of the majority of the population, through access to improved extension packages, provision of input and credit supply services, building of infrastructure, mainly rural roads and water supply, and expansion of primary education and health care services (MEDaC, 1999; Dercon, 2000; FDRE 2000). This has been complemented with targeted food transfers, either in the form of direct food handouts or food/cash-for-work programs, aimed at alleviating temporary food security problems and financing investments on public works such as rural roads, irrigation facilities, schools and clinics (MEDaC, 1999; FDRE 2000).

Evaluation of the effect of these policies on poverty reduction in Ethiopia has been limited due to the lack of appropriate and countrywide micro-data. Only recently, relative availability of good quality data has made analysis of this kind possible (Dercon and Krishnan, 1998 and later; Woldehanna and Alemu, 2000; Bigsten et al., 2003). The most comprehensive poverty study in Ethiopia to date is that of Woldehanna and Alemu (2002), which gives a comprehensive picture of poverty profiles of all the regions of the country. A thorough and careful analysis of poverty, although based on limited sample households and communities, is that of Dercon and Krishnan (1998), Dercon (2000), Dercon and Krishnan (2000) and Dercon (2001). While Dercon's series of papers based on relatively smaller sample size from 15 communities in the country and the study by Bigsten et al. (2003) showed significant improvement in levels poverty in the country², Woldehanna and Alemu (2000), using a data set of more than 16 000 households from the whole country, showed that the incidence of poverty, at best, has remained unchanged, although there was a significant reduction in the depth of and inequality in poverty. In fact, Dercon (2000) indicated that the micro evidence based on 15 villages in Ethiopia should not be taken as evidence for exact national trends on levels of poverty and well being partly because consumption growth rates in the sample were higher than in the national account figures. Moreover, Dercon (2001) also indicated that there are diverse experiences across villages in their sample underlining the need to make a careful study of regions and communities to understand the differentiated effects of policy reforms on poverty. This paper intends to fill part of the gap by providing an in depth study of poverty in

² Bigsten et al. (2003) used the same data set (plus a 1997 panel) as Dercon and Krishnan (1998) to estimate rural poverty profiles and panel data sets for selected urban centers to develop urban poverty profiles.

one of the regions of Ethiopia³, Tigray, and by examining the possible determinants of poverty and changes in poverty.

The region is predominantly semi-arid, located far from the nationally surplus producing areas and is chronically food deficit. The region was a scene of major drought, famine and social conflict for the last two or more decades (Webb et al., 1992). The latest border conflict between Ethiopia and Eritrea (1998-2000) affected the region directly with huge budgetary consequences, dislocations of people (Dercon, 2000) and household welfare. To date there was no micro data to examine the effect of the war on household welfare. The availability of panel household level data collected in 1998 and 2001, before and after the war, made it possible to assess the overall change in levels of poverty between 1997 and 2000 in northern Ethiopia as well as to examine the differential impact of the conflict on household welfare between those villages directly affected and those further away from the conflict area. This study is, hence, important in understanding the effect of economic reform programs in remote, socially unstable and ecologically fragile environment and thereby complements earlier studies to present a complete picture of how poverty has changed over time after economic recovery programs in the country.

The main objectives of this paper are the estimation of a poverty line using the cost of basic needs (CBN) approach to construct aggregate poverty measures. We undertake poverty decomposition exercises relying on region of residence (zones and *tabias*), household characteristics and specific attributes of the household head, asset holding (e.g. farm size, livestock and oxen holding), and access to services such as credit, irrigation services, off-farm employment and food transfers. By decomposing across geographic locations, we want to capture if some geographical regions, due to the variations in weather conditions and agricultural potential, population density and market access are more prone to poverty than others are. Given the availability of panel data we also tried to assess the mobility of households across welfare profiles and expenditure quintiles. We also checked if the effect of the war between Ethiopia and Eritrea has differential impacts on the 16 villages close and distant to the conflict zone. We run statistical and stochastic dominance tests to compare distributions of welfare indicators and to make ordinal judgments on how poverty has changed across locations and time. Finally, we run an econometric estimation of determinants of poverty in 1997 and 2000, and changes thereof, in the light of a host of household and household head specific characteristics, asset holdings, access to services and village level

³ Two of the villages from Tigray were included in the study by Dercon and Krishnan (1998).

differences such as agricultural potential (rainfall distribution), market access and population density and zone dummies.

The paper proceeds as follows. Part II presents the methodology used to construct poverty lines, a brief outline of the aggregate poverty measures and poverty profiles and outlines significance level tests on differences and changes in poverty. Part III presents study site, policy context and sampling techniques. Part IV outlines the results of poverty measures and poverty decomposition across locations and other socio-economic factors followed by statistical and dominance tests on differences across social groups and changes in poverty between 1997 and 2000. Part V presents changes on welfare mobility of households using transition matrices. Part VI presents the regression models used to analyse the determinants of poverty, changes in poverty and discusses regression results. Finally part VII concludes.

2. Methodology

Poverty comparisons involve the choice of a welfare measure, (a) poverty line(s) and selection of poverty indices to enable aggregation of poverty. In the poverty literature, consumption expenditure is preferred over income because the latter is volatile while households are assumed to seek stable levels of welfare over time (Ravallion, 1994; Streeten, 1998; Deaton and Grosh, 2000). We scale household consumption by adult equivalent (see Table 2A) to get consumption expenditure per adult equivalent using standards adopted from WHO (1985). We consider purchased food and the imputed value of auto-consumption to construct the welfare indicator. We follow the Cost of Basic Needs (CBN) approach in estimating the poverty line. The advantage of CBN approach is that the poverty line guarantees that poverty comparisons are consistent in the sense that two individuals with the same level of welfare are treated the same way (Ravallion, 1994).

The CBN approach⁴ stipulates consumption bundles that are deemed to be adequate in meeting basic consumption needs. Anchored to nutritional requirements for good health and composition of local food diets, CBN typically settles on a bundle of foodstuffs as the food component of a CBN poverty line. A food poverty line is defined based on the poorest 50 percent of the households deemed to be typical to the poor in the region. Once the food component of the poverty line is selected, allowance is given to the non-food component. We

⁴ Others have used the Food Energy Intake (FEI) approach that tries to anchor the poverty line to the most basic consumption need - food energy requirement – based on actual consumption data (see Anand and Harris, 1994; Greer and Thorbecke, 1986).

follow the approach of Ravallion and Bidani (1994) to derive the non-food components of the poverty line.

Of all the poverty measure indices developed (Sen 1976; Foster, 1984; Foster and Shorrocks, 1984; Foster et al., 1984), the Foster-Greer-Thorbecke (FGT) class of poverty measures is found to meet the fundamental axiomatic requirements of such poverty indexes, mainly, consistency and additive decomposability (see Foster et al., 1984). Moreover, the poverty orderings correspond precisely to the α -degree stochastic dominance of partial orderings. Interesting welfare interpretations of the poverty orderings can be given for the three members of the class P_α measures (Foster and Shorrocks, 1988).

The Foster- Greer-Thorbecke (FGT) class of poverty measures is given as:

$$P_\alpha = \frac{1}{n} \sum_{i=1}^q \left(\frac{z - y_i}{z} \right)^\alpha, \quad (4)$$

where α = Poverty aversion parameter
 n = Total number of individuals in the population
 q = Total number of poor individuals
 z = Poverty line
 y_i = Expenditure of individuals below poverty line $i = 1, 2, \dots, q$.

In contrast to Sen's measure (1976) that adopts a rank-order weighting scheme, P_α takes the weights to be the shortfalls themselves. In this case, deprivation depends on the distance between a poor household's actual expenditure and the poverty line, not the number of households that lie between a given household and the poverty line. It also meets the relative deprivation – the expenditure shortfall of that household- criterion of poverty.

If $\alpha = 0 \rightarrow P_0 = \frac{q}{n}$. This index is a head count ratio index that reflects the proportion of the poor in total population measuring the incidence of poverty in the whole population. The advantage of the head count measure is that the overall progress in reducing poverty can be assessed right away. Nevertheless, it is insensitive to the depth or severity of poverty and hence, not good to assess the impact of a policy measure. The latter is captured by the poverty-gap index.

If $\alpha = 1 \rightarrow P_1 = \frac{1}{nz} \sum_{i=1}^q (z - y_i)$. This measure, known as poverty gap, estimates the average distance separating the poor from the poverty line. The poverty gap could be understood as

the amount of income transfer needed to close up the gap. P_1 is sensitive to the depth of poverty but not to its severity.

If $\alpha = 2 \rightarrow P_2 = \frac{1}{nz^2} \sum_{i=1}^q (z - y_i)^2$. This is a measure of the severity of poverty. It depicts the severity of poverty by assigning each individual a weight equal to his/her distance from the poverty line. Hence, P_2 takes into account not only the distance separating the poor from the poverty line, but also the inequality among the poor.

In developing the poverty line, we identified the poorest 50% of the population as the reference group. We use the consumption behaviour of the reference group to determine the quantities of the basic food items that will make up the reference food basket. In this case, the basket is made up of the mean consumption levels (purchased and auto-consumption) of 19 food items (see Table A3) by the poorest 50 percent of the population in adult equivalent terms. This is estimated to be the regional reference food basket. With the information on the caloric content of food items of each of the 19 food items (see FAO, 1979; USDA, 2002), we estimate the total calories received by an individual who consumes this average basket. The minimum level of calorie consumption is chosen to be 2200 calories/adult/day⁵. The reference food basket estimated is unlikely to sum to this amount, so we scale the consumption levels up or down by a constant to attain 2200 calories/person/day.

Due to lack of regional price indexes, we estimated median prices for each item in the respective zones based on internal price data. Using estimated unit median prices, we determined the cost of consuming the reference basket of 19 food items. Moreover, we expressed consumption expenditures in terms of 2000 southern zone prices (see Table 4A). Hence, we estimated a regional poverty line given 'regional' prices of individual items.

Following Ravallion and Bidani (1994), we estimated the non-food component of the poverty line by examining the consumption behaviour of those households who can just afford the reference food basket. The non-food share of total expenditure is estimated by regressing the food share (s) of each household i on a constant and the log of the ratio of consumption expenditures to the food poverty line:

$$S_i = \alpha + \beta \log\left(\frac{y_i}{Z^f}\right) + \varepsilon_i \quad (5)$$

⁵ 2200 kcal/adult/day is adopted to be able to compare our results with results of similar studies in Ethiopia (e.g. Dercon and Krishnan, 1998; Woldehanna and Alemu, 2001).

For those whose total expenditure is just equal to the food poverty line ($y_i = Z^f$), the food share is α , and consequently the non-food share of expenditures is $(1 - \alpha)$. Thus the poverty line is

$$Z = Z^f(2 - \alpha) \quad (6)$$

Three measures, which are part of the FGT class of poverty measures, are used for the poverty profiles.

Realizing that we have only a sample of households and not the entire population, we estimated standard errors for the poverty measures so that we could test for differences in poverty across zones, among social groups, and between the two periods. We follow Kakwani (1993) in estimation of standard errors to test differences in poverty measures given the same poverty line. However, poverty comparisons can be sensitive to the choice of the poverty line. The important issue is that the poverty line yields consistent comparisons (Ravallion, 1994). Stochastic tests to test the robustness of ordinal poverty comparisons prove to be useful in poverty analysis (Atkinson, 1987). The idea of standard welfare dominance is to compare distributions of welfare indicators is to make ordinal judgment on how poverty changes (spatially or inter-temporally) for a class of poverty measures over a range of poverty lines (Ravallion, 1994; Davidson and Duclos (1998).

3. Study site and sample data description

Tigray is the northern most region of Ethiopia. Drought and famine are more frequent in the region. Severe environmental degradation problems, mainly soil erosion and nutrient depletion constrain agricultural production in the region (Hagos et al., 1999). The mainstay of the economy is agriculture, which is mainly rain-fed, in a region where rainfall is erratic and drought is prevalent. Furthermore, after a period of relative stability during 1991 to 1998, after a period of prolonged civil war, a war erupted between Ethiopia and Eritrea in May 1998 that ended two years later with serious consequences on household welfare.

Current policies in the country put emphasis on agricultural development, particularly in the smallholder sector (MEDaC, 1999; FDRE, 2000). The development strategy of the region, named Conservation-based Agricultural Development Led Industrialization, builds upon the national strategy by taking into account the agricultural constraints and potentials of the region, and the extent of environmental degradation. It focuses on conservation of natural resources, developing and promoting use of improved agricultural technologies through

improved agricultural research, extension support, input supply, credit schemes and expansion of small-scale irrigation with the aim to attain food self-sufficiency and fast economic growth (see BoPED, 1995). Besides, food transfer programs, taking the form of free food handouts (called food aid) and food-for-work (FFW), are integrated into food security and poverty alleviation strategy of the region.

Two rounds of household surveys⁶ on 400 households were conducted during 1998 and 2001 in Tigray, Northern Ethiopia. The survey covered 16 villages (*tabias*)⁷ in four zones – southern, eastern, central and western – of Tigray with differences in distance to market, population density and agricultural potential conditions. Stratification and sampling was done based on altitude⁸, market access, population density and presence of irrigation projects. List of the name of the *tabias* by *weredas* and zones, together with few key village level variables is given in Table 1A. We selected 25 households from each community from a list of all households using a simple random sampling technique. Multi-purpose questionnaires were used to gather information on household income, expenditure, access to public services and safety nets (FFW and FA), off-farm income, and household assets alongside a host of other information related to production and sale of agricultural products. Comparability of the data set is assured because the data collection process relied on similar sampling procedure and standardized questionnaire and the surveys were carried out during similar seasons, minimizing seasonal variability of income and prices. The years 1997 and 2000 were relatively comparable in terms of weather and agricultural production conditions (FAO/WFP, 1997; FAO/WFP, 2000). Moreover, the necessary statistical adjustment in prices was made to make spatial and temporary comparison of poverty possible.

4. Poverty profiles

Based on the CBN approach, we estimated the regional poverty line is Birr 1033.45 compared to Birr⁹ 909.44 based on the food poverty line. These estimates are not significantly different from the ones used by Dercon and Krishnan (1998) and Woldehanna and Alemu (2002), which established the food poverty line and moderate poverty line to be Birr 806.27 and 1075 respectively. To be able to compare our results with results of earlier studies (Dercon and

⁶ We had an attrition rate of 12 percent in the second round of the survey partly due to redefinition of boundaries of villages. We also omitted three observations due to missing values.

⁷ *Tabia* is the lowest administrative unit in Tigray. Many *tabias* make up a *wereda* (district) and many of the later make up a zone. There are five zones in the region including Mekelle (the capital) that constitutes a zone.

⁸ The sample villages included only those in the highland, i.e. those above 1500 m.a.s.l.

⁹ 1 USD is equivalent to 8.56.

Krishnan, 1998; Woldehanna and Alemu, 2002), we adopted throughout the paper Birrs 806.27 and 1075 to represent extreme and moderate poverty lines respectively. The poverty indexes calculated, based on these poverty lines for the region is given in Table 1.

Table 1: Aggregate poverty profiles

Poverty indices	1997 (n= 397)	2000 (n= 401)	% Change in poverty measures	Significance test t-test [‡]
Indices based on food poverty line (extreme poverty).				
P ₀	0.49	0.50	1	-5.64 (0.002)**
P ₁	0.20	0.16	-4	-7.350 (0.001)**
P ₂	0.10	0.07	-3	-10.122 (0.002)**
Indices based on cost of basic needs (moderate poverty)				
P ₀	0.61	0.66	5	-5.867 (0.002)**
P ₁	0.29	0.27	-7.8	-6.287 (0.001)**
P ₂	0.17	0.14	-3	-7.799 (0.552)**

[‡]Significance test for the difference in poverty levels in the two periods. Standard errors are given in parenthesis.

**, * significant at 1% and 5 % level of significance respectively

Following the food poverty line, close to 50 percent of the population in the region in both periods lived below the poverty line of just meeting its food requirements. On the other hand, about 61 and 66 percent of the population in the region in 1997 and 2000 respectively lived under the poverty line of meeting basic consumption requirements. In the region as a whole, there is no evidence of a decline in the proportion of the population living under poverty. On the contrary, the proportion of the population living under poverty has increased at 1 and 5 percent in terms of meeting their basic food and other consumption requirements respectively. However, with respect to the poverty gap, we see a fall in poverty level of four and close eight percent in 1997 and 2000 respectively indicating a positive impact of policy reform on poverty. The poverty gap squared also show a moderate fall (3%) in the severity of poverty.

We compared the calculated regional poverty profiles from this study with the results of Dercon (2000) and Woldehanna and Alemu (2002). The results are reproduced in Table 5A. Our poverty estimates are comparable with these estimates. Poverty levels in Tigray are staggeringly high compared to national figures, perhaps because the initial conditions were bad or the effect of reform programs is weak in remote, politically unstable and fragile environments.

4.1 Geographical decomposition of poverty

By decomposing across geographic locations, zones and *tabias*, we acquire a differentiated picture of the distribution of poverty and changes in poverty during the period. As can be

seen, from Tables 4.1-4.4, a high proportion of the population in the southern, central and eastern zones lived under poverty in 1997. All the households in the western zone seem to have lived above the poverty line.

Table 4.1: Poverty profiles in the southern zone

<i>Tabia</i>	Poverty profiles					
	1997 (n= 100)			2000 (n= 100)		
	P₀	P₁	P₂	P₀	P₁	P₂
Hintalo	0.98	0.48	0.27	0.85	0.36	0.20
Mahbere Genet	0.97	0.60	0.39	0.73	0.30	0.15
Mai Alem	0.98	0.61	0.42	0.87	0.37	0.18
Samre	0.87	0.45	0.26	0.52	0.19	0.09
Zonal aggregate	0.95	0.53	0.34	0.76	0.32	0.16

By 2000, however, we witness a huge proportion of the population in the western zone falling into poverty while there was a modest improvement in poverty levels in the other zones compared to 1997, although still overall poverty is higher in the southern and central zones.

The poorest villages in 1997 were all *tabias* in the southern zone followed by two *tabias* (Hagere Selam) in the eastern and (Adi Selam) central zones with a head count ratios exceeding 87 percent. All the villages in the western zone and Genfel, a village in the eastern zone, showed the lowest incidence of poverty. The picture with respect to the depth of poverty and severity of poverty is not substantially different from the trends indicated by the

Table 4.2: Poverty profiles in the eastern zone

<i>Tabia</i>	Poverty profiles					
	1997 (n= 100)			2000 (n=100)		
	P₀	P₁	P₂	P₀	P₁	P₂
Emba Asmena	0.62	0.28	0.16	0.44	0.20	0.11
Genfel	0.33	0.09	0.03	0.27	0.07	0.03
Hagere Selam	0.88	0.35	0.17	0.97	0.45	0.24
Kihen	0.65	0.18	0.06	0.34	0.13	0.06
Zonal aggregate	0.60	0.21	0.09	0.50	0.21	0.11

incidence of poverty. Both the depth and severity of poverty seem to be highest in villages with highest incidence of poverty.

Table 4.3: Poverty profiles in the central zone

<i>Tabia</i>	Poverty profiles					
	1997 (n= 97)			2000 (n= 101)		
	P₀	P₁	P₂	P₀	P₁	P₂
Adi Selam	0.95	0.51	0.31	0.78	0.35	0.18
Debedebo	0.84	0.29	0.14	0.72	0.24	0.11
May Keyahti	0.80	0.39	0.21	0.91	0.40	0.21
Seret	0.82	0.36	0.19	0.53	0.15	0.06
Zonal aggregate	0.86	0.40	0.22	0.74	0.29	0.14

By 2000, there is remarkable improvement in a good deal of the villages, except those in the western and few others in the other zones. Hadehti (in western), Hagere Selam (in eastern), May Keyahti (in central) and Hinatlo and Mai Alem (in southern) showed incidences of poverty exceeding 83 percent. The poverty gap and poverty gap squared remained highest in those villages with the highest incidence of poverty.

Table 4.4: Poverty profiles in the western zone

<i>Tabia</i>	Poverty profiles					
	1997 (n= 100)			2000 (n= 100)		
	P₀	P₁	P₂	P₀	P₁	P₂
Adi Menabir	0.00	0.00	0.00	0.55	0.25	0.13
Hadehti	0.00	0.00	0.00	0.83	0.35	0.19
Mai Adrasha	0.00	0.00	0.00	0.51	0.19	0.08
Tsaeda Ambora	0.00	0.00	0.00	0.54	0.20	0.09
Zonal aggregate	0.00	0.00	0.00	0.61	0.25	0.17

We also run statistical significance tests on the changes in P_{α} measures for the four zones between 1997 and 2000. Accordingly, there is a significant fall in the incidence of poverty in the southern zone while there is a significant increase in the incidence of poverty in the western zone. On the other hand, in spite of the apparently remarkable decline in the incidence of poverty in the other two zones, test results show that none of the test results rejected the null hypotheses of no difference between the two periods (see Table 4.5).

Table 4.5: Statistical tests for changes in poverty levels across zones between 1997 and 2000

Zones	Head count	Poverty gap index	Poverty gap index squared
	t-test	t-test	t-test
Southern	-2.085 (0.004)*	-0.146 (0.006)	-1.669 (0.005)
Eastern	-1.428 (0.007)	-1.736 (0.005)	-2.358 (0.004)*
Central	-1.777 (0.005)	-1.479 (0.006)	-1.824 (0.005)
Western	-2.050 (0.005)*	-2.309* (0.004)	-2.662 (0.003)**

**, * Significant at 1 and 5 percent respectively.

Results also show that there was significant increase in the gap and severity of poverty in the western zone. Similarly, there was a significant increase in the eastern zone in 2000 compared to in 1997.

4.2. Who are the Poor?

We tried to gain additional insight into the question of who the poor are by decomposing poverty profiles of households by other socio-economic variables. We used variables such as sex of the household head, asset holding (mainly farm and oxen holding) and access to services like formal credit, food transfers, off-farm employment and a host of village related variables such as distance to market, population density, presence of irrigation projects and whether the particular village was affected by the recent conflict. We tested for differences in poverty across socio-economic groups in the two periods using mean separation tests.

As can be seen from Table 4.6, female-headed households have apparently lower poverty in terms of the incidence, depth and severity of poverty although not in a statistically significant manner.

Not surprisingly, poverty seems to be closely related to asset holding. Ox holding is considered an important economic asset not only because it is a major source of traction power but also a source of social prestige. Households with ox holding greater or equal to a pair of oxen displayed significantly lower poverty measures, especially in 1997. Similarly, households with farm holding greater or equal to the regional mean, depict lower poverty levels than those having farm holding less than the mean.

There is also a significant difference in incidence, depth and severity of poverty depending on whether households have access to formal credit. Access to off-farm employment has led also to significant difference in poverty levels in 2000. The incidence, depth and severity of poverty are higher in households with access to FFW and food aid, in the latter especially in 1997. This may point to food transfers, taking either form, is targeted to the poor. It may also show, even in the face of food targeting, poverty is still higher among those targeted indicating the depth and severity of poverty underlining the huge income flow needed to fill the gap.

Households in communities with irrigation projects have lower incidence of poverty. The depth and severity of poverty, however, is not lower in households with access to irrigation projects. The very low level of irrigation development in the region allowing only few households to benefit from it could perhaps explain this.

Table 4.6: Socio-economic decomposition

Socio-economic variables	1997				2000			
	Poverty indexes				Poverty indexes			
	n	P ₀	P ₁	P ₂	n	P ₀	P ₁	P ₂
Sex of household head								
Male	378	0.62	0.29	0.17	344	0.67	0.27	0.14
Female	70	0.53	0.25	0.14	57	0.54	0.24	0.12
t-test*	-	-1.373 (0.007)	-1.557 (0.006)	-1.965 (0.005)*	-	-1.129 (0.008)	-1.315 (0.007)	-1.727 (0.005)
Oxen holding								
< a pair	290	0.66	0.33	0.19	333	0.70	0.30	0.15
≥ a pair	107	0.50	0.21	0.11	68	0.47	0.15	0.06
t-test	-	-2.020 (0.004)*	-2.416 (0.004)*	-3.103 (0.003)**	-	-1.339 (0.005)	-1.842 (0.005)	-2.324* (0.004)
Farm size								
< mean	282	0.63	0.31	0.19	272	0.72	0.31	0.15
≥ mean	115	0.52	0.20	0.09	129	0.46	0.17	0.08
t-test	-	-2.141 (0.004)*	-2.600 (0.002)*	-3.507 (0.002)**	-	-2.380 (0.004)*	-2.965 (0.003)**	-4.033 (0.002)**
Access to credit								
Yes	226	0.57	0.26	0.15	130	0.65	0.31	0.17
No	171	0.68	0.34	0.20	272	0.66	0.25	0.12
t-test	-	-2.858 (0.003)**	-2.956 (0.003)**	-3.542 (0.002)**	-	-2.462 (0.004)**	-2.565 (0.003)*	-3.198 (0.001)**
Access to food-for-work								
Yes	223	0.67	0.32	0.19	230	0.69	0.28	0.14
No	174	0.50	0.23	0.13	171	0.61	0.25	0.12
t-test	-	-2.858 (0.003)**	-2.956 (0.003)**	-3.542 (0.002)**	-	-2.462 (0.004)*	-2.565 (0.003)*	-2.565 (0.003)*
Access to off-farm								
Yes	365	0.60	0.28	0.16	222	0.64	0.24	0.11
No	32	0.74	0.42	0.27	179	0.67	0.29	0.15
t-test	-	-0.726 (0.013)	-0.646 (0.015)	-0.718 (0.013)	-	-2.939 (0.003)**	-3.142 (0.003)**	-4.094 (0.002)**
Access to food aid								
Yes	73	0.81	0.36	0.20	233	0.70	0.29	0.15
No	324	0.57	0.28	0.16	168	0.59	0.23	0.11
t-test	-	-1.789 (0.005)	-1.488 (0.006)	-1.787 (0.005)*	-	-2.835 (0.003)**	-3.151 (0.003)**	-4.146 (0.002)**
Access to irrigation water								
Yes	100	0.57	0.29	0.17	92	0.57	0.23	0.11
No	297	0.62	0.29	0.17	309	0.68	0.28	0.14
t-test	-	-1.191 (0.005)	-2.088 (0.004)*	-2.523 (0.004)*	-	-1.789 (0.005)*	-2.083 (0.004)*	-2.792 (0.003)*
Distance to market								
< 10 km	199	0.56	0.28	0.17	201	0.63	0.25	0.12
≥ 10 km	198	0.65	0.29	0.16	200	0.69	0.29	0.15
t-test	-	-2.883 (0.003)**	-3.109 (0.003)**	-3.782 (0.002)**	-	-2.999 (0.003)**	-3.196 (0.003)**	-4.151 (0.002)**
Population density								
< 200 persons/ km ²	149	0.46	0.17	0.08	150	0.58	0.22	0.11
≥ 200 persons/ km ²	248	0.71	0.36	0.22	251	0.70	0.28	0.15
t-test	-	-2.622 (0.003)*	-3.146 (0.003)**	-4.047 (0.002)**	-	-2.670 (0.003)**	-3.053 (0.003)**	-3.978 (0.002)
Effect of conflict[±]								
Directly affected	123	0.52	0.27	0.13	125	0.77	0.32	0.17
Not affected	274	0.65	0.31	0.18	276	0.61	0.25	0.12
t-test	-	-2.262 (0.004)*	-2.509 (0.003)*	-3.254 (0.003)	-	-2.629 (0.004)**	-2.470 (0.004)	-3.098 (0.003)**

[±] The figures for 1997 imply welfare standing of the villages before the conflict started.

**, * Significant at 1 and 5 percent respectively.

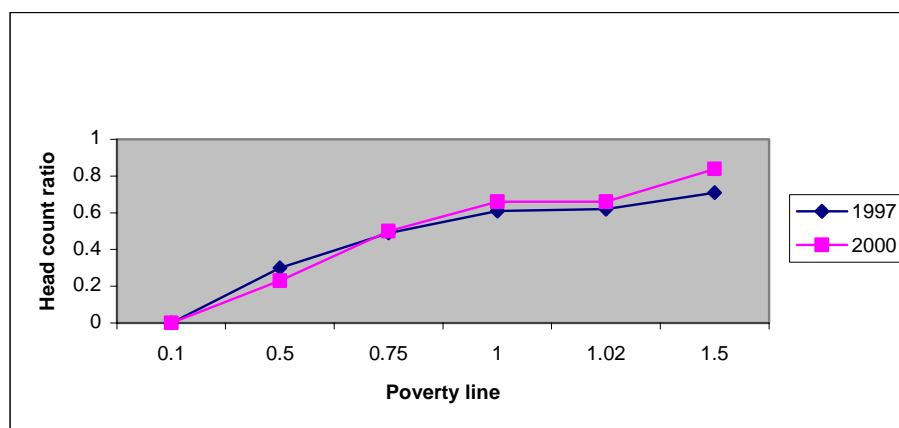
Better access to markets, as measured by distance to major (*wereda*) market, seems to reduce poverty. The incidence, depth and severity of poverty are significantly higher in those villages that are far from major market. Population density seem to be positively correlated to

increased poverty as can be witnessed in the increased incidence, depth and severity of poverty in 1997 and 2000. Finally, the effect of the conflict on household welfare is reflected in increased incidence, depth and severity of poverty in 2000 compared to the pre-war welfare standing of the same communities and relative to those communities located far from the conflict.

4.3. Stochastic dominance tests

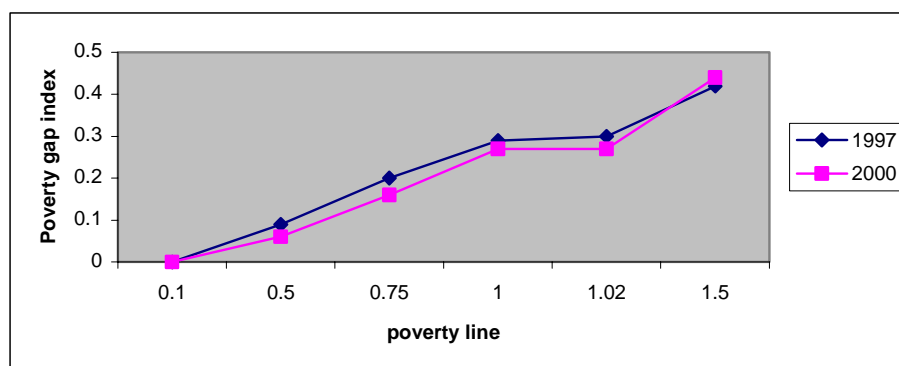
An implicit assumption behind estimating standard errors for various poverty measures is that our welfare indicators are the true measures, and that the standard errors around the poverty measures derive solely from the fact that we have a sample household, not from measurement errors. The serious problem of such mean separation tests is that it assumes that the poverty line is fixed and it is not a random variable and the poverty line is estimated without error. If the poverty line is random and estimated with error, the formulas developed for testing do not work (Woldehanna and Alemu, 2003). Hence, we need to undertake ordinal poverty comparisons using stochastic dominance tests to test the robustness of the poverty orderings. The idea here is to make ordinal judgments on how poverty changes for a wide class of poverty measures over a range of poverty lines. Results of these tests are given in Figures 1.1–1.3, 2.1–2.3 and 3.1–3.3.

Figure 1.1: First order stochastic dominance test to compare the incidence of poverty between 1997 and 2000



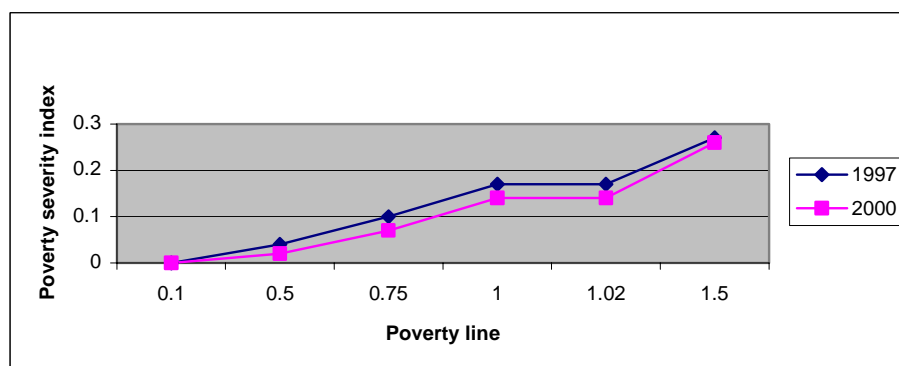
Comparing the head count ratios in 1997 and 2000, the first order stochastic dominance tests could not establish unambiguously that poverty is significantly different in the two periods (Figure 1.1). This confirms that the incidence of poverty in the region has remained the same during the period 1997 to 2000.

Figure 1.2: Second order stochastic dominance test to compare the depth of poverty between 1997 and 2000



In terms of the depth and severity of poverty, however, the second and third order stochastic dominance tests showed that there was a significant fall in poverty (see Figures 1.2-1.3). The depth of poverty in 2000 was significantly lower for the majority of the population (for those having consumption expenditures less or equal to 1.5 time the poverty line) than in 1997. This may be accounted to the positive impact of policy reforms on poverty reduction.

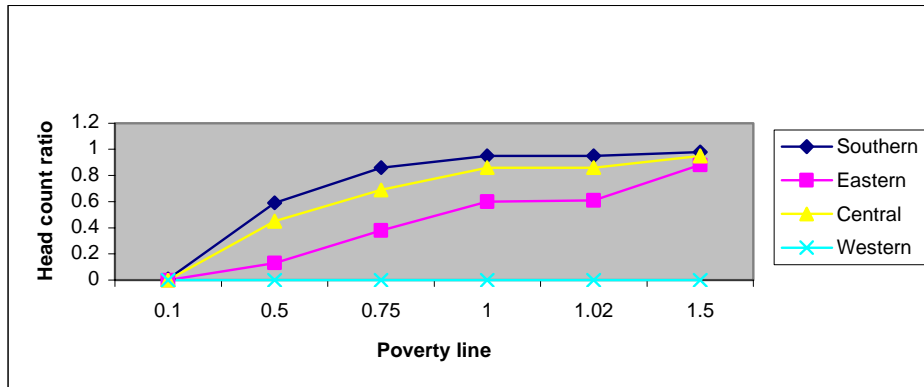
Figure 1.3: Third order stochastic dominance test to compare the severity of poverty between 1997 and 2000



Similarly, the severity of poverty in 2000 is significantly lower than in 1997. This may confirm presence of a moderate, but significant, fall in the depth of poverty and inequality in the region during the period although the proportion of the population living under poverty remained the same.

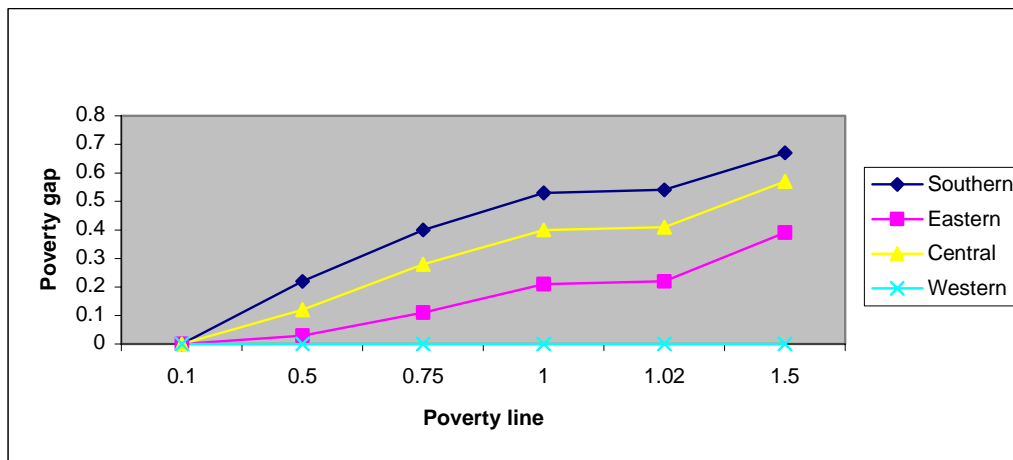
We also tested for the robustness of poverty orderings among zones in 1997 and 2000. The results are given in Figures 2.1-2.3 and 3.1-3.3. As can be seen from Figure 2.1, in 1997 the incidence of poverty was unambiguously higher in the southern zone followed by the central, eastern and western zones respectively.

Figure 2.1: First order stochastic dominance test to compare the incidence of poverty among zones in 1997



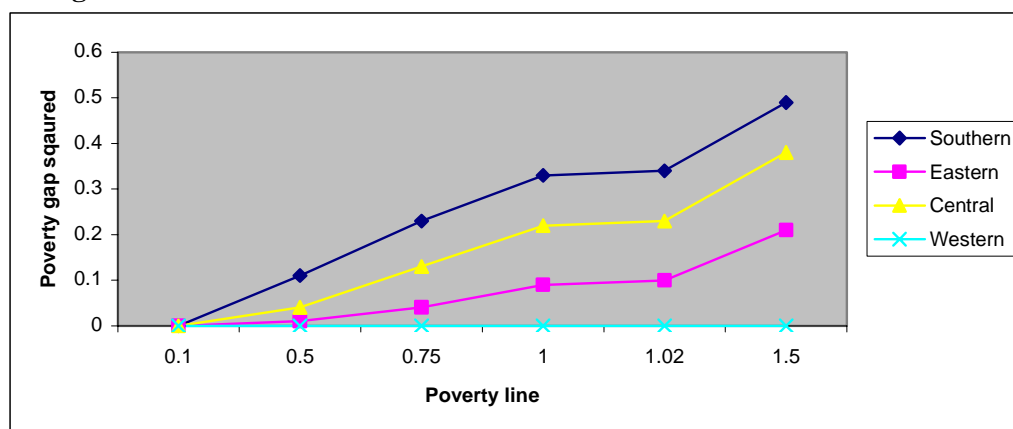
Similarly, the depth and severity of poverty was also significantly higher in the southern followed by the central, eastern and western zones respectively.

Figure 2.2: Second order stochastic dominance test to compare the depth of poverty among zones in 1997



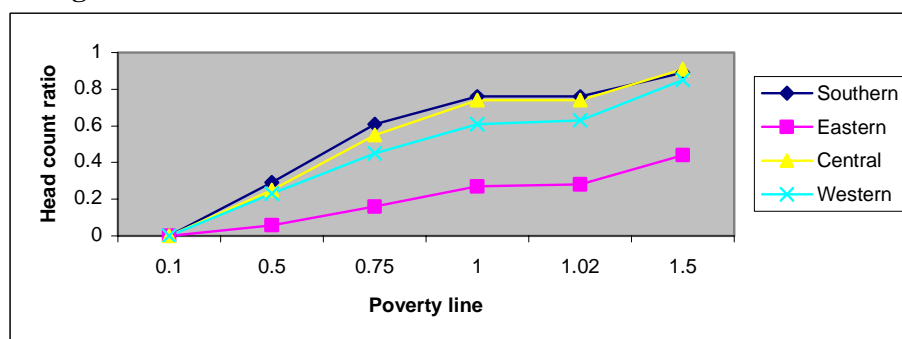
By 2000, the incidence of poverty was still highest in the southern and central zones followed by the western zone and eastern zone respectively.

Figure 2.3: Third order stochastic dominance test to compare the severity of poverty among zones in 1997



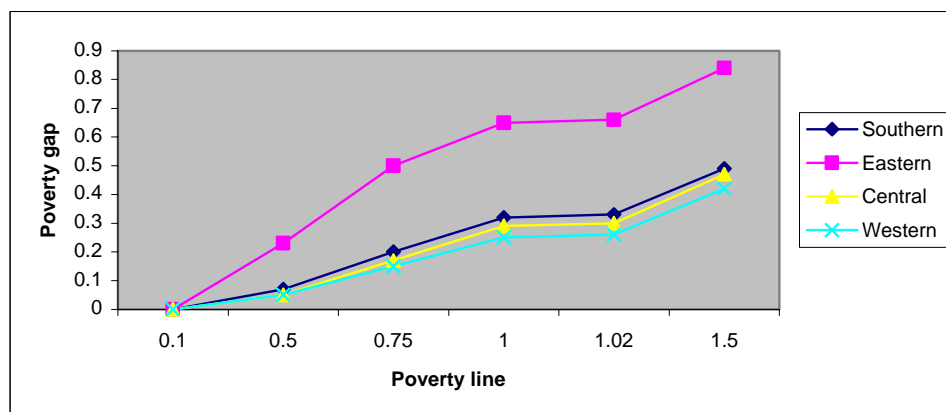
The eastern and western zones have changed positions mainly because of serious welfare deterioration in the western than improvements in the eastern zone.

Figure 3.1: First order stochastic dominance test to compare the incidence of poverty among zones in 2000



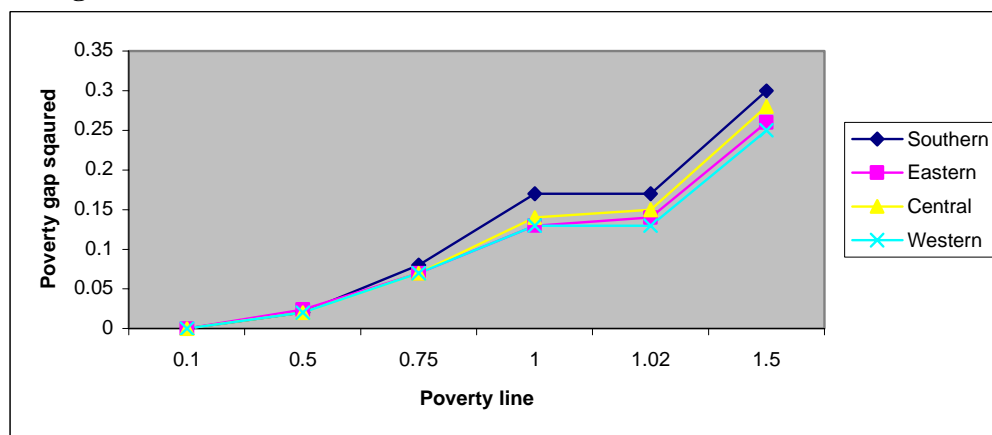
The depth of poverty, however, was significantly higher in the eastern zone followed by the southern, central and western zones respectively (Figure 3.2). This might point to the limited effect of poverty reduction strategies in the zone that, in turn, be caused by the precarious weather conditions in the zone and the possible effect of the war.

Figure 3.2: Second order stochastic dominance test to compare the depth of poverty among zones in 2000



The severity of poverty, in 2000, was unambiguously higher in the southern, followed by central, eastern and western zones.

Figure 3.3: Third order stochastic dominance test to compare the severity of poverty among zones in 2000



In a nutshell, in spite of the few exceptions, the zones, which were initially poor, remained poor during the whole period underling the presence of a geographic trap to poverty.

5. Mobility and poverty dynamics

The incidence of poverty rose from 61 to 66 percent, although not in a statistically significant manner, between 1997 and 2000. Following the trajectories of the same households over a period, we could distinguish between the people falling into or moving out of poverty and

those remaining in poverty revealing a more complex picture. This distinction has an important policy implication because different policy measures are needed to address the long-term poor vs. the temporarily poor. While the former calls for long-term investment in the poor, the latter may call for design of programs that complement the income (resource) of the poor temporarily (Grootaert et al, 1995). The figures in parenthesis (in column 1 Table 5.1) show the poverty standing in 1997 by focusing on 351 households.

Table 5.1: Poverty transitions 1997-2000

Poverty status in 1997	Poverty status in 2000			
	Non poor	Extreme poor	Poor	Total
Non poor [0.54]	0.444	0.376	0.185	1.00
Extreme poor [0.41]	0.172	0.524	0.296	1.00
Poor [0.46]	0.272	0.549	0.167	1.00

As can be seen from Table 5, from the non-poor in 1997, 56 percent moved into poverty, out of which close to 38 percent moved into extreme poverty, the remaining 44 percent remained non-poor. On the other hand, from the poor in 1997, close to 55 percent fell into extreme poverty in contrast to 27 percent that escaped poverty. The extreme poor increased from 41 percent in 1997 to about 52 percent while only 17 percent moved out of poverty underlining that the extreme poor have difficulty getting out of poverty.

A detailed mobility matrix is given in Table 5.2 that depicts the percentage of the individuals in each welfare class in 1997 that were observed in 2000 classes as defined in terms of absolute levels of well being (i.e. consumption expenditure in adult equivalent terms). The main diagonal elements of the matrix provide the percentage of individuals in each row that did not change their positions over 1997-2000. The people that remained poor throughout are the once in chronic poverty while those people that temporarily move in or out of poverty are said to be in transient poverty (Jalan and Ravallion, 1998). From the transition matrix, we could see that a considerable proportion of the population in the lower category (I and II) have remained in those

Table 5.2: Transition matrix between 1997 and 2000

Scaled expenditure per adult equivalent in (1997)	Scaled expenditure per adult equivalent in (2000) *					
	I	II	III	IV	V	Total
I [0.24]	0.258	0.517	0.082	0.129	0.017	1.00
II [0.298]	0.238	0.439	0.079	0.185	0.053	1.00
III [0.077]	0.235	0.415	0.104	0.193	0.047	1.00
IV[0.153]	0.220	0.409	0.091	0.212	0.063	1.00
V[0.241]	0.194	0.387	0.153	0.245	0.020	1.00

*I = $\leq 0.5 * Z$, II = $\leq Z$, III $\leq 1.25 * Z$, IV = $\leq 2.5 * Z$ and V $\geq 2.5 * Z$ where Z is the poverty line.

categories. Of the people that had consumption expenditures lower or equal to half of the poverty line, 23 percent of them moved out of poverty into the third, fourth and fifth classes. From those initially in category II, close to 32 percent moved out of poverty while the remaining 68 percent of the population remained in poverty. From those initially outside of poverty (categories III, IV and V), the predominant majority of them fell into poverty (in to category I and II). We defer the detailed discussion of the socio-economic characteristics of those that remained poor, moved into or out of poverty into another paper. We, however, report those factors that explained the changes in welfare standing of households in part VII.

6. Determinants of poverty: regression models

In the previous section, we presented a big picture as to what happened to poverty in Tigray region between 1997 and 2000. An analysis of poverty will not be complete without explaining why people are poor and remain poor over time. Within a microeconomic context, the simplest way to analyse the correlates of poverty consists in using a regression analysis in order to see the impact of household and demographic factors, specific individual/household head characteristics, asset holdings, village level factors, and policy related variables. Let the welfare indicator W_i be gives as:

$$W_i = Y_i / Z \quad (7)$$

where Z is the poverty line and Y_i is the consumption expenditure per adult equivalent. Denoting by X_i the vector of independent variables, the following regression

$$\text{Log} W_i = \beta' X_i + \varepsilon_i \quad (8)$$

could be estimated by OLS. In this regression, the logarithm of consumption expenditure (divided by the poverty line) is used as the left-hand variable. The right hand variables in the regressions include (a) household characteristics including the number of babies, children under 5, seniors (beyond 65 years) and other demographic factors; (b) characteristics of the household head, including sex and age (and its square), his/ her level of education (according to the categories: illiterate vs. literate), and any acquired skills and whether the household has a secondary occupation apart from his/her primary occupation (access to off-farm income); (c) some set of characteristics for the spouse of the household head such as education level and whether the spouse has any acquired skill; d) asset holding: oxen holding, livestock size (in TLU)¹⁰ and farm size all in per adult equivalent terms, adult labour (by sex) and household

¹⁰ Given in tropical livestock units (TLU) based on information in Jahnke (1982).

members with primary and secondary education; e) access to different public services: credit, extension and food transfers; and f) the geographical location of the household (in this case zones¹¹), and some community characteristics such as distance to a major market, population density, presence of irrigation projects, and a war dummy. We wanted to capture the effect of the war on those villages directly affected by the conflict vs. those not directly affected because of their proximity to the conflict area. Moreover, we introduced a conscription dummy to account for those households who had to send somebody into the war. We expect the effect of a household member being conscripted on household welfare to go both ways. Due to the transfer of income in the form of remittances, the household may improve its consumption level, hence, welfare standing. On other hand, the withdrawal of labour from production may have a negative impact on household welfare, especially on those labour constrained households.

We estimated a model for changes in welfare status of households using the following regression model:

$$\nabla Y_i = \gamma' X_{t-1} + v_i \quad (9)$$

where ∇Y_i is the difference in consumption expenditure in adult equivalent terms between 1997 and 2000 divided by the poverty line (Z), which may yield a positive or negative value implying an improvement or deterioration in welfare standing of the household¹². The vector X_{t-1} includes regressors similar to equation (8) most of them taking their initial (1997) values to test for time recursive causality. We believe that initial conditions matter because households' response to a changing economic environment is very much a function of the level of endowments prior to the change, and the prevalent behaviour with respect to income generation (Grootaert et al., 1995). It also includes variables such as the war related dummies and other village level fixed effects.

The β coefficients in equation (8) are the partial correlation coefficients that reflect the degree of association between the variables and levels of welfare and not necessarily their causal relationship. The parameter estimates could be interpreted as returns of poverty to the characteristics (Wodon, 1999). The γ coefficients in (9) are factors that might have caused a positive or negative change in welfare between 1997 and 2000.

¹¹ *Tabia* dummies were found to be collinear with many regressors.

¹² A probit model, where ∇Y_i takes values zero or one, was tried to estimate equation (9). However, the results, not surprisingly, were not as strong as the results from the survey regression model we reported here.

We used survey regression estimation techniques in both cases to account for the stratified sampling technique and, hence, adjust the standard errors to both stratification and clustering effects and thereby deal with the problem of heteroskedasticity. We also tested for other possible misspecifications (e.g. normality and multicollinearity).

6.1. Results and discussion

Descriptive statistics

The descriptive summary of the explanatory variables used in the regressions is presented in Table 6.1 below.

Average consumption expenditure per adult equivalent has increased from about Birr 528 to Birr 647, showing a growth rate of 18 percent. The average household size (adult equivalent) has increased from 4.69 (3.98) to 5.47 (4.55) implying an annual growth rate of 2.6 percent. The composition of the sexes in the total population seems to be equally distributed, especially in 1997. The ratio of dependent household members (babies, children and seniors) to those economically active is 1 to 0.94. About 82 percent of the households are male-headed.

Education levels are extremely low with illiteracy rate of household heads of 90 and 61 percent for 1997 and 2000 respectively. Education of spouse is ridiculously low accounting for 2 and 24 percent in 1997 and 2000 respectively. The proportion of household heads and spouses with acquired skills are very low accounting for close 15 and 35 percent during the same period. The proportion of members with either elementary or secondary education is also low accounting for 0.23, 1.1, 0.3, and 0.21 individuals/household in 1997 and 2000 respectively.

In terms of asset holding, the farm size per adult equivalent is below one hectare. The oxen holding per adult equivalent for 1997 and 2000 is 0.245 and 0.188 oxen units respectively. Similarly, the livestock holding per adult equivalent for 1997 and 2000 is slightly higher amounting to 0.377 and 0.414 TLU in 1997 and 2000 respectively.

Credit intake, mainly for farm inputs, has declined between 1997 and 2000 by about 24 percent. On average, however, more than 40 percent of the households have access to formal credit market. The number of households who supplement their income from off-farm sources

Table 6.1: Descriptive statistics of the explanatory variable in the regression models

Variables	Description	1997		2000	
		Mean	Std. Error	Mean	Std. Error
Household Characteristics					
Hhsize	Household size	4.69	0.116	5.47	0.029
Aduleqv	Adult equivalent	3.981	0.095	4.546	0.101
Babies	No of babies	0.118	0.016	0.184	0.019
Juniors	Children between 1 and 5 years	0.491	0.032	0.458	0.028
Children	Children between 6 and 15 years	1.567	0.0716	2.012	0.073
seniors	Beyond the age of 65	0.239	0.226	0.192	0.025
Femcomp	Female household composition	0.502	0.017	0.482	0.01
depratio	Consumer-worker ratio	2.155	0.047	2.593	0.077
Specific characteristics of the household head/spouse					
hhsex	Sex of household head (1= female)	0.176	0.018	0.137	0.017
hhage	Age of household head	49.49	0.785	52.17	0.755
eduhh	Educational dummy of the head (literate=1)	0.10	0.015	0.390	0.024
edusp	Educational dummy of spouse (literate=1)	0.016	0.006	0.241	0.022
skillhh	Household heads with any kind of acquired skill (yes=1)	0.030	0.008	0.242	0.021
skillspp	Spouses with any kind of acquired skill (yes=1)	0.022	0.007	0.069	0.012
soldrdy	Whether a household member is conscripted into the army (yes=1)	-	-	0.147	0.018
Asset holding /human capital					
adufem	Female adult household members	1.143	0.031	1.291	0.039
adumale	Male adult household members	1.166	0.047	1.344	0.051
secondar	Members with secondary education	0.027	0.1093	0.211	0.030
primary	Members with primary education	0.232	0.0347	1.149	0.060
pcfarm	Farm size per adult equivalent	0.344	0.018	0.350	0.017
pcoxen	oxen holding per adult equivalent	0.245	0.014	0.188	0.015
pctlu	Livestock holding per adult equivalent	0.377	0.028	0.414	0.026
pcexp	Consumption expenditure in adult eqvl.	525.28	28.350	647.429	26.399
Access to services					
credit2	Households with access to credit (yes=1))	0.567	0.247	0.324	0.023
extensi2	A dummy to represent access to extension related training (yes=1)	-	-	0.312	0.023
irrland	Household located in villages with irrigation projects (yes=1)	0.251	0.000	0.229	0.007
offarm2	Households with access to off-farm employment (yes= 1)	0.347	0.022	0.553	0.024
aid2	Households with access to food aid (yes= 1)	0.183	0.017	0.581	0.022
ffw2	Households with access to food-for-work projects (yes= 1)	0.561	0.022	0.573	0.023
Village characteristics					
market1	Distance to market < 10 km	0.501	0.023	0.501	0.000
market2	Distance to market > 10 km	0.498	0.0235	0.498	0.000
popn1	Population density of < 200 persons/ km ²	0.375	0.023	0.374	0.002
popn2	Population density of > 200 persons/ km ²	0.624	0.023	0.625	0.002
rainind	Rainfall index calculated as the year's means divided to the mean of many years	0.986	0.000	1.014	0.000
wardy	War dummy to indicate villages affected directly by war (yes= 1)	-	-	0.311	0.000

has increased from 34 percent to 55 percent. Food transfers, in the form of direct handouts and food-for-work programs, play an important role to rural households in Tigray region. About 18 and 58 percent of the households had access to food aid in 1997 and 2000 compared to 56 and 57 percent to food-for-work during the same period.

Access to irrigation remains very low. In general, not more than 25 percent of the households in Tigray region are located in areas with irrigation projects. Close to 50 percent of the households are categorized as having better access to major markets with < 10 kms separating them from major market centres. More than 62 percent of the households are located in densely populated villages with > 200 person/km². Finally, more than 31 percent of the households are located in villages affected by the recent border conflict.

6.2. Regression results

The results of the expenditure regressions are given in Table 6.2. In the 1997 expenditure regression, welfare was found to be a decreasing function of the number of dependents in a household. The coefficient for seniors was also negative and highly significant. Female composition of households was found to be positively correlated with welfare. In the 2000 expenditure regression, from among the household and demographic characteristics, the dependency ratio was found to be marginally significant and with the expected negative sign. Recruitment into the army of a household member turned out to be positive and significant at 10 percent level.

From the household head/spouse specific factors, age of the head was found to be negative and significantly correlated with welfare in 1997. Education of the head was also found to be significant and positive, albeit at 10 percent, in both 1997 and 2000 regressions, whereas education of spouse was not statistically significant in both regressions. Similarly, in 2000 household heads with any kind of acquired skill were found to have marginally higher welfare levels.

Asset holdings of households were closely related with the households' welfare status. In the 1997 regression, households with larger asset holdings such as farm, oxen, livestock holdings per adult equivalent and have got members with primary education have significantly higher consumption expenditures. Similarly, in 2000 regression, households with larger farm and livestock holdings had significantly higher welfare levels. Oxen holding were also found to be highly significant but with a negative sign. On the other hand, adult labour (both female and male) was found to be highly significant and negative in both regressions perhaps underlining negative marginal returns to labour and the poor functioning of labour markets in the region.

Table 6.2: Regression results on correlates of poverty and changes in poverty between 1997 and 2000

Variables	1997		2000		Changes in poverty	
	Coef.	Std. err	Coef.	Std. err	Coef.	Std. err
Household Characteristics						
babies	-0.110	0.074	0.533	0.091	-.006	.113
juniors	-0.010	0.038	-0.041	0.051	-.048	.055
seniors	-0.217	0.070***	0.103	0.070	-.107	.096
femcomp	0.175	0.058***	0.255	0.163	-.024	.060
depratio	-0.131	0.034***	-0.047.	0.027*	.106	.044**
Specific characteristics of the household head/spouse						
hhsex	-0.071	0.077	-0.004	0.113	.092	.112
hhage	-0.030	0.008***	0.004	0.012	.0002	.014
hhage^2	0.0002	0.000***	-0.000	0.000	-0.000	0.000
eduhh	0.116	0.068*	0.102	0.061*	.053	.121
edusp	0.134	0.067	0.074	0.065	-	-
skillhh	-0.154	0.181	0.104	0.063*	-.838	.535
skillspp	-0.280	0.204	-0.018	0.107	-.037	.185
soldrdy	-	-	0.137	0.076*	-.161	.102
Asset holding / human capital						
adufem	-0.112	0.040***	-0.058	0.049	.041	.046
adumale	-0.127	0.027***	-0.095	0.035***	.056	.039
primary	0.096	0.027***	-0.034	0.026	-.051	.063
secondar	0.076	0.061	0.086	0.041**	.168	.096*
pcfarm	0.334	0.118***	0.340	0.100***	.158	.082**
pcoxen	0.323	0.126***	-0.220	0.126*	-.219	.183
pctlu	0.211	0.058***	0.439	0.083***	.143	.108
Access to services						
credit2	0.031	0.045	0.010	0.060	-.078	.065
irrland	0.028	0.060	-0.049	0.073	.124	.143
extensi2	-	-	0.103	0.046	-.033	.063
offarm2	-0.017	0.086	-0.023	0.057	.188	.114*
aid2	-0.085	0.063	0.041	0.056	-.195	.101**
ffw2	-0.030	0.053	0.005	0.057	.041	.081
Village characteristics						
market2	-0.067	0.051	-0.243	0.058***	.158	.077**
popn2	0.011	0.059	-0.056	0.069	-.087	.076
rainind	0.337	0.105***	1.35	0.764*	-.004 ^a	.006
wardy	-	-	-0.401	0.073***	.044	.068
Zonal dummies						
Zone 1	-0.052	0.286	-1.789	0.843**	-.724	.386*
Zone 2	-0.434	0.309	-2.194	0.843***	-.253	.424
Zone 3	-0.352	0.301	-1.891	0.760**	-.343	.392
Zone 4	-0.296	0.271	-2.185	0.784***	-.356	.372
	N= 355		N= 373		N= 305	
	Strata= 16		Strata= 16		Strata= 16	
	Psu= 355		Psu= 373		Psu= 305	
	F(30, 310)= 97.01		F(32, 326)= 41.84		F(33, 257) = 2.32	
	Prob > F= 0.000		Prob > F =0.000		Prob > F = 0.000	
	R-squared= 0.869		R-squared = 0.774		R-squared = 0.298	

*, **, *** significant at 10, 5 and 1 percent levels of significance.

^a We used rain variability index instead of the rainfall index used earlier.

As far the effects of households' access to services are concerned, none of the coefficients was significantly related with household welfare. This result is, however, less conclusive

because a more rigorous analysis is needed, than the ordinary regression used here, to measure the impact of policy programs on household welfare (See Hagos and Holden, 2002). Few village related variables were found to be significant in explaining household welfare. In 2000, the coefficient for the war dummy turned out to be highly significant and negative underlining the adverse effects of the conflict on those communities close to the conflict. Poor access to market was also highly significant in 2000 and negatively related to welfare. The coefficient for rainfall index turned out to be positive and significant in both regressions indicating importance of weather related factors to the welfare of rural households. This is not surprising given the dominance of rain-fed agriculture in the region. Finally, the coefficients for the four zone dummies were found to be negative and highly significant in the 2000 regression perhaps capturing other effects not directly controlled for. These dummies were not significant in the 1997 regression, however.

The factors that explain the changes in household welfare are reported in column three of Table 6.2. Generally, the regression results are not as strong as the individual welfare regression results reported in the two columns in the same table.

Households who had members with secondary education in 1997 showed improvement in welfare during the period. Like in the individual regressions, households with initially larger farm holding showed a positive change in welfare. Moreover, households who had access to off-farm employment in 1997 did experience positive changes in welfare. On the other hand, contrary to our expectations, households with more dependents seem to have witnessed a positive change in welfare.

From among the services rendered, food aid seems to have contributed negatively to changes in welfare, which might point more to the indirect effects (e.g. disincentive effects) of food aid on poverty reduction. Finally, from among the village level variables, households in communities with poor access to markets showed positive improvements in welfare. This might reflect that households far from market are less vulnerable to external shocks (policy or political risk) than communities with better access, but not fully integrated into the market.

8. Conclusion

The incidence of poverty in the region, in spite of a 5 percent increase between 1997 and 2000, has remained the same, and it remained staggeringly high compared to national figures. There is, however, a moderate but significant decrease in the depth and severity of poverty in the region. The decrease in the depth of poverty might show the positive effect of policy

reforms on poverty reduction. The growth in consumption in per capita expenditure has also led to reduction in the level of inequality.

Decomposition results and stochastic dominance tests showed that there were significant differences in the geographic distribution of poverty among the zones in both 1997 and 2000. Moreover, in spite of the few changes in poverty conditions across the four zones in the region, the zones which were initially poor remained poor during the whole period underling the presence of a geographic trap to poverty.

The analysis of the dynamics of poverty showed that the proportion of the people falling into poverty was far higher than those escaping poverty. Furthermore, people living in extreme poverty had difficulty of escaping poverty pointing to poverty trap and thereby underlining the chronic nature of poverty in the region. This calls for policy measures that target long-term poverty while at the same time designing programs to support the income of those temporarily falling into poverty.

In the analysis of the determinants of poverty, households having educated head and with any kind of acquired skills seem to have achieved significantly higher welfare. Similarly, human capital resources such as household members with primary and secondary education in the 1997 and 2000 regressions respectively, had significantly higher welfare. Moreover, a positive change in welfare was associated with households having members with secondary education. Increased physical asset holding of households, in terms of farm and livestock holding, was highly correlated with improved welfare status of households. Change in welfare of households was significantly related to initial farm holding. These results underline the significance of enhancing the poor's human and physical endowments in poverty reduction. On the other hand, the size of adult labour in the household seems not to have generally contributed to improved welfare of households perhaps underlining negative marginal returns to labour and the poor functioning of labour markets in the region. This calls for policy measures that attack poverty through increased investments for employment creation that tap on the idle labour resource. This is strengthened by the positive effect of access to off-farm income in 1997 on positive changes in household welfare.

As far as the effect of households' access to services are concerned, none of the service related variables have significant effect on welfare perhaps pointing to the limited effect of these programs on poverty reduction. This result, although less conclusive, might indicate the limited effectiveness of such programs in remote, politically unstable and fragile environments compared to areas with high potential and better market access conditions. This might also be related to the need for a sustained long-term investment in poverty reduction

measures until such measures show tangible results in terms of improved welfare reaching the majority of the poor.

Regression results also showed the importance of village level factors such as war, market access and rainfall. The coefficient for war points to the adverse effects of political risk to poverty reduction. Peace and social stability are quite important to economic development and poverty reduction. Increased access to markets, through investments in marketing infrastructure may also contribute to poverty reduction, although it may expose poor households to external shocks until they are fully integrated into the market. Finally, agricultural production in the region is highly dependent on weather related factors. This calls for a public intervention to reduce the heavy dependence of rural production on unreliable rainfall through investments in irrigation. This is imperative given the chronic nature of poverty and the recurrent drought in the region triggering famine of massive proportions.

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Appendix 1

Table 1A: List of *Tabias* and their location with few key village level variables

Tabia	Location		Population density (persons/km ²)	Distance to Wereda market (in km) [†]	Mean rainfall* *	Affected by conflict (Yes =1)	Irrigation project (Yes =1)
	Wereda	Zone					
Hintalo	Hintalo Wajerat	Southern	80.2	14	503.7 (183.5)	0	1
Samre	Seharti Samre	Southern	248.9	1.25	557.5 (175.7)	0	0
Mahbere Genet	Enderta	Southern	441.5	8*	552.1 (93.83)	0	1
Mai Alem	Enderta	Southern	429.6	6*	552.1 (93.83)	0	0
Kihen	Wukro	Eastern	160.6	23	420.4 (205)	0	0
Genfel	Wukro	Eastern	166.5	4	420.4 (205)	0	1
Emba Asmena	Tsaeda Emba	Eastern	631.10	7	596.8 (123.9)	0	0
Hagere Selam	Gulo Mekada	Eastern	749.4	39	419.05 (190.2)	1	0
Seret	Degua Tembien	Central	707	12.5	761.4 (178.9)	0	0
Debdebo	Ahferom	Central	161	6	668.52 (232.9)	1	0
Mai Keyahti	Ahferom	Central	636.6	16	736.6 (109.53)	0	0
Adi Selam	Mereb Leke	Central	206.8	29	579.32 (109.99)	1	0
Hadegti	Laelay Adiabo	Western	130.8	9	832 (156.7)	1	0
Tsaeda Ambera	Laelay Adiabo	Western	41.8	20	596.55 (152.63)	1	0
Mai Adrasha	Tahtay Koraro	Western	440	5.2	893.55 (152.63)	0	1
Adi Menabir	Tahtay Koraro	Western	236	21	783.4 (158.2)	0	0

* Even though the wereda market is about 20 km away, the Mekelle market is close (5-10 km).

** It is calculated based on rainfall data gathered in 1991 to 2001 at the wereda level by the regional Bureau of Agriculture. Standard deviations are given in brackets.

[†] We categorized *tabias* into distant from market for those greater than or equal to 10 kms away from a major market and population density on a benchmark of greater than or equal to 200 persons/km².

Table 2A: Equivalence scales

Years of age	Men	Women
0-1	0.33	0.33
1-2	0.46	0.46
2-3	0.54	0.54
3-5	0.62	0.62
5-7	0.74	0.70
7-10	0.84	0.72
10-12	0.88	0.78
12-14	0.96	0.84
14-16	1.06	0.86
16-18	1.14	0.86
18-30	1.04	0.80
30-60	1.00	0.82
60 plus	0.84	0.74

Source: Adopted from Dercon and Krishnan (1998).

Table 3A: Regional food basket and average consumption (per year)

Item	Mean	Type	kcal	Real price (Southern 2000 price= 100)
111	26.68	Teff	341	2.5
112	31.09	Barley	354	1.75
113	7.190	Maize	362	2.0
114	36.39	Sorghum	347	1.75
115	3.64	Millet	329	2.25
116	4.58	Fava Bean	104	2.5
117	0.61	Lathyrus	348	2.0
118	1.29	Pepper	312	10.0
119	0.91	Beef	235	5.0
120	0.55	Mutton	255	5.0
121	0.29	Goat meat	170	4.2
122	0.43	Chicken	140	10.0
123	0.57	Milk	39	2.0
124	1.23	Butter	885	10.0
125	0.633	Sugar	400	6.0
126	0.70	Edible oil	884	9.0
127	2.75	Salt	0	2.5
128	3.27	Coffee	2	10.0
129	17.34	Wheat	351	2.5

Table 4A: Lespeyres price Index deflated by 2000 southern price

Zones	2000	1997	Relative change	Change
Central	49.41	56.71	-14.78	Decrease
Eastern	56.56	64.88	-14.75	Decrease
Southern	100	112.36	-12.37	Held constant
Western	50.88	55.43	-8.9	Increase

Table 5A: Poverty profiles from similar studies

Measures	Dercon and Krishnan (1998)			Woldehanna and Alemu (2002)		Bigsten et al. (2003) [†]		
	1994a	1994b	1995	1995\96	1999\00	1994	1995	1997
P ₀	0.39	0.32	0.41	0.455	0.442	41.9	37.6	35.5
P ₁	0.16	0.10	0.17	0.129	0.119	16.8	16.2	12.7
P ₂	0.08	0.05	0.09	0.051	0.045	8.8	9.1	6.2
Regional poverty profile								
P ₀	-	-	-	0.579	0.616	-	-	-
P ₁	-	-	-	-	0.185	-	-	-
P ₂	-	-	-	-	0.072	-	-	-

[†] We report only poverty profiles of rural communities.