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## Factors Associated with Farm Households' Movement Into and Out of Poverty in Kenya: The Rising Importance of Livestock

by

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# FACTORS ASSOCIATED WITH FARM HOUSEHOLDS' MOVEMENT INTO AND OUT OF POVERTY IN KENYA: THE RISING IMPORTANCE OF LIVESTOCK

**by**

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## EXECUTIVE SUMMARY

This study explores the dynamics of poverty in Kenya. The study specifically examines how initial conditions, household decisions, and other factors that may change over time affect poverty. Dynamic relationships are identified between behavioral variables, exogenous shocks at one point in time, and indicators of household welfare in subsequent years.

Most quantitative studies characterizing rural poverty have been based on analysis of cross-sectional household survey data, which cannot provide insights into how or why households move into or out of poverty over time. In particular, it is difficult to identify specific behavioral decisions at one point in time that alter the path of households' living standards over the future, which is arguably critical for designing effective poverty alleviation strategies.

The study uses longitudinal data collected from 1,324 households which participated in three nationwide surveys conducted over seven years, in 1997, 2000, and 2004, to identify salient household-level and community-level correlates of poverty in rural Kenya. Next, dynamic relationships are identified between time-invariant initial conditions, lagged household resource allocation, technology adoption decisions, and current income and wealth outcomes. Last, the paper draws implications for designing policies and programs for alleviating rural poverty and promoting income growth.

After ranking households into terciles (or thirds) in each year, it is shown that the majority of households (57%) remained at the same relative poverty tercile in 2004 as that in which they began in 1997. Twenty-two percent of households made some progress in moving out of poverty, while 21% experienced a decline in welfare. The distribution of wealth across these households is highly unequal, with the value of assets owned by the 217 poorest households being only 13% of the value of the median household. The 249 households consistently in the top asset tercile had over eight times that of the median household.

Some of the factors helping to explain variation in asset-poverty levels across rural households in Kenya include the age and education of the household head, whether someone in the family has a formal job, land ownership, family size, and the distance to a tarmac road. While geographic location is an important factor, the differences in wealth among households in a given village tend to be greater than differences in mean household wealth across villages. Even within the same villages, rural households are very heterogeneous.

The findings from this study show that access to land continues to be a major determinant of rural household welfare. The consistently non-poor group cultivates three to four times more land on average than the chronically poor. Households that had made positive progress out of poverty had significantly increased the amount of land they controlled, from an average of three acres in 1997 to five acres in 2004. The direction of causality is not clear.

More types of crops were grown in 2004 than in 1997 by poorer as well as non-poor households. An increasing diversity is seen in off-farm income sources by the poorest households, particularly into lower entry-barrier, higher risk income generating activities. This finding lends support to earlier theories that the poor, or those suffering a negative shock to their incomes may

rely on such activities as temporary poverty alleviation. This study shows, in a dynamic context, that such short term solutions rarely lead to long term growth, and may in fact be poverty traps.

There has also been an increase in the types of livestock sold, particularly by non-poor households, who sell four times as many types of livestock and livestock products than do the poor. The importance of livestock production and marketing to the welfare of successful households holds irrespective of farm size. This seems to be particularly true for the dairy market. This study shows that the consistently wealthy are more likely to be producing, that the production is more commercialized, and that it is a greater share of total income compared to other poverty groups. Households whose wealth and asset holdings are increasing over the seven-year period are more likely to be intensifying their animal-based income-earning activities than other households.

The findings from this study have a number of implications for the design of strategies, policies, and instruments for reducing poverty and supporting agricultural growth in rural areas of Africa. First, the analysis demonstrates that the primary sources of variations in asset-poverty are at the household level, where asset holdings define a household's capability to pursue different livelihood activities that generate income. Sustainable poverty reduction needs to be built on a solid understanding of household asset positions and the contexts where assets are used as the basis for identifying livelihood strategies that lead to pathways out of poverty.

Second, greater support for poor households to enter and/or expand their participation in dairy and other animal product markets may provide a dynamic source of poverty reduction and growth.

Third, given the importance of land in household asset portfolios, agricultural growth and poverty reduction strategies need to take into account the realities of declining farm sizes and inequalities in access to land. The practical implication of declining available cultivated land per agricultural person is that raising labor and crop productivity on small farms under any plausible productivity growth scenarios is necessary, but not singularly sufficient to drive rural economic growth. Poverty reduction and growth strategies need to recognize the multi-dimensionality of rural livelihoods and the importance of farm-nonfarm linkages in facilitating rural growth. Policy priority, therefore, should be given to providing an enabling environment for commercial activities that support competitiveness of household producers, lower level of formal and informal taxes, and increased investment in public goods, such as agricultural research, extension, and infrastructure. No single approach taken alone is likely to alleviate poverty.

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| | |
|---|---|
| AEZ | Agricultural-ecological Zone |
| ANOVA | Analysis of Variance |
| CPI | Consumer Price Index |
| FAO STAT | Food and Agriculture Organization Statistical Database |
| FD | First Difference |
| FTAE | Full Time Adult Equivalent |
| GDP | Gross Domestic Product |
| HCI | Household Commercialization Index |
| IPW | Inverse Probability Weights |
| Ksh | Kenya Schillings |
| OLS | Ordinary Least Squares |
| TAMPA | Tegemeo Agriculture Monitoring and Policy Analysis |
| USAID | United States Agency for International Development |

## 1. INTRODUCTION

For at least four decades, African governments and donors have experimented with a series of alternative approaches for addressing rural poverty, each giving way to a new paradigm as the persistence of poverty created disillusionment with prevailing approaches.[1] In 2000, more than 45% of Sub-Saharan Africa's population was estimated to be below the poverty line, and this situation has not improved in at least the last 15 years (World Bank 2000). Even after two successive years of 5% growth in real GDP in Sub-Saharan Africa in 2004 and 2005, rural poverty appears to be either steady or even increasing (World Economic Situation and Prospects 2006). The co-existence of strong economic growth and deepening poverty underscores the fact that the causes of poverty are complex and that appropriate policy responses are inadequately understood.

Recent literature examining these complexities indicate that agricultural growth is more likely to benefit the literate and those with access to relatively large landholdings, credit, and markets, while the relatively impoverished, the landless, and the otherwise constrained get left behind (Ravallion and Datt 2002; Jayne et al. 2003; Geda, Shimeles, and Zerfu 2006). Other studies have found that poor households may fall back on low entry-barrier activities, such as wage labor and petty trading, but that these activities often fail in terms of long-term growth (Daniels, Mead, and Musinga 1995; Reardon 1997; Barrett et al. 2000). Furthermore, while income diversification strategies do help some households climb out of poverty, there is discouraging evidence that simultaneously many households are falling into poverty, primarily due to health-related reasons (Krishna 2004; Kristjanson et al. 2004; Kristjanson et al. forthcoming).

Nonetheless, there are still many aspects of poverty that remain enigmatic. In particular, there is a dearth of knowledge about the dynamics of poverty: why some households are able to rise out of poverty over time, while others fall into poverty? Most quantitative studies characterizing rural poverty have been based on analysis of cross-sectional household survey data.[2] While this approach can identify factors that are contemporaneously correlated with indicators of household poverty, cross-sectional analysis cannot provide insights into how or why households move into or out of poverty over time. In particular, it is difficult to identify household behavioral decisions at one point in time that alter the time path of their living standards over the future, which is arguably critical for designing effective poverty alleviation strategies.

This study explores the dynamics of poverty, specifically to examine how certain initial conditions, household decisions, and other factors that may change over time affect poverty. The study uses longitudinal data collected from 1,324 households which participated in three nationwide surveys conducted over seven years, in 1997, 2000, and 2004. Dynamic relationships between behavioral variables, exogenous shocks at one point in time, and indicators of household welfare in subsequent years are identified.

[1] These broad strategies included "growth and trickle down" in the 1960s; integrated rural development and basic human needs in the 1970s; structural adjustment and economic liberalization in the 1980s and 1990s; and most recently, participatory poverty reduction strategies.

[2] Some notable exceptions are Deininger and Okidi 2003 (see special issue of World Development on poverty), Barrett and Swallow 2006, and Gamba 2004 (using a subset of the data used in this study).

These guiding research questions are:

- What is the relationship between households' *current* crop, livestock, and non-farm incomes, and household behavioral and investment choices in earlier years? How is this relationship affected by landholding size and labor quality (proxied by educational attainment)?
- How do prior farm investments affect the stability of household income in subsequent periods?
- What is the extent of households' movement into poverty, and what livestock and crop decisions and household characteristics appear to be associated with this?
- What is the extent of households' movement out of poverty, and what livestock and crop decisions and household characteristics are associated with this?

The study starts by developing a welfare indicator and characterizing the degree of poverty mobility, i.e., the extent to which households move into and out of poverty over time. Salient household-level and community-level correlates of poverty in rural Kenya are identified, then identify dynamic relationships between time-invariant initial conditions, lagged household resource allocation and technology adoption decisions, and current income and wealth outcomes. Last, the paper draws implications for designing policies and programs for alleviating rural poverty and promoting income growth for households of different landholding sizes.

This study finds the majority of the sample remaining static in terms of welfare throughout the seven-year period, although there is a degree of poverty mobility that provides interesting insights. As expected, it was found that reliance on low entry-barrier informal businesses as poverty alleviation strategies characterize the poor, while education and access to more land tend to characterize the relatively non-poor. Using more in-depth analysis, it was also found that consistently non-poor households are more heavily invested in certain livestock activities, such as dairy production. Moreover, able households' decisions to enter into livestock markets are also found to be highly correlated with positive welfare changes over time.

## 2. DATA AND METHODS

### 2.1. Sample

This study uses data from three surveys implemented by the Tegemeo Institute of Egerton University in Nairobi, Kenya. In 1997, the sampling frame was designed in consultation with the Central Bureau of Statistics, and contained 1,540 households randomly chosen to represent eight different agricultural-ecological zones (AEZ), reflecting population distribution. Of the original sample, 1,428 households (93%) were re-interviewed in 2000, and 1,324 (86%) were re-interviewed in 2004. Holding consistently at just above 7% per survey, this rate of attrition is reasonably low compared to similar surveys in developing countries (Yamano and Jayne 2004). Nonetheless, when performing analysis on panel data, it is always advisable to examine the specific nature of attrition in order to determine whether it is random or systematic, as well as whether it is necessary to correct for potential attrition bias.

Table 1 examines key household characteristics by attrition status. The characteristics shown are those from the most recent survey in which the households that left the sample participated. Therefore, the information in columns 1 and 2 are from 1997, while columns 3 and 4 show characteristics in 2000. All cash values are shown in 2004 Kenyan schillings (Ksh) using the Kenyan consumer price index (CPI). Mean household value of assets was higher in 1997 among the households that left the sample in 2000 than that of those who remained in the sample. The opposite is true when comparing the 2000 value of assets between households falling out of the sample in 2004 and those remaining. Mean initial income levels between these groups were generally no different in 2000, while in 2004 the mean initial income of those that left the sample was significantly lower. In both periods smaller households are apparently more likely to leave the sample. Potential attrition bias is examined in more detail later in the paper.

### 2.2. Estimating Welfare and Comparing Households

The next task is to decide how poverty will be measured. Many prior studies have focused on consumption and income levels as measures of household welfare. More recently, however, there is a trend towards observing the value of a household's assets as perhaps a more appropriate measure, arguing that asset levels will be less susceptible to random shocks while still providing accurate description of a household's true level of poverty (some examples are Carter and Barrett 2006; Barrett and Swallow 2006; Krishna 2004). Income, on the other hand, is likely to be very much affected by transitory shocks, such as weather fluctuations. In this context, research was conducted using an asset-based welfare measure. To test the robustness of these findings, income-based measures of poverty were computed and performed similar analyses of poverty mobility. Household asset and income levels are highly correlated and therefore reasonably consistent measures of poverty, although the income measures were more volatile, as expected. Full results and discussion of the income-based measure can be found in Appendix A.[3]

[3] Since the initiation of this study, further poverty dynamics research has been conducted using these data with an income-based poverty matrix and using a hazard model (Kirimi and Sindi 2006).

**Table 1. Mean Household Characteristics by Attrition Status**

| | Surveyed 1997, Attrition 2000 | Surveyed 1997 and 2000 | Surveyed 1997 and 2000, Attrition 2004 | Surveyed All Years |
|---|---|---|---|---|
| | Values Reported in 1997 Survey | | Values Reported in 2000 Survey | |
| | (1) | (2) | (3) | (4) |
| Number of Households | 112 | 1428 | 104 | 1324 |
| Income (,000 2004 Ksh) | 177.6 | 173.4 | 150.3 | 207.8 |
| Assets Value (,000 2004 Ksh) | 222.1 | 135.5 | 60.4 | 102.0 |
| Share of Net Income (mean %) | | | | |
| Crop | 39 | 46 | 40 | 65 |
| Livestock | 17 | 11 | 22 | 12 |
| Non-Farm | 44 | 43 | 38 | 24 |
| Acres Cultivated (main season) | 3.48 | 3.48 | 2.90 | 4.62 |
| Own Land Title Deed (%) | 46 | 44 | 31 | 48 |
| Full Time Adult Equivalents[a] | 5.1 | 5.6 | 4.9 | 5.6 |
| Distance to Tarmac Road (km) | 6.7 | 8.3 | 7.3 | 7.9 |
| Has Formal Income (%) | 34 | 38 | 45 | 59 |
| Has Members over 40 years (%) | 72 | 77 | 74 | 85 |
| Polygamous Household (%) | n.a.[b] | n.a.[b] | 2.9 | 4.4 |

Source: TAMPA household surveys in 1997 and 2000

[a] A household member's full time adult equivalent is the World Bank adult equivalent based on age and gender multiplied by the fraction of the year they spent in the household.

[b] This information is not available in the 1997 survey.

In principle, deriving an asset-based measure of welfare is a simple process of multiplying each of a household's assets by the local value of that asset, and summing up across the value of all assets. Then, using a Kenyan CPI, these values are inflated to 2004 Ksh so they can be accurately compared. To more precisely observe each household's level of welfare, this figure is then divided by the number of full time adult equivalents (FTAE) in the household. The FTAE weights each household member by two things: their adult equivalent according to the World Bank scale based on age and gender, and the number of months spent in the household. This is shown in the following equation:

$$FTAE_{it} \equiv \sum_{k} \left( ae_{kt} * m_{kt} \div 12 \right)$$

Where *i* indexes households
*t* indexes time
*k* indexes individuals
*ae* = adult equivalent (using the World Bank measure)
*m* = the number of months spent in the household

Next, the ratio of household asset levels per FTAE to the 1997 median value were computed. This measure now allows assessment of a household's welfare in any particular year compared to the initial (1997) median value among all surveyed households. The function for the asset-based measure thus far is:

$$RA_{it} \equiv \left[ \left( \sum_j \left( A_{ijt} * V_{ijt} \right) \Big/ \ CPI_t \right) \Big/ FTAE_{it} \right] \Big/ med97$$

Where $j$ indexes productive assets[4]
$RA$ = the ratio of household productive asset value to the 1997 median
$A$ = Asset j for household i in year t
$V$ = Local Value of asset j (Ksh) in year t for household i
$CPI$ = Consumer Price Index figure used to inflate value to 2004 Ksh
$FTAE$ = Full Time Adult Equivalents
$med97$ = 1997 median value of the numerator

Finally, this ratio is stratified into terciles (or thirds) for each year giving the three relative poverty rankings: very poor, moderately poor, and non-poor. This procedure is conducted in each year (1997, 2000, and 2004), to see how the relative welfare of each household changes (or does not change) over time. Four specific categories of households were identified: (a) those consistently in the wealthiest tercile; (b) those consistently in the poorest tercile; (c) those who moved from the bottom wealth tercile to the top tercile over the seven-year period; and (d) those that descended from the top to the bottom tercile over this period. This allows further investigation of which factors may influence poverty mobility. For example, if observing a group of households to have been very poor in 1997, moderately poor in 2000, and not poor in 2004, researchers have the chance to examine what characteristics of this group were associated with this steady upward trajectory. This is done with descriptive as well as econometric analysis.

### 2.3. Limitations

Ideally the value of land would be included when calculating the total value of household assets. Because land markets do exist in most areas of rural Kenya, survey respondents were able to provide sales and annual rental values for land in their villages. When including land valuation in total household assets, it was found that land tends to be a large share of most households' total asset value. This is comprehensively demonstrated in Table 2. Here the households are ranked into terciles by landholding size in each year. Each of these three land size terciles were further separated according to the share of land in the total value of their productive assets. Each cell reports the number of farms in each land tercile according to the share of land in total asset value. In other words, "Row %" indicates the portion of households within each farm size tercile that have the specified share of total assets in landholdings. For example, in 1997, among the smallest farms, 61.6% had more than 75% of their total assets tied up in land. In each year, the majority of all households have 75% to 100% of the value of their total assets in land. Furthermore, and somewhat surprisingly, there seems to be little or no correlation between farm size and the share of land in the total value of productive assets.

[4] Productive assets counted in all survey years are: ploughs (tractor and animal traction), cart, trailer, tractor, cars, trucks, spray pump, irrigation equipment, water tanks, stores, wheelbarrow, combine harvester, donkey, bulls, chickens, goats, sheep, calves, cows, pigs, turkeys, and ducks.

**Table 2. Contribution of Land in Total Assets of Rural Small Farm Households**

| | Share of Land in Total Assets (%) 1997 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0-25 | | 25-50 | | 50-75 | | 75-100 | |
| Farm Sizes | n | Row % [a] | n | Row % [a] | n | Row % [a] | n | Row % [a] |
| 1997 | | | | | | | | |
| Smallest Third | 17 | (3.9) | 50 | (11.4) | 102 | (23.2) | 271 | (61.6) |
| Middle Third | 12 | (2.7) | 37 | (8.4) | 104 | (23.6) | 287 | (65.2) |
| Largest Third | 4 | (0.9) | 31 | (7.0) | 79 | (17.8) | 330 | (74.3) |
| 2000 | | | | | | | | |
| Smallest Third | 11 | (2.5) | 29 | (6.6) | 75 | (17.0) | 326 | (73.9) |
| Middle Third | 2 | (0.5) | 20 | (4.6) | 87 | (19.9) | 329 | (75.1) |
| Largest Third | 5 | (1.1) | 18 | (4.0) | 69 | (15.5) | 353 | (79.3) |
| 2004 | | | | | | | | |
| Smallest Third | 6 | (1.4) | 34 | (7.7) | 83 | (18.8) | 318 | (72.1) |
| Middle Third | 3 | (0.7) | 21 | (4.8) | 67 | (15.2) | 351 | (79.4) |
| Largest Third | 7 | (1.6) | 28 | (6.3) | 69 | (15.6) | 337 | (76.4) |

Source: TAMPA survey data, 1997, 2000, and 2004

[a] Row % indicates the portion of households within each farm size tercile that exhibit the specified share of land in total assets.

Given its major influence in valuing assets, there is reason to consider the appropriateness of including land in the measurement. Obviously its inclusion is theoretically sound, but there are several countervailing arguments. First, because of data limitations, the measurement of landholding is according to land *farmed*, not necessarily land *owned*, which causes estimation errors. Furthermore, the valuations of land prices were obtained at the village level, so the measure does not account for variations in land quality within villages.[5] Last, because the value of land accounts for such a large share of household wealth and tends not to vary much over time, including it in a study of poverty dynamics would tend to bias the results to show very little variation over time. Again, to test the robustness of these results, poverty mobility results both including land (in Appendix A) and excluding land (in the main body of the paper) were reported. As will be described later, the results and implications are highly consistent.

In summary, asset (wealth)-based measures of poverty were computed, all households were ranked into poverty terciles, and the degree of poverty mobility over time was assessed. Four specific categories of households were identified: (a) those consistently in the wealthiest tercile; (b) those consistently in the poorest tercile; (c) those who moved from the bottom wealth tercile to the top tercile over the seven-year period; and (d) those who descended from the top to the bottom tercile over this period. Researchers then performed both descriptive and econometric

[5] The problem of varying degrees of quality is not as concerning when dealing with the values of the other assets in the analysis. For example, one would assume that a household reporting a new tractor would report a value much higher than one reporting a 20-year old tractor. This is evident in the data; 17 different values for 33 tractors were reported ranging from 1,000 Ksh to 160,000 Ksh. While this is no means without error, it is certainly a smaller margin of error than if forced to assign one value to all 'like' assets.

analyses of the initial conditions, exogenous shocks, and household behavioral decisions associated with these four groups.

## 3. ESTIMATING WELFARE MOBILITY

Excluding owned land, the poverty mobility findings summarized in Table 3 were obtained. Each row describes a particular poverty path between 1997 and 2004, which are listed according to mobility groups. More specifically, a "poverty path" describes a particular household's asset holdings over time in relation to initial (1997) median household asset holdings, i.e., whether it is accumulating or de-cumulating assets over time. Moreover, because poverty is defined according to the 1997 median level of assets, this measure examines whether asset poverty in this nationwide sample of small farm households is rising or falling over time. In the two far right columns are the number of households and percent of the sample that have followed each of the 27 possible paths.

The first treatment group was identified, those consistently in the wealthiest tercile, as the 249 households (18.8%) of the sample started out in the top third in 1997, stayed in the top third in 2000, and again in 2004. Similarly, the next treatment group was identified, those consistently in the poorest tercile, as the 217 household (16.4% of the sample) started out relatively very poor (bottom) in 1997, remained at the bottom tercile in the year 2000, and again in 2004. The third treatment group, those who moved from the bottom wealth tercile to the top tercile over the seven-year period, consists of the 34 households meeting that criteria, regardless of their relative welfare in 2000. Similarly, the fourth group was identified, those who descended from the top to the bottom tercile over the seven-year period, as the 37 households meeting that criteria, regardless of their relative welfare in 2000.

The first thing to note from this table is that the majority of households (57%) were in the same relative welfare level in 2004 as they were in 1997, reflecting the persistence of poverty as previously discussed. However, there is an observable degree of poverty mobility. Although less than 6% of the sample is classified as "rising from poverty" or "falling into poverty," it should be noted that this is in part due to the definition of mobility, which focuses on those households that have demonstrated "large" changes over time, i.e., going from the bottom to the top, or vice versa, from 1997 to 2004. This approach identifies households that have most conclusively experienced clear improvements or declines in their livelihoods over the seven-year period. If the definition was expanded to include households which have experienced "small" welfare changes over time, it can seen that 22% are in a higher tercile in 2004 than in 1997, and 21% fall to a lower tercile during the same period. By this definition, one could conclude there is a significant amount of poverty mobility.

**Table 3. Household Poverty Movements Over Time: Where Households Are Ranked in Terms of Welfare Terciles (Bottom 3rd Middle 3rd Top 3rd) by Year**

| Poverty Mobility Group | Household Rank in Terms of Welfare Terciles (Bottom 3rd Middle 3rd Top 3rd) 1997 | 2000 | 2004 | Number of Households | Percent of Total Sample (%) |
|---|---|---|---|---|---|
| Rising from poverty | Bottom | Bottom | Top | 9 | 0.7 |
| | Bottom | Middle | Top | 17 | 1.3 |
| | Bottom | Top | Top | 8 | 0.6 |
| | | | | 34 | 2.6 |
| Declining into poverty | Top | Top | Bottom | 10 | 0.8 |
| | Top | Middle | Bottom | 16 | 1.2 |
| | Top | Bottom | Bottom | 11 | 0.8 |
| | | | | 37 | 2.8 |
| Consistently non-poor | Top | Top | Top | 249 | 18.8 |
| Consistently poor | Bottom | Bottom | Bottom | 217 | 16.4 |
| Consistently in the middle | Middle | Middle | Middle | 107 | 8.1 |
| | | | | 573 | 43.3 |
| Otherwise in the same wealth tercile in 1997 and 2004 | Bottom | Middle | Bottom | 49 | 3.7 |
| | Bottom | Top | Bottom | 5 | 0.4 |
| | Middle | Bottom | Middle | 50 | 3.8 |
| | Middle | Top | Middle | 38 | 2.9 |
| | Top | Bottom | Top | 10 | 0.8 |
| | Top | Middle | Top | 34 | 2.6 |
| | | | | 186 | 14.0 |
| Smaller increases in relative welfare over time | Bottom | Bottom | Middle | 59 | 4.5 |
| | Bottom | Middle | Middle | 67 | 5.1 |
| | Bottom | Top | Middle | 10 | 0.8 |
| | Middle | Bottom | Top | 10 | 0.8 |
| | Middle | Middle | Top | 50 | 3.8 |
| | Middle | Top | Top | 54 | 4.1 |
| | | | | 250 | 18.9 |
| Smaller decreases in relative welfare over time | Top | Top | Middle | 55 | 4.2 |
| | Top | Middle | Middle | 43 | 3.2 |
| | Top | Bottom | Middle | 13 | 1.0 |
| | Middle | Top | Bottom | 12 | 0.9 |
| | Middle | Middle | Bottom | 59 | 4.5 |
| | Middle | Bottom | Bottom | 62 | 4.7 |
| | | | | 244 | 18.4 |
| Total Sample | | | | 1,324 | 100 |

Table 4 examines how the welfare measure of these groups and of the sample has changed over time, vis-à-vis the 1997 median level of wealth. There is a sizable difference in 1997 between the average wealth of the consistently poor (15% of the 1997 median) and that of the consistently

**Table 4. Changes in Asset Level Over Time by Poverty Group**

| | Mean Household Value of Assets per Resident Adult Equivalents as a Ratio of the 1997 Median | | |
|---|---|---|---|
| Asset-Poverty Category | 1997 | 2000 | 2004 |
| Consistently low tercile (n=217) | .1541 | .1036 | .1343 |
| Consistently high tercile (n=249) | 10.1227 | 6.8005 | 8.0837 |
| Upward (n=34) | .3260 | 1.3946 | 3.4817 |
| Downward (n=37) | 3.6486 | 1.2303 | .2896 |
| Other (n=787) | 1.5688 | 1.1658 | 1.2693 |
| Total (n=1,324) | 2.9718 | 2.0591 | 2.3943 |

Source: TAMPA survey data, 1997, 2000, and 2004

non-poor, who had assets valuing over ten times the 1997 median. Second, the mean value of productive assets for the entire sample in 1997 is nearly three times higher than the 1997 median value. Together, these findings suggest a high degree of welfare inequality within the sample, specifically a distribution of assets that is highly skewed to the right. These findings are consistent with other studies focusing on inequality in Kenya.[6] In 2000, the mean value of assets for the entire sample dipped to just over 200% of the initial median, rebounding slightly to around 240% in 2004. The same trend of a dip and partial recovery is evident among the consistently poor and consistently non-poor, showing that household welfare levels are stagnant, if not declining, in more recent years compared to 1997.

One admitted limitation of the way terciles were computed is that by forcing equal numbers of households in the 2000 and 2004 terciles, it is possible that there are shifts in the real level of assets over time such that the entire distribution of household wealth goes up or down, but one would not be able to detect it because equal numbers of households were forced to be in each tercile in 2000 and 2004 as there were in 1997. The regression analysis in Section 5 overcomes this potential limitation. However, it is useful to know how household wealth at various levels of the distribution have changed over this seven-year period. Table 5 reports the real level of household assets at the $10^{th}$, $25^{th}$, $50^{th}$, $75^{th}$, and $90^{th}$ percentiles of the distribution for each year: 1997, 2000, and 2004. Table 5 tells whether inequality was rising over time, falling over time, and whether the absolute levels of wealth at various parts of the distribution was rising or falling.

As with the means of various asset-poverty groups, the distribution at these various levels experiences a dip in 2000 (a drought year in much of Kenya) and partial recovery in 2004. What is interesting, however, is how this recovery varies or, perhaps more importantly, how the dip itself varies, at these different levels of the distribution of asset wealth. Notice that although the tenth percentile in 2004 is higher than it was in 2000, it is 34% lower than it was in 1997. The ninetieth percentile, however, is only 2% lower than it was in 1997. This is an indication that

[6] For more on inequalities in Africa, see McCollough, Baulch, and Cherel-Robson 2000; Sahn and Stifel 2003; and Jayne et. al. 2003.

**Table 5. Percentiles of Asset Levels Over Time (2004 Ksh per HH)**

| Percentile | Household Value of Productive Assets per Resident Adult Equivalents | | | Percent Change, 1997-2004 |
|---|---|---|---|---|
| | 1997 | 2000 | 2004 | |
| | ----------2004 Ksh per household---------- | | | ---- % ---- |
| 10 | 582 | 278 | 433 | -34 |
| 25 | 3,378 | 2,163 | 2,879 | -17 |
| 50 | 9,294 | 7,043 | 8,561 | -9 |
| 75 | 22,334 | 18,788 | 20,479 | -9 |
| 90 | 51,565 | 45,245 | 50,797 | -2 |
| Mean | 27,619 | 19,136 | 22,252 | |

Source: TAMPA survey data, 1997, 2000, and 2004

while the level of wealth among the relatively wealthy has been consistent, the level of wealth among the relatively poor has declined. That is not to say that these are necessarily the same households (that is the subject of the rest of this study). Instead, this simply says that the bottom 10% of households in terms of wealth in 2004 is worse off than the bottom 10% were in 1997. Meanwhile, the top 10% in 2004 have not changed much at all in terms of asset wealth. This, again, is another sign of growing inequality among Kenya's rural households.

Figure 1 examines the distribution of wealth in yet more detail. Here the sample is segregated by wealth per FTAE at increments of 5,000 Ksh. Once again, these results suggest a high degree of inequality in the sample. The lowest welfare group, those with 0 to 5,000 Ksh of assets per FTAE (roughly zero to US$65) consistently contains the largest segment of the sample. Meanwhile, in each year there is a sizable portion of the sample enjoying more than 50,000 Ksh per FTAE.

Figure 2 shows changes in the value of assets over time for each household on a scatter-plot. Each point represents a household, with changes in the period between 1997 and 2000 on the vertical axis and changes between 2000 and 2004 on the horizontal axis. This representation of the sample seems to highlight three groups of households. In the upper left quadrant of this figure, a number of households show large increases in welfare for the initial period, followed by a loss of nearly the same amount during the second period. A second group, shown in the lower-right quadrant, includes households that endured a sizable loss of wealth in the first period, many of which rebounded with an increase during the second period. The third and largest group is concentrated around the origin, and includes households experiencing relatively small changes in welfare throughout the seven-year period of the survey.

**Figure 1. Distribution of Wealth**

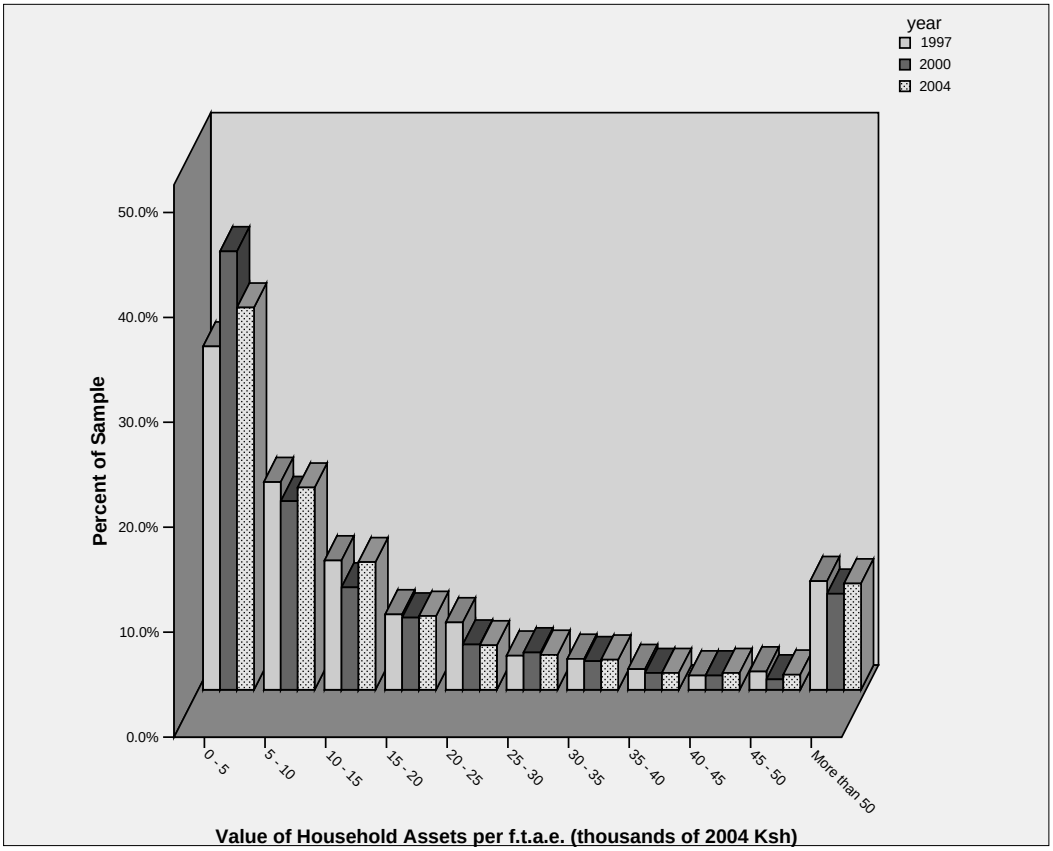
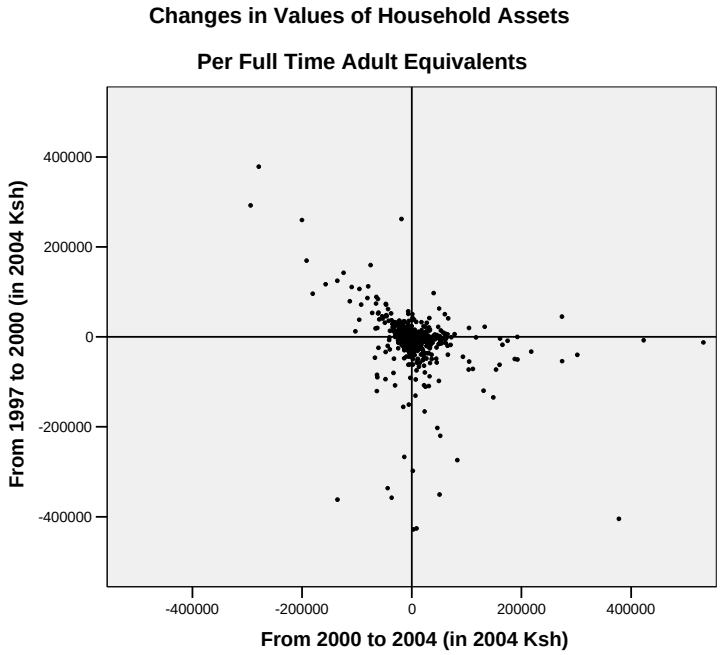



Figure 3 represents the data in a similar fashion, but here the focus is more on the third group described above, only showing households experiencing changes of less than 20,000 Ksh in both periods. Again, a cluster of observations around the origin was found, having experienced very little change in wealth throughout, and the rest of this group seems fairly randomly dispersed in terms of changes in welfare.

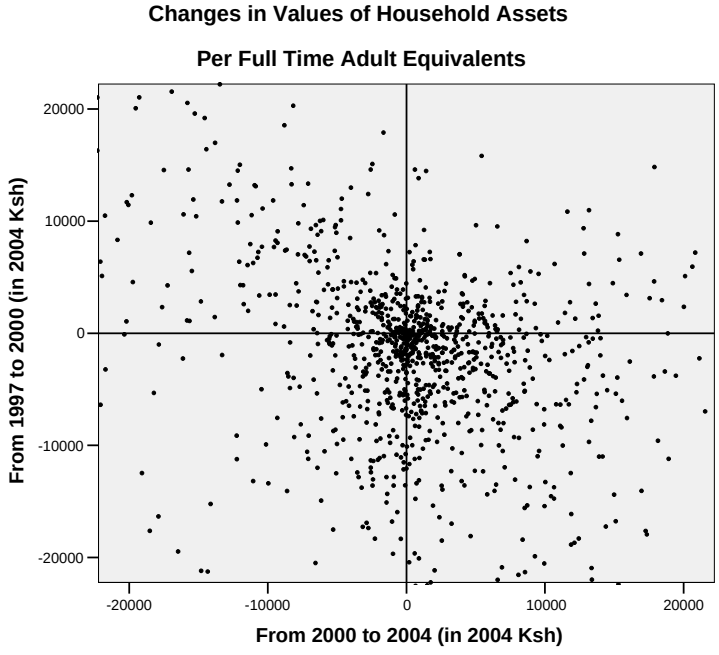
From the generally random distributions of households shown in Figures 2 and 3, one can hypothesize that changes in welfare are dependent upon more than simply the passage of time, thus presenting interesting research questions as was discussed above.

**Figure 2. Households' Changes in Asset Values from 1997 to 2000, and from 2000 to 2004**




Source: Tegemeo survey data

**Figure 3. Households' Changes in Asset Values from 1997 to 2000, and from 2000 to 2004 Among Households with Changes Below 20,000 Ksh in Both Periods**




Source: Tegemeo survey data

In summary, after ranking the households into terciles and mapping their poverty movement over time, the majority of observations are relatively no better (or worse) off after seven years than they were in the initial period. Second, welfare among the entire sample is fairly stagnant, if not decreasing, over time. Also, there is evidence of a high degree of inequality among the sample. Finally, despite the majority of the sample remaining in the same wealth tercile throughout, there are many cases showing significant changes in welfare over the seven years, and these changes are likely dependent on more than simply the passage of time. This presents the opportunity to investigate the research questions originally motivating this paper. The next section will examine these questions with primarily descriptive analysis, followed by a section using multivariate analysis.

## 4. DESCRIPTIVE ANALYSIS OF FACTORS ASSOCIATED WITH CURRENT WELFARE AND WELFARE ANALYSIS

It is essentially undisputed that welfare inequality is present and persistent in rural Kenya. Furthermore, studies have shown that a portion of the variation in welfare can be explained by household location both geographically (Kristjanson et al. 2005) and in time. Table 6 shows the results from various pooled OLS models that examine these effects on welfare, as measured here and throughout the paper by the ratio of household productive assets per FTAE to the 1997 median. In each case, one dummy variable was omitted from the regression, subsuming its effect into a constant term.

These results tell that a model including only dummy variables for the eight AEZs represented in the sample explains 4.6% of the variation in welfare. A similar model with only dummies for the 23 districts included in all three surveys explains 8.2% of this variation, while a separate model with dummies for each of the 106 villages surveyed each year explains 17.8% of welfare variation. The model with only time dummies for the different years of the survey explains 0.3% of the variation. The model containing only household characteristics explains 18.2% of the overall variation, which is more than any of the models from which these variables are excluded. A full model, containing household characteristics, village dummies, and time dummies explains 29.2% of the variation of estimated welfare in the sample. The implication of these models is that while geography is an important determinant of poverty, the greatest variations in household asset levels are at the household level, since household characteristics evidently explain more of the variation in wealth than any set of geographic dummy variables.

The relationship between welfare and geography is also examined in Table 7, where the population of each AEZ is shown by asset-poverty mobility group. Thus, each row will sum to 100%, while statistics in each column can be compared to the statistics from the entire sample. For example, 58% of the observations in the Coastal Lowlands are consistently in the lowest welfare tercile, compared to just 16% of the entire sample. Likewise, the Western Lowlands, Transitional, and Highlands are disproportionately consistently poor, compared to the sample.

**Table 6. Spatial, Time, and Household Characteristic Effects on Welfare Variance**

| $RA_{it}$ = | $R^2$ |
|---|---|
| F1(Constant, Household Characteristics[a]) + $v_{it}$ | .182 |
| F2(Constant, Zone Dummies) + $v_{it}$ | .046 |
| F3(Constant, District Dummies) + $v_{it}$ | .082 |
| F4(Constant, Village Dummies) + $v_{it}$ | .178 |
| F5(Constant, Time Dummies) + $v_{it}$ | .003 |
| F6(Constant, Household Characteristics, Time Dummies, Village Dummies) + $v_{it}$ | .292 |

Source: TAMPA survey data 1997, 2000, and 2004

Note: *RA* is the ratio of the value of each household's productive assets to the 1997 median, *v* is the residual term, *i* indexes households, and *t* indexes time.

[a] Household characteristics are dummies for any member who has a formal job, is over 40 years old, has achieved at least a secondary education, and whether the household's primary land tenure is ownership with a deed. Continuous variables are the number of FTAEs, kilometers to a tarmac road, that distance squared (distance to tarmac not included in F6 due to collinearity with village dummies), the number of main season acres farmed, and that acreage squared.

**Table 7. Welfare Distribution of Households (%) by Agricultural-Ecological Zone**

| | Asset-Poverty Category | | | | |
|---|---|---|---|---|---|
| Zone | Consistently Low Tercile (n=217) | Consistently High Tercile (n=249) | Upward (n=34) | Declining (n=37) | Other (n=787) |
| Coastal Lowlands (n=78) | 58 | 8 | 2 | 1 | 31 |
| Eastern Lowlands (n=152) | 11 | 8 | 4 | 7 | 70 |
| Western Lowlands (n=161) | 25 | 4 | 4 | 4 | 63 |
| Western Transitional (n=155) | 21 | 3 | 6 | 2 | 68 |
| High-Potential Maize Zone (n=362) | 9 | 37 | 2 | 2 | 51 |
| Western Highlands (n=131) | 29 | 3 | 0 | 2 | 66 |
| Central Highlands (n=246) | 5 | 26 | 1 | 1 | 66 |
| Marginal Rain Shadow (n=39) | 0 | 46 | 5 | 5 | 44 |
| Total Sample (N=1,324) | 16 | 19 | 3 | 3 | 59 |

Source: TAMPA surveys 1997, 2000, and 2004

Conversely, observations in the Central Highlands, High Potential Maize Zone, and Marginal Rain Shadow Zone are more likely to be consistently in the top welfare tercile, where 26%, 37%, and 46% of their respective populations, compared to just 19% of the entire sample.

The geographic concentration of poverty is not surprising. Western Kenya is occasionally plagued by drought, while the High-Potential Maize and Marginal Rain Shadow Zones provide friendlier agricultural environments. It is important to note that these results reflect only the prevalence of poverty in these zones, not the absolute numbers of poor. That is to say, although low potential areas may have a greater proportion of households in poverty, high potential areas may contain greater numbers of poor people.

The remainder of Section 4 will investigate in more detail what household characteristics and decisions are associated with welfare and welfare mobility.

### 4.1. Land Holdings

Many densely populated areas of East Africa are facing potentially explosive problems of inadequate access to land. As shown in Table 8, average farm sizes within the smallholder sectors of many African countries are trending steadily downward as population growth outstrips available arable land. In Kenya, mean land-to-person ratios have declined from 0.49 hectares per person in the 1960s to 0.23 hectares per person in the 1990s. Moreover, access to land is highly skewed within the smallholder sector. Roughly a quarter of rural farm households in Kenya are virtually landless, controlling less than one acre, including rented land. Half of the farm population in Kenya controls less than three acres. The downward trend in farm size, the skewed distribution of land within the small-farm sector, and increasing landlessness will compel rural households to change their livelihood strategies, including the way they allocate their labor, their land, their choice of crops, and their use of livestock.

**Table 8. Land to Person Ratio (Ten-Year Average) in Selected Countries**

| | 1960-69 | 1970-79 | 1980-89 | 1990-99 |
|---|---|---|---|---|
| | ---------- hectares per person in agriculture ---------- | | | |
| Ethiopia | 0.508 | 0.450 | 0.363 | 0.252 |
| Kenya | 0.459 | 0.350 | 0.280 | 0.229 |
| Mozambique | 0.389 | 0.367 | 0.298 | 0.249 |
| Rwanda | 0.215 | 0.211 | 0.197 | 0.161 |
| Zambia | 1.367 | 1.073 | 0.896 | 0.779 |
| Zimbabwe | 0.726 | 0.664 | 0.583 | 0.525 |

Sources: FAO STAT
Note: Land to person ration = (land cultivated to annual and permanent crops) / (population in agriculture)

Table 9 further emphasizes the importance of considering land constraints on poverty alleviation, showing how the area of controlled land varies by poverty mobility groups. The group of households consistently in the lowest wealth tercile is also consistently controlling the least amount of land, on average. The only exception to this trend occurs in 2000, when the group falling from the top assets tercile to the bottom assets tercile controls only slightly less land than the consistently poor. As expected, the consistently non-poor are in each period controlling three to four times more land than the consistently poor. Perhaps most importantly, the group of upwardly welfare-mobile households experiences an unparalleled 61% average increase in controlled land, rising from just less than three acres in 1997 to nearly five acres in 2004. Surprisingly, the sample shows a spike in land use in 2000. It is important to note that the calculations are carried out focusing only on crops for which there are data from all three surveys, thus ruling out the inclusion of new crops in the survey as the cause of this increase in estimated land use. In fact, this phenomenon appears to be legitimate and is examined further in Appendix B, which disaggregates land use by AEZ and crop type.

The data in Table 9 clearly indicate that meaningful discussions of rural poverty alleviation must be grounded within the context of prevailing farm size distribution patterns. Curiously, however,

**Table 9. Mean Total Area Controlled (Acres) by Asset-Poverty Category**

| | Asset-Poverty Category | | | | | |
|---|---|---|---|---|---|---|
| | Consistently Poor (n=217) | Consistently Non-poor (n=249) | Upward (n=34) | Downward (n=37) | Other (n=787) | Total Sample (n=1,324) |
| Acres Cultivated | | | | | | |
| 1997 | 1.82 | 7.33 | 2.94 | 2.61 | 2.91 | 3.55 |
| 2000 | 2.30 | 8.85 | 4.25 | 2.66 | 3.21 | 4.13 |
| 2004 | 2.10 | 6.21 | 4.73 | 2.77 | 3.32 | 3.68 |

Source: TAMPA survey data 1997, 2000, and 2004
Note: Area Controlled is measured as acres farmed during the main harvest season, which includes rented and owned land.

very little discussion of rural livelihood and poverty alleviation in Africa pays explicit attention to these fundamental changes in farm size and land-to-labor ratios.[7]

The remainder of Section 4 explores different levels of diversification (in Section 4.2), commercialization, and importance to total household income (in Section 4.3). These sections are respectively seeking to answer:

- What are households doing for income?
- How commercialized are these activities (as opposed to being primarily consumption motivated activities)?
- How important are these activities to income as a whole? These questions will be examined in the context of poverty mobility, for households with different farm size endowments.

### 4.2. Income Diversification

In the context of land constraints, it is important to examine investment and income activity decisions of households in various poverty mobility groups. It is widely recognized that low entry-barrier off-farm activities are often entered into for purposes of consumption smoothing or short term poverty alleviation (Daniels, Mead, and Musinga 1995; Reardon 1997; Barrett et al. 2000). However, prior research has been largely unable to identify the kinds of decisions made by households whose welfare subsequently improves (and declines) over time.

Table 10 examines the cash generating enterprises that each poverty mobility group is engaging in. Here an "enterprise" is defined as any activity providing cash income, regardless of the intensity that the enterprise is used for cash versus consumption. In other words, selling both cows and goats for cash are counted as two cash-generating enterprises. This is irrespective of whether the household sells one of each, ten of each, one cow and ten goats, etc. This broad stroke approach looks at the differences in basic patterns of diversification between these groups, as opposed to the degree of commercialization, which will be further examined later. In Table 10, livestock sales include the selling animals such as bulls, cows, goats, sheep, chickens, and others, while livestock products capture the sale of milk, eggs, honey, and others.

First, in all poverty mobility groups, most households rely more heavily on crop enterprises to provide cash income than on any other type of enterprise. Also notice that this number increases among all groups over the seven-year period, more than doubling for the sample as a whole. This is true even though Table 10 reports income only from crops included in all three surveys, and suggests a growing level of crop diversity in rural Kenya. Second, notice the consistently poor households average more off-farm activities than any other group in 1997 at .88 activities per household. In 2004, that number climbed to more than one activity per household, suggesting that chronically poor households are depending on a greater variety of off-farm activities in their livelihood strategies. Also this is seen occurring for those households who

[7] For example, neither of the World Bank's (2000) synthesis chapters on "Addressing Poverty and Inequality" or "Spurring Agriculture and Rural Development" contain any references to the role of constrained access to land or land distribution inequalities in contributing to poverty.

**Table 10. Household Income Diversification in 1997 and 2004 by Asset-Poverty Category**

| Enterprises Providing Cash Income | Asset-Poverty Category: Consistently Poor (n=217) | Consistently Non-poor (n=249) | Rising (n=34) | Declining (n=37) | Other (n=787) | Total Sample (n=1,324) |
|---|---|---|---|---|---|---|
| | ----------Number of Enterprises---------- | | | | | |
| 1997: | | | | | | |
| Crops | 1.53 | 2.75 | 1.74 | 2.43 | 2.19 | 2.18 |
| Livestock Products[a] | .24 | 1.23 | .79 | .73 | .78 | .78 |
| Livestock Sales | .65 | 1.20 | .82 | 1.32 | 1.07 | 1.02 |
| Off-Farm | .88 | .42 | .62 | .49 | .65 | .64 |
| Total Across Sources[b] | 3.05 | 4.37 | 3.18 | 4.24 | 3.90 | 3.84 |
| 2004: | | | | | | |
| Crop Enterprises | 3.76 | 5.39 | 4.38 | 3.92 | 4.98 | 4.81 |
| Livestock Products | .29 | 1.30 | .97 | .54 | .77 | .79 |
| Livestock Sales | .17 | .73 | .62 | .46 | .48 | .48 |
| Off-Farm | 1.06 | .65 | .97 | 1.05 | .87 | .87 |
| Total Across Sources | 4.99 | 6.78 | 5.97 | 5.43 | 6.32 | 6.15 |

Source: TAMPA surveys 1997, 2000, and 2004

[a] Livestock product sales data not available in 1997 because products sold were not distinguished from products consumed. Hence these figures reported are from 2000.

[b] Excluding Livestock Products

have fallen from the top tercile to the bottom during this period. This lends support to the theory that many such activities provide only temporary poverty alleviation for the otherwise desperately poor.

The consistently non-poor and "rising" households also show an increase in off-farm activity, albeit not to the same extent, indicating that some off-farm activities may be beneficial indeed. Off-farm activities are considered in more detail later in the paper, and results from Table 10 are examined in more detail in Appendix D.

A final observation from Table 10 is the sizable difference between groups in the number of livestock selling enterprises providing cash. Here, each type of livestock sold counts as an enterprise, again regardless of how many animals are sold. In 1997, the sample average was to sell just more than one type of livestock, while the households consistently in the top tercile and those who were in the top at the time but later fell to the bottom, the declining group, were selling 18% to 30% more types than that, suggesting that diverse livestock marketing strategies may play a role in keeping households non-poor, and conversely, that loss of livestock assets may be a contributing factor to movements into poverty (as seen in Kristjanson et al. 2004). Meanwhile, the consistently low and upward-moving households (who were then in the bottom tercile) groups were selling only .65 and .82 types of livestock, respectively. Unfortunately data are unavailable for livestock products in 1997, but the households incurring a decline in their wealth status over time also incurred a sizeable decline between 2000 and 2004 in the number of cash income generating activities from livestock products.

In 2004, although all households are selling fewer types of livestock, dropping the sample average to .48, the consistently non-poor and rising households (now in the top tercile) are selling decidedly more. That is .73 types of livestock for the consistently non-poor, compared to .17 types for the consistently poor. Moreover, 2004 data were able to examine the number of livestock products being sold, and the consistently non-poor and rising households at much higher levels of participation (averaging 1.3 and .97 types of livestock, respectively) than the consistently poor and declining households (averaging .29 and .54 types, respectively). This implies there are profitable opportunities in the livestock product markets that can lead to increased and sustained wealth, and that some households are taking part in these opportunities. The two main types of products represented in Table 10 are milk and eggs, which will be examined in more detail later.

### 4.3. Commercialization and Importance to Household Income

In order to examine how intensely households are participating in different activities to earn income, a Household Commercialization Index (HCI) is used. For each product, this index is the percent of the value of total production that is sold for cash. For example, if a household has a HCI of 50 for staple crops, that household sold half of the staple crops they harvested. The results of this analysis are presented in Table 11 as means by asset-poverty groups. Moreover, in order to ground the discussion in the context of prevailing farm sizes, results are further segregated by farm sizes. Households were assigned a farm size of either small, medium, or large, ranked by terciles, according to both rented and owned acres farmed during the 1997 main

## Table 11. Household Commercialization Index[a] in 1997 and 2004 By Asset Poverty Category and Farm Size

| | Asset-Poverty Category | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Consistently Low Tercile -------Relative Farm Size[a]--------- | | | Consistently High Tercile -------Relative Farm Size[a]--------- | | | Upward -------Relative Farm Size[a]--------- | | | Declining ------Relative Farm Size[a]-------- | | | Other -------Relative Farm Size[a]-------- | | | Total |
| | Small (n=120) | Medium (n=62) | Large (n=35) | Small (n=37) | Medium (n=71) | Large (n=141) | Small (n=8) | Medium (n=13) | Large (n=13) | Small (n=12) | Medium (n=16) | Large (n=9) | Small (n=263) | Medium (n=278) | Large (n=246) | Sample N=1,324 |
| Staple Carbohydrates | | | | | | | | | | | | | | | | |
| 1997 | 5 | 13 | 15 | 13 | 20 | 55 | 5 | 15 | 24 | 11 | 26 | 35 | 9 | 14 | 27 | 20 |
| 2004 | 13 | 9 | 16 | 25 | 27 | 52 | 22 | 23 | 27 | 13 | 29 | 27 | 14 | 21 | 31 | 24 |
| Horticultural Products | | | | | | | | | | | | | | | | |
| 1997 | 33 | 47 | 45 | 40 | 39 | 40 | 37 | 40 | 50 | 35 | 48 | 49 | 41 | 39 | 43 | 41 |
| 2004 | 30 | 34 | 45 | 35 | 33 | 40 | 24 | 22 | 43 | 25 | 37 | 39 | 31 | 35 | 38 | 35 |
| Industrial Cash Crops | | | | | | | | | | | | | | | | |
| 1997 | 93 | 95 | 100 | 90 | 93 | 95 | 50 | 100 | 100 | 100 | 51 | 100 | 90 | 94 | 93 | 93 |
| 2004 | 93 | 95 | 99 | 95 | 100 | 97 | 100 | 100 | 100 | 80 | 100 | na[b] | 95 | 97 | 97 | 96 |
| Other Crops | | | | | | | | | | | | | | | | |
| 1997 | 21 | 45 | 40 | 13 | 13 | 14 | 31 | 21 | 0 | 30 | 27 | 34 | 31 | 31 | 27 | 27 |
| 2004 | 30 | 20 | 32 | 5 | 8 | 7 | 6 | 5 | 26 | 21 | 35 | 8 | 15 | 18 | 15 | 16 |
| Dairy HCI | | | | | | | | | | | | | | | | |
| 2000[c] | 34 | 20 | 17 | 51 | 48 | 52 | 31 | 29 | 48 | 48 | 49 | 72 | 36 | 36 | 37 | 40 |
| 2004 | 22 | 24 | 14 | 54 | 50 | 51 | 34 | 30 | 38 | 25 | 31 | 35 | 34 | 35 | 31 | 38 |

Notes: Farm sizes are ranked by terciles, according to acres farmed during the 1997 main season, whether land is owned or rented. Small farms are 0 to 1.6 acres, medium farms are 1.6 to 3.25 acres, and large farms are larger than 3.25 acres.

If a household was not producing one of the categorized products, it was not considered in the estimation of cross-tabulated mean HCI.

[a] HCI for product i is (value of product i sold / value of product i produced)*100

[b] None of the households in this group were selling industrial cash crops in 2004

[c] Data not available for 1997

harvest season. If a household was not producing one of the categorized products, it was not considered in the estimation of cross-tabulated means.

Here again the obvious correlation between farm size and wealth is seen, with 182 of the 217 (84%) consistently poor households failing to meet the "large farm" criteria, with most of them being categorized as small. Conversely, 141 of the 249 consistently non-poor (57%) are also in the top farm size tercile in 1997. The weight of the burden on the landless poor is more starkly evident when comparing the HCI of staple crops. The consistently non-poor households who enjoy the benefit of large farms are on average selling more than half of the staples they produce, compared to the consistently poor in the lowest landholding tercile who sold only 5% of their staples in 1997, increasing to 13% in 2004.

Although to be able to compute a HCI for dairy in 2000 and 2004, it is remarkably different between poverty groups. Consistently poor households, most of which are in the lowest landholding tercile, are on average selling 20% to 34% of the milk they produce in 2004, whereas the consistently non-poor are on average selling more than 50% of their milk. Furthermore, only 17% of the 120 consistently poor small farmers were producing milk at all, compared to 97% of the 141 consistently non-poor large farmers.[8] Moreover, households incurring a decline in their wealth ranking over time incurred steep declines in their dairy commercialization index between 2000 and 2004, whereas households in the other categories generally had small increases or relatively small declines.

Another point of interest may be that among the upward moving households with large farms, there was a HCI of 0 for their "other" crops in 1997, but this number increases to 26 by 2004. Although these are only 13 households, and a fairly small source of income, this is a dramatic shift. A closer look at these households reveals the crops driving this change. The crops produced by these households in 1997 were groundnuts, animal fodder (leaves), simsim (a Swahili word for a sesame like seed), and soybeans. As shown, however, these households did not sell any of these crops that year. In 2004, the increase in the average HCI is being driven by three households producing and selling three different crops on six fields. Each of these three households has begun to sell their groundnuts, and two of those have also begun to sell green grams (a bean). The other household has begun to sell soybeans.

In order to observe how different activities are contributing to overall income and ultimately wealth, their contributions to total gross income were calculated. Ideally this would be done using net income. However, based on analysis thus far, it was desired to separate the contributions of livestock products and the sale of livestock themselves. Although data are available for costs such as veterinary and feeding, specific costs cannot be assigned to specific livestock activities. Thus, for the sake of consistency, all values are reported as shares of gross income. While this may misrepresent the contributions of certain high-overhead activities, it will still allow observation of behavioral differences between poverty mobility groups. Again, in order to ground the discussion in the context of prevailing farm sizes, the sample is segregated by farm size, and results are presented in Table 12.

[8] A full table of the percent of households producing each category in Table 11 can be found in Appendix C.

## Table 12. Household Income Shares (%) in 1997 and 2004 by Asset Poverty Category and Farm Size

| | Asset-Poverty Category | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Consistently Low Tercile | | | Consistently High Tercile | | | Upward | | | Declining | | | Other | | | |
| | --------Relative Farm Size[a]--------- | | | --------Relative Farm Size[a]--------- | | | -------Relative Farm Size[a]--------- | | | -------Relative Farm Size[a]--------- | | | -------Relative Farm Size[a]--------- | | | |
| Income Shares[b] | Small (n=120) | Medium (n=62) | Large (n=35) | Small (n=37) | Medium (n=71) | Large (n=141) | Small (n=8) | Medium (n=13) | Large (n=13) | Small (n=12) | Medium (n=16) | Large (n=9) | Small (n=263) | Medium (n=278) | Large (n=246) | Total Sample N=1,324 |
| *Crops* | | | | | | | | | | | | | | | | |
| Staple Carbohydrates | | | | | | | | | | | | | | | | |
| 1997 | 21 | 29 | 25 | 17 | 15 | 41 | 18 | 22 | 27 | 22 | 32 | 22 | 19 | 21 | 29 | 24 |
| 2004 | 21 | 23 | 17 | 13 | 14 | 29 | 12 | 18 | 15 | 18 | 24 | 22 | 18 | 19 | 25 | 21 |
| Horticulture Products | | | | | | | | | | | | | | | | |
| 1997 | 9 | 11 | 10 | 14 | 11 | 6 | 13 | 2 | 9 | 8 | 13 | 15 | 12 | 10 | 9 | 10 |
| 2004 | 12 | 16 | 17 | 11 | 12 | 8 | 13 | 5 | 7 | 11 | 14 | 10 | 15 | 13 | 11 | 12 |
| Industrial Cash Crops | | | | | | | | | | | | | | | | |
| 1997 | 4 | 5 | 6 | 4 | 10 | 7 | 1 | 16 | 16 | 12 | 4 | 0 | 7 | 11 | 13 | 9 |
| 2004 | 4 | 7 | 7 | 4 | 10 | 7 | 2 | 8 | 17 | 8 | 4 | 0 | 7 | 9 | 11 | 8 |
| Other Crops | | | | | | | | | | | | | | | | |
| 1997 | 1 | 2 | 1 | 0 | 0 | 0 | 2 | 2 | 4 | 0 | 3 | 2 | 1 | 1 | 1 | 1 |
| 2004 | 2 | 2 | 2 | 3 | 4 | 1 | 2 | 5 | 3 | 1 | 4 | 2 | 3 | 3 | 2 | 2 |
| *Off-Farm Activities* | | | | | | | | | | | | | | | | |
| Informal/Ag Wages | | | | | | | | | | | | | | | | |
| 1997 | 11 | 10 | 7 | 1 | 1 | 1 | 6 | 2 | 3 | 5 | 0 | 5 | 7 | 3 | 2 | 4 |
| 2004 | 3 | 6 | 2 | 2 | 0 | 1 | 0 | 3 | 0 | 1 | 0 | 13 | 2 | 2 | 1 | 2 |
| Informal Business | | | | | | | | | | | | | | | | |
| 1997 | 23 | 15 | 16 | 14 | 16 | 12 | 18 | 13 | 5 | 14 | 9 | 24 | 19 | 18 | 14 | 17 |
| 2004 | 26 | 20 | 31 | 14 | 9 | 13 | 25 | 12 | 11 | 19 | 23 | 13 | 16 | 16 | 14 | 16 |
| Formal Salaried Income | | | | | | | | | | | | | | | | |
| 1997 | 20 | 18 | 24 | 37 | 22 | 11 | 13 | 26 | 20 | 20 | 13 | 15 | 18 | 19 | 15 | 18 |
| 2004 | 19 | 16 | 14 | 24 | 15 | 10 | 12 | 15 | 13 | 19 | 7 | 12 | 15 | 14 | 12 | 14 |
| Other[c] | | | | | | | | | | | | | | | | |
| 1997 | 8 | 6 | 9 | 3 | 5 | 6 | 18 | 12 | 6 | 10 | 14 | 3 | 8 | 7 | 5 | 7 |
| 2004 | 6 | 4 | 4 | 5 | 4 | 4 | 10 | 8 | 1 | 13 | 4 | 4 | 5 | 4 | 4 | 5 |
| *Livestock Activities* | | | | | | | | | | | | | | | | |
| Products | | | | | | | | | | | | | | | | |
| 1997 | 2 | 1 | 1 | 6 | 14 | 11 | 9 | 2 | 5 | 2 | 8 | 9 | 5 | 7 | 8 | 7 |
| 2004 | 5 | 5 | 3 | 21 | 28 | 23 | 20 | 21 | 24 | 10 | 18 | 17 | 16 | 15 | 16 | 16 |
| Animal Sales | | | | | | | | | | | | | | | | |
| 1997 | 2 | 2 | 2 | 4 | 6 | 5 | 1 | 4 | 6 | 7 | 5 | 4 | 4 | 4 | 5 | 4 |
| 2004 | 2 | 2 | 3 | 4 | 3 | 5 | 4 | 5 | 9 | 1 | 2 | 6 | 4 | 4 | 4 | 4 |

[a] Farm sizes are ranked by terciles, according to acres farmed during the 1997 main season, whether land is owned or rented. Small farms are 0 to 1.6 acres, medium farms are 1.6 to 3.25 acres, and large farms are larger than 3.25 acres.

[b] Full income means valuing of all household production, including crops and livestock products both sold and consumed.

[c] "Other" includes remittances, pensions, and dividends.

Here the vast majority of the poor small farmer's income is being generated from off-farm activities, the largest share of which is coming from informal entrepreneurial activities. These include maize trading, carpentry, masonry, shop keeping, tailoring, and others, all characterized by relatively low barriers to entry. This shows, as expected, that without access to land and thus limited opportunity to diversify agricultural investments, poor households are relying on off-farm activities to supplement income. Moreover, given the persistence of poverty in these households, these off-farm activities seldom lead to long-term growth. This is also apparent among the small- and medium-sized farm households whose welfare declines over the seven years, as their share of income from informal business rises substantially during the same period.

The income diversification which characterizes the consistently non-poor group is now considered. These results suggest that in 1997 there were three types of relatively wealthy households. The first is small farms, producing on average an approximately equal value of staples and horticultural products from their land, but whose lion's share of income comes from formal, presumably skilled, employment. The second group is composed of medium-sized farms who are more likely to be involved in cash crops than their contemporaries, but where the largest share of income is from livestock products. The third most common type is large farms strongly focused on crop production and, as seen in Table 9, sale of staple crops.

By 2004 an unambiguous shift among the non-poor towards livestock products was observed, irrespective of farm size. This is most profound among the small farms of this group, showing a change in the average share from 6 % to 21% of total gross income. Unlike households that are staying poor, it seems that successful households are investing more in livestock-related sources of income. It is also apparent that this household decision is associated with long-term growth when looking at the upwardly mobile households. This is particularly true for the mid-sized farms in that group, increasing the average share of gross income from livestock products from 2% to 21%.

Also notice that the declining households also increased their livestock product share of income from 1997 to 2004, but not as much so as the "rising" and "consistently non-poor" households. Even with income diversification through livestock, the "declining" households are unable to prevent themselves from falling into poverty. There are many possible explanations for this phenomenon, such as the fact that many Kenyan households fall into poverty primarily for health-related reasons (Krishna et al. 2004). It is also important to recognize that for these declining households, this larger share of income from livestock comes from what is likely a smaller total income. Thus, this could simply be reflecting habit persistence, whereby families losing wealth over time are more reluctant to exit livestock product markets. It is also possible that the importance of livestock products has increased during this period for the sample as a whole. Finally, and most likely, the households with different poverty mobility characteristics may be involved in different livestock product markets, and this warrants further exploration.

To summarize, the land constrained persistently poor households are relying on informal off-farm activities to supplement their income, but that these activities are unlikely to translate into long-term growth. On the other hand, many of the households who are capable are diversifying into livestock product markets are seen, and that this is associated with growing wealth over time. The households declining in wealth over time are also involved in livestock activities, but

they are likely different activities. The other things equal effects of participation in different livestock markets are more closely investigated in the next section of this paper.

# 5. ECONOMETRIC ANALYSIS OF FACTORS ASSOCIATED WITH CURRENT WELFARE AND WELFARE MOBILITY

Although illuminating, the descriptive analyses conducted thus far are limited in their ability to generate firm conclusions. First, given the steady rate of 7% attrition between surveys, the potential issue of attrition bias must be dealt with. Second, it is necessary to use multivariate techniques in order to control for other factors affecting household indicators of poverty. For example, the conclusions on the importance of livestock activities among the relatively wealthy and "rising" households is somewhat perplexing, since the households with declining wealth also show an increase in livestock activities, albeit to a lesser extent. This section presents basic econometric techniques to deal with these problems.

## 5.1. Determinants of Re-interview

To deal with the potential for attrition bias, the models are estimated using Inverse Probability Weights (IPW), as described by Wooldridge (2002). This is where an auxiliary model is developed, using conditions and household characteristics from initial period observations, to estimate the probability of re-interview in the next period. This means separately estimating probabilities of attrition in 2000 and 2004. Then, each observation in the panel is weighted according to the probability of them being interviewed in both 2000 and 2004, or the product of the two probabilities. In this way observations which were less likely to be re-interviewed are assigned a heavier weight to make up for similar households that fell out of the sample. Results from the re-interview model are found in Table 13. Notice that the enumeration team to which they were assigned had consistently significant affects on the probability of re-interview, indicating that some of the attrition in the sample may be due to enumerator team training and motivation. Re-interviewed households also had larger families, larger farms, a higher share of total income from crops, and a lower share of their income derived from livestock and off-farm activities. Re-interviewed households were also more likely to own a land title deed and to have formal employment, factors that would tend to motivate households to remain in their villages. To test the robustness of the results, subsequent models will be shown with and without correction for attrition bias. It should also be noted that in this and all subsequent econometric analyses continuous variables were tested for quadratic relationships. Omitted quadratic terms are an indication that they were not found to be significant.

**Table 13. Household-level Re-Interview Models, Using Probit Estimation**

| | Dependent Variable = 1 for Re-interviewed Households | | |
|---|---|---|---|
| | Pooled | 2000 | 2004 |
| *Household Characteristics* | | | |
| Full time adult equivalents | 0.008*** | 0.007** | 0.008*** |
| | (3.93) | (2.56) | (3.07) |
| Any members over 40=1 | 0.011 | 0.005 | 0.022 |
| | (1.00) | (0.36) | (1.35) |
| Value of productive assets (2004 | -0.000* | -0.000 | -0.000 |
| Ksh) | (1.82) | (1.34) | (0.08) |
| Livestock share of net income | -0.004* | -0.071** | -0.002 |
| | (1.76) | (2.38) | (0.79) |
| Off-farm share of net income | -0.027 | -0.044** | -0.018 |
| | (1.44) | (2.02) | (0.74) |
| Area under cultivation (acres) | 0.003 | 0.002 | 0.004* |
| | (1.57) | (0.79) | (1.87) |
| Land tenure with deed=1 | 0.018* | 0.000 | 0.036*** |
| | (1.94) | (0.03) | (2.85) |
| Formal employment=1 | 0.020* | 0.012 | 0.027** |
| | (1.89) | (0.78) | (2.12) |
| Any secondary school=1 | -0.011 | -0.014 | -0.006 |
| | (1.12) | (1.06) | (0.45) |
| Distance to tarmac road (km) | 0.003** | 0.002 | 0.003* |
| | (2.35) | (1.54) | (1.80) |
| Distance squared | -0.000** | -0.000 | -0.000*** |
| | (2.54) | (1.34) | (2.89) |
| *Enumeration Team Dummies* | | | |
| Team 2 in 2000 | 0.059*** | 0.063*** | N/A |
| | (4.87) | (3.84) | |
| Team 3 in 2000 | 0.024* | 0.023 | N/A |
| | (1.93) | (1.43) | |
| Team 4 in 2000 | 0.034*** | 0.028* | N/A |
| | (2.86) | (1.76) | |
| Team 2 in 2004 | 0.033*** | N/A | 0.036*** |
| | (2.61) | | (2.61) |
| Team 3 in 2004 | 0.026** | N/A | 0.037*** |
| | (2.11) | | (2.81) |
| Team 4 in 20004 | 0.049*** | N/A | 0.058*** |
| | (3.78) | | (4.04) |
| *Joint Test on Team Effects* | 35.39 [0.00] | 14.9 [0.00] | 19.58 [0.00] |
| *Joint Test on Household Effects* | 38.21 [0.00] | 18.57 [0.07] | 42.96 [0.00] |
| *E[y]* | 0.938 | 0.936 | 0.945 |
| Observations | 2,968 | 1,540 | 1,428 |

Note: z statistics in parentheses, p-values for joint tests in brackets. Estimated with heteroskedasticity robust standard errors (clustered by household in the pooled regression). Estimated coefficients are marginal changes in probability around the data means.
* significant at 10%
** significant at 5%
*** significant at 1%

### 5.2. Probit Analysis on Initial Conditions Associated with Consistent Welfare Status

To better understand the relationship between livestock activities and welfare status, a household-level Probit model is used, focusing on initial conditions, to estimate marginal probability effects on belonging to poverty mobility groups. The model uses dummy variables for whether the household sold products in the following livestock markets in 1997: bulls and cows, chickens, goats, other livestock, milk, and eggs. In light of the earlier findings involving the apparent significance of geographic location and access to land, land tenure, area cultivated, distance to tarmac roads, and AEZs were controlled. To control for labor, variables for the number of FTAEs in 1997 were added, as well as a dummy variable for whether the household experienced the death of a prime aged adult (ages 15 through 59) during the period from 1997 to 2000. Researchers wanted to further control for ability and longevity of the household, using the education level and age of the household head, but these data were not available in 1997. These "initial conditions" were therefore obtained from the 2000 data. Results from these models are shown in Table 14.

The first thing noticed is the similar estimates with and without weighting to correct for attrition bias. This was expected given the reasonably low rate of attrition. Second, it should be noted that the models for the consistently poor and the consistently non-poor are not mirror images of each other by construction. That is to say, not being in the group of households consistently in the top tercile is quite different from actually being in the group consistently in the lowest tercile. For this reason, when observing opposite and significant effects between these models, one can infer robustness in the conclusions.

This brings the attention to the strong positive correlation between milk production and relative wealth. By doing a simple simulation of a household that represents the data means of other variables, it is estimated at a 1% level of significance that having produced milk in 1997 increases the probability of consistently (in 2000 and 2004) being among the wealthiest households by 13%. When setting all explanatory variables at their mean levels, the predicted probability of a household consistently being in the relatively wealthy tercile in all three years was 18.8%, whereas households with these same mean conditions but producing milk in 1997 were estimated as having a 31.4% probability of being in the top wealth terciles in 2000 and 2004. Moreover, it is estimated with the same significance level an equal and opposite effect on the probability of being consistently among the poorest households.

Again, notice the importance of land. Using the same simulation as before, it is estimated that cultivating one additional acre of land in 1997 increases the probability of consistently being among the wealthiest households by 2%. It is further estimated that one additional acre decreases the probability of being persistently poor by 3%. Both of these estimates are also significant at the 1% level.

**Table 14. Household Level Welfare Probability Models (Probit)**

| | Marginal Probabilities Associated with Household Being Consistently N*on-poor* | | Marginal Probabilities Associated with Household Being Consistently P*oor* | |
|---|---|---|---|---|
| | Corrected For Attrition | Un-weighted Model | Corrected For Attrition | Un-weighted Model |
| Sell bulls or cows in 1997=1 | 0.051** | 0.053*** | -0.030** | -0.031** |
| | (2.92) | (3.04) | (2.03) | (2.16) |
| Sell chickens in 1997=1 | -0.055** | -0.054*** | 0.017 | 0.019 |
| | (2.99) | (2.89) | (1.23) | (1.41) |
| Sell goats in 1997=1 | 0.006 | 0.006 | -0.016 | -0.015 |
| | (0.37) | (0.34) | (1.15) | (1.13) |
| Sell other livestock in 1997=1 | 0.024 | 0.022 | -0.044** | -0.044*** |
| | (1.33) | (1.23) | (2.56) | (2.66) |
| Produce milk in 1997=1 | 0.125** | 0.126*** | -0.126*** | -0.126*** |
| | (5.80) | (5.74) | (7.32) | (7.46) |
| Produce eggs in 1997=1 | 0.002 | 0.000 | -0.021 | -0.024 |
| | (0.10) | (0.01) | (1.38) | (1.59) |
| Major land tenure with deed=1 | 0.041* | 0.039** | -0.017 | -0.018 |
| | (2.36) | (2.25) | (1.37) | (1.51) |
| Area cultivated in 1997 (acres) | 0.020** | 0.020*** | -0.026*** | -0.025*** |
| | (6.18) | (6.31) | (5.96) | (5.95) |
| Male head of household in 2000=1 | 0.028 | 0.029 | -0.007 | -0.006 |
| | (1.21) | (1.25) | (0.33) | (0.29) |
| Age of head of household | 0.002** | 0.002*** | -0.001 | -0.001 |
| (Years, as of 2000) | (2.81) | (2.79) | (1.50) | (1.49) |
| Education of the head of household | 0.009** | 0.009*** | -0.002 | -0.002 |
| (Years, as of 2000) | (4.05) | (4.09) | (1.38) | (1.46) |
| Full time adult equivalents | -0.026** | -0.027*** | 0.014*** | 0.014*** |
| | (6.31) | (6.27) | (4.95) | (5.01) |
| Did hh experience a prime age death | -0.028 | -0.028 | 0.030 | 0.023 |
| (15 to 59) between 1997 and 2000 | (0.79) | (0.76) | (1.10) | (0.90) |
| Distance to a tarmac road (10 km) | -0.0045 | -0.0059 | -0.0066 | -0.0070 |
| | (0.24) | (0.31) | (0.45) | (0.49) |
| Distance squared | 0.0046 | 0.0049 | 0.0014 | 0.0015 |
| | (1.30) | (1.36) | (0.46) | (0.49) |
| Zone dummies | Yes | Yes | Yes[a] | Yes[a] |
| Observations | 1,320 | 1,320 | 1,320 | 1,320 |

Note: Heteroskedasticity robust z statistics in parenthesis, clustered by household

[a] These regressions do not include a dummy for the Marginal Rain Shadow agro-ecological zone, because no observations in this zone were consistently poor.

* significant at 1%

** significant at 5%

*** significant at 1%

To better understand the importance of these household characteristics and decisions, the series of simulations were conducted and are presented in Table 15. First consider a benchmark case, using data means for all continuous variables and zone dummies, and 0 (No) for all other dummies except male head of household, which is held at 1 (Yes). That is, the benchmark is a hypothetical household that has not had a prime-age death, did not primarily own land, and did not participate in any of the livestock or livestock product markets in 1997. It is estimated that such a household has a 2% probability of being in the consistently non-poor poverty group, but a 30% probability of being among consistently poor.

Compare this to a "land rich" household that primarily *does* own land, and that cultivates nearly nine acres, which is about one standard deviation above the data mean. It is estimated that this household's probability of being consistently non-poor rises to 15%, while the probability of being consistently poor falls to only 3%. The same probabilities are computed for a "land poor" household that does not primarily own land and is virtually landless at .05 acres farmed (which is the data minimum and less than one standard deviation below the mean). This household has a less than 1% probability of being consistently non-poor, and a staggering 62% probability of being consistently poor. This is very strong evidence supporting the notion that access to land is of utmost importance in poverty alleviation discussions.

Now return to the benchmark household, but suppose one allows them to participate in the milk market and to sell bulls or cows in 1997. Based on these initial conditions, it is estimated that the probability of this household being consistently non-poor rises from 2% to 23%. Conversely, the probability of this household being consistently poor falls from 30% to 5%. Once again, this is strong evidence that relatively well-off households are participating in these activities.

**Table 15. Probability Simulations of Being Poor and Non-Poor for Rural Households[a]**

| State of Nature | Area Farmed (acres) | Primarily Owns Land | Produce Milk | Sell Bulls or Cows | Probability of Being Non-Poor | Probability of Being Poor |
|---|---|---|---|---|---|---|
| Benchmark[b] | 3.6 | No | No | No | .02 | .30 |
| Primarily Owns Land | 3.6 | Yes | No | No | .04 | .27 |
| Land Rich[c] | 8.98 | Yes | No | No | .15 | .03 |
| Land Poor[d] | .05 | No | No | No | .01 | .62 |
| Sell Bulls and Produce Milk | 3.6 | No | Yes | Yes | .23 | .05 |
| Land Rich, Sell Bulls, Produce Milk | 8.98 | Yes | Yes | Yes | .51 | .00 |

Source: Tegemeo survey data 1997, 2000, and 2004

[a] Based on Probit estimates controlling for agro-ecological zones, area cultivated in 1997, household head age, and years of education in 2000, the number of full time adult equivalents, distance to a tarmac road, that distance squared, as well as dummy variables for whether major land tenure is ownership with deed, male head of household, whether household suffered a prime-age death, and dummies for participation in the following markets in 1997: bulls and cows, chickens, goats, other livestock, milk, and eggs. All controls not shown in this table are held at their data means, unless otherwise specified.

[b] Using data means for all continuous variables and zone dummies, and 0 (No) for all other dummies except male head of household which is held at 1 (Yes).

[c] Land Rich differs from the benchmark in that primary land tenure is ownership with deed and area cultivated is data mean, plus one standard deviation.

[d] Land Poor differs from the benchmark in that primary land tenure is not ownership with deed, and area cultivated is the data minimum (less than one standard deviation from the data mean).

Incidentally, if one allows this household to be land rich as well, they now have a 51% chance of being non-poor, and almost no chance of being poor throughout the seven years.

Admittedly this model has limitations. First, many of these market participation variables may be endogenous to the level of assets a family has. This may render one unable to make inferences as to causality; however the correlations themselves provide interesting insights. Second, fortunately or unfortunately the number of households categorized as declining or rising in terms of welfare were too few to conduct similar Probit analysis. To address this issue, estimates were conducted of a First Difference (FD) model on changes in wealth in the next section of the paper.

### 5.3. First Difference Model of Factors Associated with Changes in Wealth Over Time

In order to examine more closely the relationship between livestock markets and changes in wealth over time, and look at how starting and stopping new livestock activities are correlated with household welfare status, a FD model was constructed. That is, all time-variant variables in the regression are differenced, thereby controlling for all time-invariant unobserved effects, such as geography and innate ability. Since the variables of interest are participation in certain markets, the effects of not changing behavior will also be differenced out of this model. Instead, dummy variables were included for whether a household has entered or exited these markets in the time between surveys. Imposing dummy variables in a FD model in this way is tantamount to conducting Difference in Differences analysis, but controlling for other time-variant factors that may be correlated with the dependent variable (Wooldridge 2002). Results from this analysis are presented in Table 16.

Again, with this regression the results are very similar with and without correction for attrition bias. What immediately stands out is that in addition to being correlated with current wealth, milk production is highly correlated with growing wealth over time. It is estimated that the other things equal difference in the change in wealth from one survey to the next for households entering this market to be more than 30,000 Ksh (nearly US$500) per household. A correlation of equal magnitude was found among households who have begun selling small ruminants, such as goats and sheep, and again with bulls and cows. Conversely, negative correlation was seen between changes in wealth and beginning to sell chickens and eggs. This suggests that these livestock activities, much like many informal off-farm activities, are more likely poverty alleviation strategies. It should be noted that, although less significant statistically, these correlations are also found for the income measure of welfare.

To summarize, using econometric analyses found little attrition bias in the sample, if any. Then, using Probit analysis and controlling for factors exogenous to the household, such as geography and infrastructure, a significant and highly positive relationship was found between sustained wealth and certain livestock activities, specifically milk production and the selling of bulls and

**Table 16. First Difference Model for Factors Associated with Changes in Wealth**

| | Change in Total Value of Household Productive Assets | |
|---|---|---|
| | Corrected for Attrition | Un-Weighted Model |
| Change in area under cultivation (acres) | 2,192.027 | 1,708.299 |
| | (0.83) | (0.74) |
| Change in the number of men age 17-39 | 2,826.358 | 2,429.264 |
| | (0.49) | (0.42) |
| Change in the number of women age 17-39 | 1,079.039 | 1,145.833 |
| | (0.23) | (0.26) |
| Distance to a tarmac road (km) | -557.605 | -639.282 |
| | (0.42) | (0.50) |
| Distance squared | -844.244 | -683.030 |
| | (1.67) | (1.59) |
| Entered milk market=1 | 33,634.431** | 32,341.723** |
| | (3.19) | (3.21) |
| Exited milk market=1 | -6,924.265 | -8,849.481 |
| | (0.79) | (1.01) |
| Entered egg market=1 | -1,124.272 | -2,672.606 |
| | (0.07) | (0.19) |
| Exited egg market=1 | 10,037.457 | 8,676.657 |
| | (0.91) | (0.84) |
| Entered bull/cow market=1 | 26,504.650* | 26,270.287* |
| | (2.12) | (2.22) |
| Exited bull/cow market=1 | -5,399.276 | -6,476.001 |
| | (0.77) | (0.91) |
| Entered chicken market=1 | -35,063.170** | -32,061.267** |
| | (3.07) | (3.02) |
| Exited chicken market=1 | -11,701.880 | -10,863.636 |
| | (1.47) | (1.40) |
| Entered goat/sheep market=1 | 32,556.773** | 31,471.612** |
| | (2.94) | (3.04) |
| Exited goat/sheep market=1 | -5,807.316 | -6,850.538 |
| | (0.47) | (0.60) |
| Dummy for period | 29,439.941** | 28,888.767** |
| | (3.46) | (3.51) |
| Constant | -33,291.779** | -32,751.816** |
| | (3.32) | (3.36) |
| Observations | 2,648 | 2,648 |

Note: Robust t statistics in parentheses, clustered by household
* significant at 5%
** significant at 1%

cows. The selling of chickens, on the other hand, was found to be associated with the persistently poor. Using a FD model, it was found the same activities associated with sustained wealth are highly correlated with growing wealth as well. Given the likely endogenous nature of participation in these activities, it is not possible to make inferences about causality. One thing, however, is quite clear. Whether they are relatively wealthy because of livestock, or involved in livestock because they are relatively wealthy, participation in livestock markets is an unambiguous trend among rural Kenya's growing and wealthiest households.

## 6. SUMMARY AND IMPLICATIONS

Using an asset-based measure of welfare and looking at household poverty movements from 1997 to 2004 for 1,324 rural households across Kenya, it was found that the majority of households (57%) remained at the same relative poverty level in 2004 as they were at in 1997. Twenty-two percent of households made some progress out of poverty, while 21% experienced a decline in welfare. The distribution of wealth across these households is highly unequal, with the value of assets owned by the poorest households being only 13% of the value of the median household, compared to 808% for the wealthiest group.

Some of the factors helping to explain variation in asset-poverty levels across rural households in Kenya include the age and education of the household head, whether someone in the family has a formal job, land ownership, family size, and the distance to a tarmac road. While geographic location is an important factor, household characteristics explain more of the variation in asset-poverty than do geographic factors.

Farm sizes have been steadily declining across Kenya, and the findings show that access to land continues to be a major determinant of rural household welfare. The consistently non-poor group cultivates three to four times more land on average than the chronically poor. Households that had made positive progress out of poverty had significantly increased the amount of land they controlled, from an average of three acres in 1997 to five acres in 2004. The direction of causality is not clear. Differences in landholding sizes at any given point in time may reflect differences in prior motivation and initiative, intergenerational differences in households' standing in the community, closeness to traditional authorities, or other social factors.

More types of crops were grown in 2004 than in 1997 by poorer as well as non-poor households. An increasing diversity in off-farm income sources by the poorest households was seen. There has also been an increase in the types of livestock sold, particularly by non-poor households, who sell four times as many types of livestock and livestock products than do the poor.

What are the successful households (i.e., those that are consistently non-poor and those that have improved) doing that other households are not? Answering this question requires distinguishing groups by landholding size, because the patterns of "success stories" are somewhat different between these three groups:

- Small (0-1.6 acres) crop-livestock farms with the majority of income coming from off-farm
- Medium-sized farms (1.6-3.25 acres) with cash crops and the largest share of income coming from livestock
- Large farms (more than 3.25 acres) focused on the sale of staple crops

The importance of livestock production and marketing (especially milk) to the welfare of successful households shows up clearly, and this holds irrespective of farm size.

Why are some households able to remain non-poor while others remain poor? Households that sell milk and cattle have more access to land and have smaller, more educated families and are more likely to be consistently non-poor. Conversely, the probability of staying poor is higher for

households that are not selling cattle, are selling chickens, have little land, and large families. In fact, it is estimated that, all else equal, a household who is initially land poor, not selling cattle, and not producing milk has a 62% probability of remaining consistently poor, and only a 1% probability of being non-poor. By contrast, a household with over 3.25 acres of land and that is producing milk and selling cattle has a 51% chance of being consistently non-poor, and almost no chance of being consistently poor.

Although the group of households identified as rising from poverty over time was relatively small (34 households), some trends from that group were seen. These households increased the number of income-earning activities, and that most of these additional activities come from crops. For the small- and medium-sized farms in this group, this was coupled with an increased commercialization of staple grain crops, while the larger farms became more commercialized in various other bean-like crops. For all these households, regardless of farm size, the largest increase over time in any particular activity's share of total income comes from livestock products. Although more research is needed in this area, this and the findings about the consistently non-poor households suggest that various crops may provide lower entry barrier pathways from poverty, and that livestock activities (primarily dairy sales) provide sustainable wealth once a household can enter those markets.

The group of households characterized as declining into poverty is also relatively small (37 households), but this group, too, provides some interesting insights. This group has also become more diversified in their cash generating crop activities. However, unlike the upwardly mobile households, this group has decidedly decreasing numbers of livestock related cash generating activities, and an increasing numbers of off-farm activities. Moreover, despite the diversification, crop activities for these households are generally characterized by decreasing commercialization. Across all farm sizes, the level of commercialization for dairy decreases significantly from 2000 to 2004. Consistent with the theory that households struck by poverty will often rely on low entry-barrier off-farm activities to smooth consumption, observation of informal activities is becoming increasingly important for these households. The small and medium farmers of this group show an increase in the informal business share of income, while the large farms show an increasing dependence on informal agricultural wages. Interestingly, livestock products are an increasing share of total income for this group as well. Recall, however, that this is an increased share of what is very likely a smaller income. Thus, the real level of income from these activities may be changing very little, suggesting that livestock activities may provide a steady source of income, even for those households who are otherwise falling into poverty.

The findings from this study have a number of important implications for the design of strategies, policies, and instruments for reducing poverty and supporting agricultural growth in rural areas of Africa. The study finding is that of limited mobility between poverty groups co-existing with a high level of inequality. This finding may suggest that there are relatively few profitable growth opportunities in rural Kenya that have low entry barriers which would allow poor households to become engaged in. The most profitable opportunities tend to be skewed towards better off households with larger and better quality asset endowments. Strategies to bring about sustainable improvements in poverty need to encompass growth options and targeted interventions that address inequalities in the distribution of key livelihood assets, such as land. In

this regard it is important to note that location-level poverty analysis helps identify key area-level determinants of poverty, including markets, public goods, rural institutions, and governance. These variables shape the contexts in which household assets are used and define available livelihood opportunities, such engagement in commercialization activities and of off-farm rural employment. Notwithstanding this, the analysis demonstrates that the primary sources of variations in asset-poverty are at the household level where asset holdings define their capability to pursue different livelihood activities that generate income. This study shows that insufficient access to key assets, such as land, livestock, and human capital and low returns to asset, are important causes of chronic poverty among rural populations in Kenya. Sustainable poverty reduction needs to be built on solid understanding of household asset positions and the contexts where assets are used as the basis for identifying livelihood strategies that leads to pathways out of poverty.

Given the importance of land in household asset portfolios, agricultural growth and poverty reduction strategies need to take into account the realities of declining farm sizes and inequalities in access to land. The practical implication of declining available cultivated land per agricultural person is that raising labor and crop productivity on small farms under any plausible productivity growth scenarios is necessary, but it will be inadequate to drive rural economic growth in many rural areas of Africa. Most rural households pursue multiple livelihood strategies. Poverty reduction and growth strategies need to recognize the multi-dimensionality of rural livelihoods and the importance of farm-nonfarm linkages in facilitating rural growth. Policy and interventions that support farming as well as diversification into higher return off-farm and non-farm activities are likely to have relatively high payoffs than those that focus only on crop productivity growth. Policy priority, therefore, needs to be given to providing an enabling rural environment for commercial activities, such as institutional innovations that support competitiveness of household producers, lower level of formal and informal taxes, and increased investment in public goods such as agricultural research, extension, and infrastructure.

Diversification into off-farm strategies can lock households into poverty traps or put them on an accumulation and growth path. Many poor people engage in low-return and high-risk off-farm activities that lock them into poverty traps. In other cases, some households engage in off-farm activities that provide virtuous ladders out of poverty. The growing importance of a diversified set of livelihood activities in household livelihood strategies points to the need for better understanding of entry barriers into high return activities, risk management strategies, and pathways from poverty that strengthen the growth potential from diversification opportunities.

These findings have highlighted the seldom recognized, yet critical role, that livestock plays in helping to alleviate poverty through accumulation strategies or serving as safety nets. This suggests that poverty intervention options that fully exploit the opportunities created by livestock assets need to be given serious consideration on the development agenda. In some cases, income generation from livestock and livestock activities, for example cattle and milk sales, provide pathways out of poverty in successful diversification strategies. In other cases, livestock activities, such as backyard poultry keeping, do not provide growth opportunities but are important safety nets, particularly for the poor. Livestock-mediated pathways out of poverty therefore need to encompass growth options that improve livestock productivity and support participation in markets, as well as those that reduce vulnerability to food insecurity by

protecting their livestock assets. In many respects, efforts to improve access to, and functioning of, rural livestock and dairy markets would involve a range of appropriate institutional arrangements including collective action, private, and public-private partnerships.

A key overall implication of this study is that successful poverty reduction and agricultural growth strategy in Africa must consciously integrate current trends of declining farm sizes, inequality in land distribution, and diversification into livestock and other higher-return activities. Future strategies that strengthen these linkages will be crucial in designing and implementing strategies that help rural communities work their way out of poverty and achieve the poverty and hunger targets that the development community aspires.

## Appendix A. Income-based Poverty Measure

The following are results from the descriptive and econometric analysis using the income-based measurement of relative poverty. These tables are occasionally referenced throughout the main body of the paper.

There are three major sources of income that need to be extracted from the data and then added together before the rest of the analysis can take place. These sources are crop income, livestock income, and non-farm income. Crop income is the value of production of all crops observed in all three surveys less the fertilizer and land preparation costs. Notice that production retained for consumption is included in this measurement, since this too is a valuable return on investments. Of course there are other production costs not accounted for (such as seed cost), but some cannot be accounted for because they are not available throughout the data pool. Livestock income is measured as the value of livestock sold, plus the value of livestock products produced (such as milk), minus money spent on veterinary services, salaried workers, and animal feed. Unfortunately, the cost of livestock purchases cannot be included, since it was not asked in 1997. Finally, non-farm income is a sum of salaries, remittances, pensions, and money earned in the informal sector throughout the year.

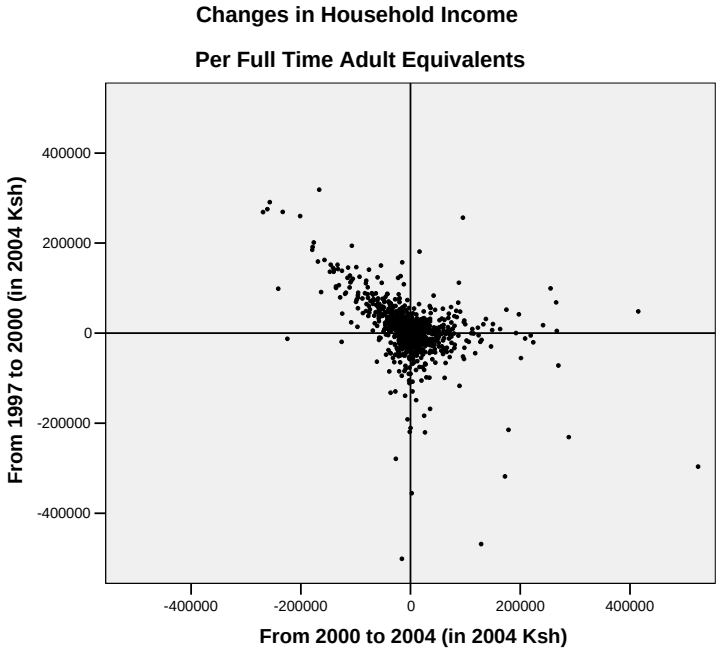
Once aggregated, these figures are similarly inflated to values in 2004 Ksh, divided by the households total FTAE, converted to a ratio of that figure to the 1997 median figure, and ranked into terciles to observe household level poverty mobility relative to the sample population. This, of course, is the same method as described in more detail above. The results of this analysis can be seen in Table A1 and Figure A1.

Income-based measures of poverty mobility are examined in the same way the asset-based measurement was discussed thus far, and assess the robustness of the results. As should be expected, the income measurement of poverty demonstrates much more 'movement' of households between poverty terciles. Notice that only 27.2% of the sample is static throughout the seven-year period, compared to 43.3% when using the asset based measurement of poverty. This seems to confirm the hypothesis that income measurements are less stable and likely to respond more drastically to random shocks. Indeed, evidence of some such shock seems to be apparent in Figure 3. Notice the trend of household falling on or near an imaginary line stretching from the origin to the upper-left hand corner in the first quadrant. Given the scale of the graph, households falling on this line demonstrate an increase in income during the first period (1997 to 2000), and a decrease of the exact same amount during the second period (2000 to 2004). This suggests that many households in the sample experienced some kind of income-increasing shock between 1997 and 2000, and then fell back to 1997 levels in the 2004 season. Upon closer inspection, the relative volatility of the income based measure of welfare is also evident in Table A1. Table A1 shows that 194 households, or 14.7% of the sample, jumped up one or more terciles between 1997 and 2000, only to fall back one or more between 2000 and 2004. That is compared to only 8.7% of the sample having done so according to the more stable asset based measurement of welfare.

**Table A1. Dynamic Household Ranking by Total Value of Household Income per Full Time Adult Equivalents**

| | 2000 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | Bottom 3rd | | | Middle 3rd | | | Top 3rd | | |
| Bottom 3rd | | 2004: | | | 2004: | | | 2004: | |
| | bottom 3rd : | 151 | (11.4%) | bottom 3rd : | 61 | (4.6%) | bottom 3rd : | 21 | (1.6%) |
| | middle 3rd : | 66 | (5.0%) | middle 3rd : | 57 | (4.3%) | middle 3rd : | 14 | (1.1%) |
| | top 3rd : | 21 | (1.6%) | top 3rd : | 25 | (1.9%) | top 3rd : | 25 | (1.9%) |
| Middle 3rd | | 2004: | | | 2004: | | | 2004: | |
| | bottom 3rd : | 73 | (5.5%) | bottom 3rd : | 47 | (3.5%) | bottom 3rd : | 18 | (1.4%) |
| | middle 3rd : | 55 | (4.2%) | middle 3rd : | 81 | (6.1%) | middle 3rd : | 43 | (3.2%) |
| | top 3rd : | 15 | (1.1%) | top 3rd : | 46 | (3.5%) | top 3rd : | 64 | (4.8%) |
| Top 3rd | | 2004: | | | 2004: | | | 2004: | |
| | bottom 3rd : | 29 | (2.2%) | bottom 3rd : | 29 | (2.2%) | bottom 3rd : | 12 | (0.9%) |
| | middle 3rd : | 17 | (1.3%) | middle 3rd : | 44 | (3.3%) | middle 3rd : | 65 | (4.9%) |
| | top 3rd : | 14 | (1.1%) | top 3rd : | 52 | (3.9%) | top 3rd : | 179 | (13.5%) |

**Figure A1. Changes in Household Income per Full Time Adult Equivalents**

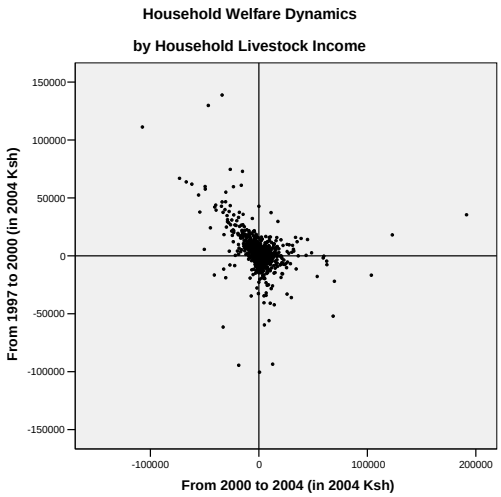


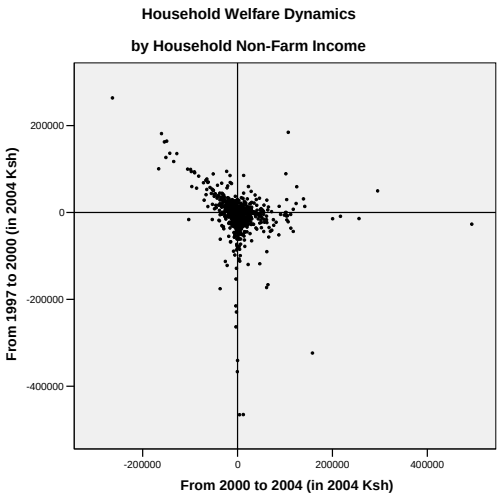

Source: Tegemeo survey data

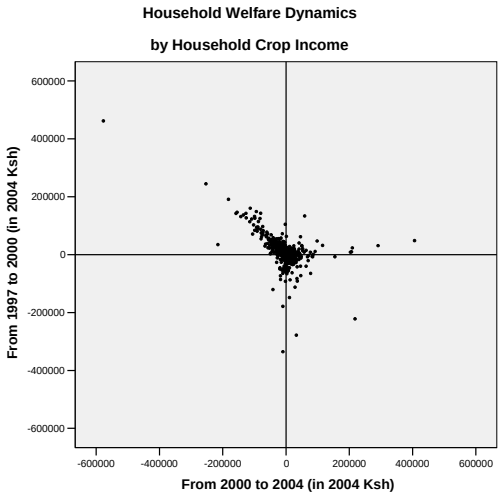
To investigate this matter further, similar graphs were derived for each of the three income sources separately. These results are shown in Figure A2, where the numbers inside each graph indicate the household identification number assigned to each case during the survey. In each of the livestock and non-farm income graphs this trend is slight, if at all apparent by this simple analysis. By stark contrast, however, the crop income graph shows clearly the source for the

overall trend discussed above. This realization would seem to indicate that the suspected shock to which the income measurement so drastically responded was simply the weather, specifically rainfall.

**Figure A2. Household Welfare Dynamics by Household Livestock Income, Non-farm Income, and Household Crop Income**



To further explore this question, some simple regressions were conducted that are tantamount to ANOVAs, but provide interesting (albeit unsurprising) results. Changes in the main season's rainfall and changes in the short season's rainfall data were analyzed as separate variables. Note that this means the exclusion of certain divisions who do not have a short planting season in the regression analysis.[9] An F-test was used to determine that a linear model would be more appropriate than a quadratic model when using these data. Initially, changes in all income combined was regressed against these variables, then changes in each of three components of that income were regressed separately. Finally, for comparison, the change in asset values is regressed using the same model. Results of these regressions are found in Table A2.

The main findings of these models are in the $R^2$ values of each. Changes in rainfall alone have been demonstrated to explain 9% of the variation in change in total income for the households included in the analysis, compared to explaining only 1% of the variation in their change in value of assets. Furthermore, it can be seen that this effect on total income, unsurprisingly, is most likely attributed to effects of change in rainfall on changes in crop income. When income was disaggregated into the three categories of crop, off-farm, and livestock incomes, changes in rainfall explains 11% of the variation in crop income, and only 1% of either off-farm or livestock income. This descriptive regression suggests that livestock and off-farm income sources may play an important role in stabilizing household income in response to weather shocks.

**Table A2. Household Welfare Measurements (2004 Ksh per FTAE)**

| Explanatory Variables | Change in Total Income | Change in Crop Income | Change in Livestock Income | Change in Non-Farm Income |
|---|---|---|---|---|
| Dmain | 40.038** | 42.026** | 4.303 | -6.292* |
| | (3.03) | (5.19) | (0.52) | (2.03) |
| Mainpd | -36.217* | -37.613** | -6.382 | 7.778* |
| | (2.41) | (4.08) | (0.68) | (2.20) |
| Dshort | 78.429** | 53.795** | 31.851* | -7.216 |
| | (3.34) | (3.74) | (2.17) | (1.31) |
| Shortpd | -72.396** | -60.608** | -18.319 | 6.532 |
| | (2.70) | (3.69) | (1.09) | (1.04) |
| Period dummy | -3,909.905 | -10,688.716** | 9,592.029** | -2,813.218** |
| 1997-2000=0 | (1.40) | (6.24) | (5.49) | (4.29) |
| Constant | 2,326.919 | 5,768.885** | -6,115.414** | 2,673.448** |
| | (1.17) | (4.74) | (4.93) | (5.74) |
| Observations | 2,082 | 2,082 | 2,082 | 2,082 |
| R-squared | 0.01 | 0.04 | 0.02 | 0.01 |

Note: Absolute value of t statistics in parentheses
* significant at 5%
** significant at 1%

[9] These divisions are Kinango, Kimilili, Tongaren, Lugari, Kimulot, Cherangani, Saboti, Ainabkoi, and Moiben.

The exploration of these pooled data seems to confirm that an asset value based measurement of welfare would be most telling in the research into poverty mobility in Kenya. For several reasons, this measurement may better serve if it excludes land values. Finally, indications have been seen that this measurement is less likely to be affected by random shocks, such as rainfall. With income based measurements, such shocks could cause temporary, and misleading, changes in relative poverty. Nonetheless, to test the robustness of the results, the results of poverty dynamics analysis using land values in measurement of welfare can be found in Table A3. Results from regression analysis using the income-based measures of welfare and the same models as in the main body of the paper can be found in Tables A4 (Probit analysis) and A5 (First Difference analysis).

**Table A3. Dynamic Household Ranking by Total Value of Household Assets and Land per Full Time Adult Equivalents**

| | 2000 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | Bottom 3rd | | | Middle 3rd | | | Top 3rd | | |
| | | 2004: | | | 2004: | | | 2004: | |
| Bottom 3rd | bottom 3rd : | 225 | (17.0%) | bottom 3rd : | 47 | (3.6%) | bottom 3rd : | 8 | (0.6%) |
| | middle 3rd : | 73 | (5.5%) | middle 3rd : | 53 | (4.0%) | middle 3rd : | 7 | (0.5%) |
| | top 3rd : | 4 | (0.3%) | top 3rd : | 14 | (1.1%) | top 3rd : | 7 | (0.5%) |
| | | 2004: | | | 2004: | | | 2004: | |
| Middle 3rd | bottom 3rd : | 58 | (4.4%) | bottom 3rd : | 62 | (4.7%) | bottom 3rd : | 16 | (1.2%) |
| | middle 3rd : | 48 | (3.6%) | middle 3rd : | 120 | (9.1%) | middle 3rd : | 39 | (3.0%) |
| | top 3rd : | 7 | (0.5%) | top 3rd : | 42 | (3.2%) | top 3rd : | 49 | (3.7%) |
| | | 2004: | | | 2004: | | | 2004: | |
| Top 3rd | bottom 3rd : | 10 | (0.8%) | bottom 3rd : | 13 | (1.0%) | bottom 3rd : | 1 | (0.1%) |
| | middle 3rd : | 11 | (0.8%) | middle 3rd : | 40 | (3.0%) | middle 3rd : | 50 | (3.8%) |
| | top 3rd : | 4 | (0.3%) | top 3rd : | 50 | (3.8%) | top 3rd : | 262 | (19.8%) |

**Table A4. Household Level Income Based Welfare Probability Models (Probit)**

| | Consistently Non-poor | | Consistently Poor | |
|---|---|---|---|---|
| | Corrected for Attrition | Un-weighted Model | Corrected for Attrition | Un-weighted Model |
| Sell bulls or cows in 1997=1 | 0.029** | 0.029** | -0.032** | -0.031** |
| | (3.35) | (3.22) | (3.31) | (3.31) |
| Sell chickens in 1997=1 | -0.004 | -0.003 | -0.001 | -0.000 |
| | (0.45) | (0.31) | (0.06) | (0.04) |
| Sell goats in 1997=1 | -0.006 | -0.004 | 0.015 | 0.014 |
| | (0.67) | (0.43) | (1.37) | (1.39) |
| Sell other livestock in 1997=1 | 0.014 | 0.014 | -0.004 | -0.007 |
| | (1.56) | (1.45) | (0.36) | (0.59) |
| Produce milk in 1997=1 | 0.029** | 0.030** | -0.008 | -0.007 |
| | (3.07) | (3.04) | (0.74) | (0.70) |
| Produce eggs in 1997=1 | -0.004 | -0.004 | -0.010 | -0.011 |
| | (0.43) | (0.45) | (0.98) | (1.08) |
| Major land tenure with deed=1 | 0.023** | 0.024** | -0.010 | -0.009 |
| | (2.71) | (2.65) | (1.04) | (1.03) |
| Area cultivated in 1997 (acres) | 0.003** | 0.004** | -0.018** | -0.017** |
| | (3.42) | (3.49) | (5.46) | (5.47) |
| Male head of household in 2000=1 | -0.005 | -0.006 | -0.024 | -0.020 |
| | (0.30) | (0.35) | (1.57) | (1.38) |
| Age of head of household | 0.001** | 0.001** | -0.000 | -0.000 |
| (Years, as of 2000) | (3.42) | (3.32) | (0.93) | (0.96) |
| Education of the head of household | 0.010** | 0.010** | -0.005** | -0.005** |
| (Years, as of 2000) | (8.25) | (8.09) | (4.01) | (4.09) |
| Full time adult equivalents | -0.011** | -0.011** | 0.014** | 0.014** |
| | (4.67) | (4.74) | (6.65) | (6.64) |
| Did hh experience a prime age death | -0.015 | -0.016 | 0.025 | 0.025 |
| (15 to 59) between 1997 and 2000 | (0.88) | (0.92) | (1.37) | (1.44) |
| Distance to a tarmac road (10 km) | 0.068** | 0.072** | -0.0043 | -0.0050 |
| | (3.81) | (3.74) | (0.42) | (0.51) |
| Distance squared | -0.023** | -0.024** | 0.0018 | 0.0019 |
| | (2.89) | (2.83) | (0.87) | (1.00) |
| Zone dummies | Yes | Yes | Yes[a] | Yes[a] |
| Observations | 1,320 | 1,320 | 1,320 | 1,320 |

Note: Robust z statistics in parentheses
* significant at 5%
** significant at 1%
[a] None of the households consistently in the lowest tercile were located in the Marginal Rain Shadow Zone, so this dummy variable was omitted.

**Table A5. First Difference Model for Factors Associated with Changes in Income**

| | Changes in Total Household Income | |
|---|---|---|
| | Corrected for Attrition | Un-Weighted Model |
| Change in area under cultivation (acres) | 4,122.868 | 4,034.158 |
| | (0.75) | (0.73) |
| Change in the number of men age 17-39 | 21,160.277** | 21,532.451** |
| | (3.19) | (3.23) |
| Change in the number of women age 17-39 | 2,270.426 | 1,610.830 |
| | (0.31) | (0.22) |
| Distance to a tarmac road (km) | 555.280 | 808.011 |
| | (0.18) | (0.25) |
| Distance squared | -695.740* | -639.121* |
| | (2.51) | (2.50) |
| Entered milk market=1 | 10,352.722 | 12,668.950 |
| | (0.44) | (0.52) |
| Exited milk market=1 | -747.385 | -271.611 |
| | (0.03) | (0.01) |
| Entered egg market=1 | -18,445.745 | -19,224.993 |
| | (0.82) | (0.85) |
| Exited egg market=1 | -60,244.620* | -65,539.071* |
| | (2.18) | (2.31) |
| Entered bull/cow market=1 | 34,038.286 | 35,331.010 |
| | (1.50) | (1.54) |
| Exited bull/cow market=1 | -39,629.308 | -41,798.285 |
| | (0.85) | (0.88) |
| Entered chicken market=1 | -8,468.598 | -5,414.331 |
| | (0.40) | (0.26) |
| Exited chicken market=1 | 37,615.106 | 39,316.461 |
| | (1.34) | (1.36) |
| Entered goat/sheep market=1 | 15,632.524 | 16,113.456 |
| | (0.84) | (0.86) |
| Exited goat/sheep market=1 | -13,676.822 | -14,071.006 |
| | (0.60) | (0.60) |
| Dummy for period | -278,505.798** | -282,231.054** |
| | (11.31) | (11.39) |
| Constant | 149,664.334** | 149,947.471** |
| | (7.45) | (7.43) |
| Observations | 2,648 | 2,648 |
| R-squared | 0.12 | 0.13 |

Note: Robust t statistics in parentheses
* significant at 5%
** significant at 1%

## Appendix B. Land Use in Rural Kenya

The following is a table developed to investigate the apparent spike in 2000 in land use among the households in the sample. Although the spike remains largely unexplained, the randomness of changes in land use seems to indicate that it was genuine, as opposed to being a data problem.

## Table B1. Area Farmed (Acres) Each Year by Zone and Crop Type

| Crop Types | | Agriculture-regional Zones | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Coastal Lowlands | Eastern Lowlands | Western Lowlands | Western Transitional | High Potential Maize | Western Highland | Central Highland | Marginal Rain Shadow | Total by Crop Type |
| Staples | 1997 | 0.41 | 0.38 | 0.49 | 0.58 | 3.21 | 0.21 | 0.14 | 0.06 | 1.12 |
| | 2000 | 0.65 | 0.64 | 0.50 | 0.47 | 3.58 | 0.13 | 0.16 | 0.13 | 1.25 |
| | 2004 | 0.37 | 0.51 | 0.53 | 0.46 | 1.92 | 0.11 | 0.35 | 0.15 | 0.81 |
| Horticulture | 1997 | 0.25 | 0.14 | 0.03 | 0.21 | 0.22 | 0.16 | 0.26 | 0.46 | 0.20 |
| | 2000 | 0.33 | 0.72 | 0.07 | 0.30 | 0.37 | 0.21 | 0.41 | 0.52 | 0.36 |
| | 2004 | 0.33 | 0.68 | 0.12 | 0.18 | 0.26 | 0.12 | 0.30 | 0.32 | 0.28 |
| Industrial Cash Crops | 1997 | 0.00 | 0.08 | 0.36 | 2.03 | 0.19 | 0.31 | 0.54 | 0.00 | 0.48 |
| | 2000 | 0.00 | 0.02 | 0.33 | 1.97 | 0.24 | 0.15 | 0.62 | 0.00 | 0.47 |
| | 2004 | 0.00 | 0.01 | 0.47 | 1.48 | 0.19 | 0.19 | 0.49 | 0.00 | 0.39 |
| Other (Non-intercropping) | 1997 | 0.00 | 0.06 | 0.03 | 0.10 | 0.09 | 0.11 | 0.09 | 0.03 | 0.08 |
| | 2000 | 0.00 | 0.33 | 0.05 | 0.14 | 0.07 | 0.15 | 0.29 | 0.03 | 0.15 |
| | 2004 | 0.19 | 0.11 | 0.08 | 0.07 | 0.15 | 0.17 | 0.20 | 0.08 | 0.14 |
| Maize, Legumes, and Horticulture Intercropping | 1997 | 1.32 | 2.03 | 0.95 | 1.36 | 1.91 | 0.74 | 0.76 | 1.43 | 1.36 |
| | 2000 | 2.41 | 2.73 | 1.31 | 1.70 | 2.91 | 1.10 | 0.76 | 1.11 | 1.89 |
| | 2004 | 2.12 | 2.29 | 1.34 | 1.49 | 2.18 | 1.02 | 0.63 | 1.18 | 1.57 |
| Maize and Other Intercropping | 1997 | 0.33 | 0.04 | 0.23 | 0.02 | 0.00 | 0.05 | 0.00 | 0.00 | 0.06 |
| | 2000 | 0.09 | 0.05 | 0.23 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.04 |
| | 2004 | 0.12 | 0.05 | 0.18 | 0.00 | 0.02 | 0.02 | 0.01 | 0.00 | 0.05 |
| Other (Non-maize) Intercropping | 1997 | 0.45 | 0.33 | 0.14 | 0.01 | 0.34 | 0.08 | 0.43 | 0.00 | 0.26 |
| | 2000 | 0.77 | 0.73 | 0.45 | 0.50 | 0.24 | 0.51 | 0.31 | 0.10 | 0.42 |
| | 2004 | 0.77 | 0.71 | 0.48 | 0.45 | 0.30 | 0.39 | 0.47 | 0.14 | 0.45 |
| Total by Zone | 1997 | 2.76 | 3.05 | 2.23 | 4.31 | 5.95 | 1.66 | 2.23 | 1.98 | 3.55 |
| | 2000 | 4.26 | 5.21 | 2.94 | 5.08 | 7.42 | 2.27 | 2.56 | 1.88 | 4.59 |
| | 2004 | 3.91 | 4.35 | 3.20 | 4.14 | 5.02 | 2.02 | 2.45 | 1.86 | 3.68 |

## Appendix C. Income Generating Activity Involvement

The following table lends more weight to observations made in reference to Table 11 in the main body of the paper, but was too cumbersome to report. This was also referenced in a footnote.

**Table C1. Share of Households Reporting for HCI by Asset Poverty Category and Farm Size (%)**

| | Asset-Poverty Category | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Consistently Low Tercile --Relative Farm Size-- | | | Consistently High Tercile --Relative Farm Size-- | | | Upward --Relative Farm Size-- | | | Downward --Relative Farm Size-- | | | Other --Relative Farm Size-- | | | Total Sample |
| | Small | Medium | Large | Small | Medium | Large | Small | Medium | Large | Small | Medium | Large | Small | Medium | Large | |
| Staple Carbohydrates | | | | | | | | | | | | | | | | |
| 1997 | 97 | 98 | 97 | 97 | 94 | 100 | 75 | 92 | 100 | 100 | 100 | 100 | 98 | 99 | 99 | 98 |
| 2004 | 98 | 100 | 94 | 100 | 100 | 99 | 100 | 100 | 100 | 100 | 94 | 100 | 100 | 100 | 100 | 99 |
| Horticultural Products | | | | | | | | | | | | | | | | |
| 1997 | 58 | 68 | 77 | 86 | 79 | 70 | 100 | 46 | 62 | 58 | 69 | 89 | 63 | 69 | 63 | 67 |
| 2004 | 98 | 100 | 97 | 100 | 100 | 97 | 100 | 92 | 100 | 100 | 100 | 100 | 100 | 99 | 99 | 99 |
| Industrial Cash Crops | | | | | | | | | | | | | | | | |
| 1997 | 23 | 31 | 17 | 24 | 37 | 27 | 25 | 46 | 31 | 33 | 19 | 11 | 37 | 45 | 39 | 35 |
| 2004 | 28 | 32 | 20 | 27 | 39 | 25 | 25 | 31 | 46 | 42 | 13 | 0 | 44 | 42 | 33 | 35 |
| Other Crops 1997 | 23 | 27 | 23 | 11 | 7 | 14 | 38 | 31 | 31 | 17 | 31 | 22 | 20 | 17 | 24 | 20 |
| 2004 | 51 | 56 | 46 | 73 | 66 | 48 | 88 | 69 | 62 | 58 | 44 | 56 | 70 | 67 | 56 | 61 |
| Dairy 2004 | 17 | 29 | 11 | 95 | 94 | 97 | 75 | 85 | 92 | 33 | 44 | 78 | 70 | 72 | 78 | 68 |

Note: Farm sizes are ranked by terciles, according to acres farmed during the 1997 main season, whether land is owned or rented. Small farms are 0 to 1.6 acres, medium farms are 1.6 to 3.2 acres, and large farms are larger than 3.2 acres.
HCI for product i is (value of product i sold / value of product i produced)*100.

## Appendix D. Attributes of Asset-Welfare Groups

### Table D1. Crop Enterprises Providing Cash by Asset-Welfare Groups Over Time

| | 1997 | | 2004 | |
|---|---|---|---|---|
| | Asset Poverty Category | | | |
| Crop | Rising (n=34) | Declining (n=37) | Rising (n=34) | Declining (n=37 |
| | Number of Households in Group Generating Cash | | | |
| Dry maize | 9 | 10 | 19 | 15 |
| Dry beans | 6 | 6 | 11 | 8 |
| Sorghum | 1 | 0 | 2 | 1 |
| Millet | 1 | 2 | 0 | 3 |
| Bananas | 7 | 9 | 11 | 13 |
| Coffee mbuni | 2 | 6 | 3 | 1 |
| Tea | 2 | 2 | 2 | 2 |
| Wheat | 2 | 0 | 0 | 2 |
| Cotton | 3 | 0 | 1 | 1 |
| Industrial sugarcane | 4 | 0 | 7 | 1 |
| Cowpeas | 2 | 1 | 3 | 1 |
| Fodder | 0 | 1 | 0 | 4 |
| French beans | 1 | 6 | 0 | 3 |
| Irish potatoes | 1 | 2 | 2 | 3 |
| Cassava | 1 | 6 | 3 | 3 |
| Groundnuts | 0 | 1 | 4 | 0 |
| Green grams | 0 | 0 | 2 | 1 |
| Sweet potatoes | 2 | 6 | 8 | 5 |
| Tomatoes | 3 | 4 | 5 | 7 |
| Sukuma wiki | 2 | 2 | 11 | 14 |
| Spinach | 0 | 0 | 1 | 3 |
| Capsicum | 0 | 0 | 2 | 0 |
| Pawpaws | 0 | 0 | 3 | 3 |
| Guava | 1 | 0 | 3 | 2 |
| Mangoes | 1 | 1 | 4 | 1 |
| Lemons or oranges | 1 | 0 | 6 | 2 |
| Pumpkin | 0 | 0 | 4 | 1 |
| Snowpeas | 0 | 0 | 0 | 2 |
| Cabbage | 1 | 7 | 2 | 6 |
| Onions | 1 | 3 | 4 | 7 |
| Avocado | 1 | 8 | 6 | 13 |
| Lugard | 0 | 3 | 1 | 3 |
| Matomoko | 0 | 0 | 0 | 2 |
| Pineapples | 1 | 0 | 1 | 0 |
| Passion fruit and mero | 0 | 0 | 2 | 2 |
| Indigenous vegetables | 0 | 0 | 9 | 6 |
| Chewing sugarcane | 2 | 1 | 4 | 4 |
| Total | 59 | 90 | 149 | 145 |

Source: Tegemeo survey data 1997, 2000, and 2004

Note: Coconut, sunflower, rice, arrow roots, carrots, soybeans, and green peas were omitted from this table. In each case only one household used these crops to generate cash income across all welfare groups and time periods.

Table D1 looks more carefully at the crop activities from which different mobile welfare groups generate cash income. The overall increase in cash generating activities throughout these two groups is observed. In 1997 the 34 households identified as rising in wealth over the survey period have only 59 cash generating crop enterprises, compared to 90 such enterprises for the 37 households in the group identified as declining over time. By 2004, the number of cash generating crop enterprises for the rising group increase more than 250% to 149, while the declining group's number of enterprises increases only 161% to 145. Rising households seem to be outpacing the declining group in important crops such as maize, beans, and industrial sugarcane, as well as several tree fruits.

Table D2 examines the non-farm activities from which the mobile welfare groups generate cash income. These results, consistent with other findings in the main body of the paper, show informal activities to be of increasing importance to households of declining wealth. Of the 37 households in this group, only 16 participated in such activities in 1997, increasing to 24 households by 2004. Conversely, among the 34 households in the group rising in relative wealth, this number decreases from 19 to 18 over the same period. This decrease in the importance of informal activities for this group is even more evident when looking at wages, where the number of households involved declines from 7 to 2 over the period of increasing wealth.

**Table D2. Non-Farm Activities by Welfare Group Over Time**

| | 1997 | | 2004 | |
|---|---|---|---|---|
| | Asset Poverty Category | | | |
| Non-Farm Activity Type | Rising (n=34) | Declining (n=37) | Rising (n=34) | Declining (n=37) |
| | Number of Households in Group Generating Cash | | | |
| Informal/Agricultural Wages | 7 | 4 | 2 | 5 |
| Informal Business | 12 | 12 | 16 | 19 |
| Formal Salaried Income | 12 | 13 | 11 | 10 |
| Other[a] | 15 | 13 | 11 | 14 |

Source: Tegemeo Survey Data 1997, 2000, and 2004

[a] "Other" includes remittances, pensions, and dividends.

## Appendix E. Maize Market Participation

The role and effectiveness of government price supports in the maize market has long been debated in Kenya. Both sides of the debate have been subject to speculation driven by preconceived notions, which until recently was compounded by a dearth of household level information on how such policies affect various types of farmers. Prior to the late 1990s, conventional wisdom was that the majority of Kenyan farmers wanted and would benefit from higher maize prices. Since then, research has shown the majority of rural farmers in Kenya are in fact either only buying maize or they are net buyers. Moreover, the relatively well-off households are more likely to benefit from price supports (Jayne et al. 2001).

This paper is uniquely capable of revisiting this issue in the context of welfare dynamics. Table E1 shows the various roles different poverty mobility groups play in Kenya's maize market. In general, strong evidence is found that price supports would not only primarily benefit the relatively non-poor, but would also be detrimental to the consistently poorest households. In 1997 a staggering 80% of the persistently poor are entirely or net buyers of maize and maize meal, an overwhelming share of which are not selling maize at all. This trend continues into 2004 when 71% of the poorest are still buyers of maize. Conversely, 46% of the continuously non-poor are sellers of maize in 1997, the vast majority of which are not buying maize at all. By 2004 this share climbed to over half of this group of households.

**Table E1. Changes in Position in Agricultural Markets, By Asset Poverty Category**

| | Asset-Poverty Category | | | | | |
|---|---|---|---|---|---|---|
| | Consistently Low Tercile (n=217) | Consistently High Tercile (n=249 ) | Upward (n=34) | Declining (n=37) | Other (n= 787) | Total Sample (n=1,324) |
| Net Maize + Maize Meal Sales (kgs/hh) | | | | | | |
| 1997 | -398.78 | 2,479.73 | -344.29 | -106.42 | -6.59 | 385.26 |
| 2004 | -148.80 | 2,398.87 | 233.19 | 258.69 | 270.33 | 644.32 |
| % of Households That Are: | | | | | | |
| Only Sellers of Maize/Meal | | | | | | |
| 1997 | 5 | 43 | 9 | 14 | 14 | 18 |
| 2004 | 10 | 49 | 24 | 19 | 18 | 23 |
| Only Buyers of Maize/Meal | | | | | | |
| 1997 | 75 | 26 | 62 | 65 | 58 | 55 |
| 2004 | 64 | 23 | 35 | 51 | 48 | 46 |
| Net Buyers | | | | | | |
| 1997 | 5 | 13 | 9 | 11 | 8 | 8 |
| 2004 | 7 | 16 | 24 | 16 | 16 | 15 |
| Net Sellers | | | | | | |
| 1997 | 6 | 3 | 9 | 3 | 6 | 6 |
| 2004 | 10 | 2 | 9 | 5 | 6 | 6 |
| Neither Buy nor Sell | | | | | | |
| 1997 | 9 | 14 | 12 | 8 | 14 | 13 |
| 2004 | 8 | 10 | 9 | 8 | 11 | 10 |

The issue of farmer preferences was also addressed in the 1997 and 2000 surveys. Each of the 1,324 households in the sample were asked in 1997 whether they preferred higher or lower maize prices. Then, after a period of reform during which many price controls were relaxed, in 2000 they were asked if they preferred the current system or the old controlled system. Responses to these questions are summarized by asset poverty category in Table E2.

As the expected based on the results previously discussed, lower prices are preferred by the greater part of the national sample in 1997. Unsurprisingly, the only group of households whose majority preference is for higher prices is the consistently non-poor, whom have shown to be maize sellers. By 2000 the bulk of the sample responding in support of the current (uncontrolled) maize market. Astonishingly, the strongest support is seen for the uncontrolled system coming from the groups of consistently non-poor and upwardly mobile households.

To summarize, the analysis finds unambiguous support for the notion that controlled maize prices will primarily benefit the relatively well off, if anyone, and burden the relatively poor. Moreover, after the initial period of reform, strong support is found for uncontrolled maize markets among all poverty mobility groups.

**Table E2. Household Preferences Concerning the Maize Market by Asset Poverty Mobility Group**

| | Whether Household Prefers Higher or Lower Maize Prices (1997) | | Preference for Current Marketing System vs. System During Control Period (2000) | | |
|---|---|---|---|---|---|
| | High Prices | Lower Prices | Current System | Control System | No Change |
| | ---- % of households responding --- | | --- % of households responding --- | | |
| Consistently Poor | 11 | 89 | 60 | 36 | 4 |
| Consistently Non-Poor | 67 | 31 | 68 | 32 | 0 |
| Upward | 24 | 77 | 77 | 19 | 3 |
| Declining | 30 | 70 | 60 | 40 | 0 |
| Other | 29 | 71 | 66 | 32 | 2 |
| National Average | 33 | 67 | 66 | 32 | 2 |

Source: Tegemeo Rural Household Survey, 1997and 2000

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