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**PATHWAYS INTO AND OUT OF POVERTY: A STUDY
OF RURAL HOUSEHOLD WEALTH DYNAMICS IN
KENYA**

Milu Muyanga, T.S. Jayne, and William J. Burke

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EXECUTIVE SUMMARY

The recent availability of longitudinal survey data provides a new means to analyze the dynamics of household wealth accumulation and deterioration. This paper identifies the factors associated with smallholder farm households having ascended out of poverty or descended into poverty between 1997 and 2007. Using a nationwide balanced panel of 1,275 farm households in 22 districts in Kenya interviewed in 1997, 2000, 2004, and 2007, we find that a relatively small fraction of the sample experienced either an appreciable improvement or decline in their relative asset wealth over the 10-year period. Over 70% of the sampled farm households are in roughly the same wealth position as they were 10 years earlier, although more households experienced an increase in asset wealth than a decline. Evidence also points to a decline in poverty rates, which is consistent with Government of Kenya findings of declining national poverty rates over the same general period.

For the 25% of households that did experience an appreciable change in asset wealth between 1997 and 2007, we revisited 84 of these households in 2008 with more detailed retrospective *life history* surveys to capture a wider range of factors influencing current household livelihoods. Households successfully accumulating assets and rising out of poverty (i) were more likely to have remained healthy and suffer no unexpected deaths during the decade prior to the start of the initial survey in 1997; (ii) were less adversely affected by mortality that did occur during the panel period compared to other households; (iii) were consistently headed by a male; (iv) received relatively more land from their parents at the time the household was formed; and (v) had parents who were relatively well-off and educated. Moreover, the ascenders were able to acquire more land, cultivate 70% more land, and increase their use of fertilizer over the 2000-2007 period, consistent with the overall agricultural and economy-wide growth in Kenya that occurred during the 2004-2007 period.

Among households reporting a significant decline in asset wealth, roughly half experienced unexpected shocks, such as premature death and chronic illness. These households reported spending 22% of their annual incomes and 47% of their assets on medicines and caregiving. Households with declining asset trajectories were also more likely to have turned from male- to female-headed due to male mortality, have two or more wives in the household, poorly educated household heads, fathers of household heads who were relatively uneducated, and relatively little land and other assets inherited from parents. Small inheritances among the *descenders* can be traced to a smaller amount of land per number of sons of the household head's father. The descenders also tended to lose land and animal assets over the panel period (in some cases due to disease and need to pay for medical expenses) in sharp contrast to the ascenders. Perhaps surprisingly, the descenders were more likely to use fertilizer, had higher fertilizer application rates per acre cultivated, and were more likely to receive agricultural credit than the ascender households.

Consistently better-off households were more likely to: (i) have been male headed; (ii) have members with secondary and/or post-secondary educations; (iii) not be polygamous; and (iv) receive significantly more land and other assets at the time the household was formed. They were also less affected by mortality in the family. These consistently better-off households owned more land and applied more organic and inorganic fertilizer than either the ascenders or descenders. However, they were no more likely to receive agricultural credit or grow major cash crops than the descenders.

These findings underscore the importance of staying healthy in households' ability to accumulate productive assets and move out of poverty. Households' agricultural performance

and earnings over time is in many cases related to their lagged health status. The study also highlights the role of intergenerational wealth transfers. Poor households are able to transfer little to the next generation, which then makes it very difficult for them to climb out of poverty.

Key words: poverty, assets, shocks, intergenerational transfers, Kenya

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ACRONYMS

CDF	Constituency Development Fund
CPI	Consumer Price Index
CRE	Correlated Random Effects Estimator
DFID	Department for International Development
FAO	Food and Agriculture Organization of the United Nations
FGT	Foster Greer Thorbecke
GDP	Gross Domestic Product
GISAMA	Guiding Investments in Sustainable Agricultural Markets in Africa
KIHBS	Kenya Integrated Household Budget Survey
KNBS	The Kenya National Bureau of Statistics
KSh	Kenyan Shilling
LATF	Local Authorities Transfer Fund
MSU	Michigan State University
MTEF	Medium Term Expenditure Framework
NARC	National Rainbow Coalition
PRAP	Poverty Reduction Strategy Paper
SNA	System of National Accounts
USAID	United States Agency for International Development

1. INTRODUCTION

For the past half-century, African governments and development agencies 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. These broad strategies included *growth and trickle down* in the 1960s; basic human needs and state-led integrated rural development in the 1970s; structural adjustment and economic liberalization in the 1980s and 1990s; and, since 2000, a heterodox mix of donor budget support to empower government ownership in the design of participatory poverty reduction strategies, and resurgent interest in agricultural development and food security, which has been pursued in highly disparate ways throughout Sub-Saharan Africa but which in general has been associated with a re-emergence of direct state operations in agricultural markets. However, rural poverty in Africa remains pervasive. In 2005, more than 40% of Sub-Saharan Africa's population was estimated to be below the poverty line, and this situation appears to have improved only marginally over the past decade (World Bank 2006). Despite successive years of five percent growth in real gross domestic product (GDP) in Sub-Saharan Africa in 2004, 2005, 2006, and 2007, rural poverty appears to be declining only marginally, and is even increasing in some countries.

Yet some smallholder farm households have successfully climbed out of poverty, which provides an opportunity to learn about the economic pathways that might enable other rural smallholders to do so. If researchers and policy makers had greater micro-level insight into the factors enabling some households to have risen out of poverty, it might be possible to replicate these factors more broadly through poverty reduction strategies. Conversely, some households that were once well above the poverty line have now descended into poverty. Such cases may also provide insights about the design of programs and policies to address rural poverty. Additional insights may be possible by identifying *successful* farmers who have consistently outperformed others in their communities and the reasons for it. This study is motivated by the need to better understand the micro-level factors enabling rural households in Sub-Saharan Africa to escape from poverty and remain non-poor, as well as those that may push relatively wealthy households into poverty.

This study examines the factors associated with dramatic changes in farm household asset wealth over a 10-year period in Kenya. The study makes use of household panel survey data collected in 1997, 2000, 2004 and 2007 to identify three types of smallholder farm households: (i) those experiencing a major improvement in asset wealth; (ii) those experiencing a major decline in wealth leading to living standards below the poverty line; and (iii) successful smallholder farmers consistently in the top quartile of asset wealth throughout the 10-year period. Seventy-eight households were revisited in 2008 to conduct retrospective in-depth life history surveys. The sample was confined to smallholder farming households controlling less than four hectares of land, given that 95% of Kenya's smallholder population is also in this situation. The study thus omits cases of poverty reduction arising from obtaining access to substantial additional land, a situation that is infeasible for the vast majority of rural African households.

The study measures poverty and wealth in terms of households' assets. While most studies to date have tended to measure household welfare in terms of income or consumption, arguments have been raised in support of households' value of assets as a more appropriate measure of welfare. Asset holdings are considered to be a more stable indicator of current welfare and future vulnerability especially in regions where households rely greatly on their physical assets for their livelihoods (Krishna 2004; Barrett and Swallow 2006; Carter and

Barrett 2006; Cooper 2008). In environments where credit and insurance markets are not available, households have been found to rely on their assets to smooth consumption and to ensure survival through repeated shocks. Thus, assets act as a *safety-net* when households' income streams are interrupted (Carter and Barrett 2006; Zeller and Sharma 2000). For these reasons, the study of household asset dynamics – how households build up their asset base and why asset bases get depleted – is likely to be important in developing effective poverty reduction strategies.

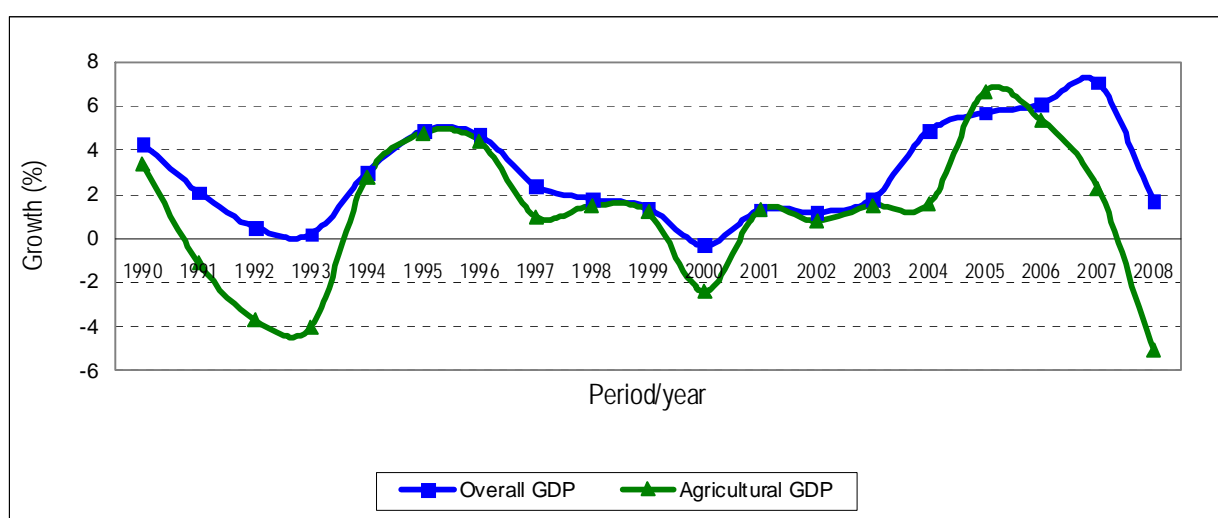
The study is organized as follows: Section 2 examines poverty trends in Kenya over the past 20 years based on official government statistics. Section 3 describes the data and sampling methods used in this study. Section 4 reviews the literature on the determinants of poverty in rural Africa based on prior studies and reports descriptive trends and factors correlated with asset wealth and poverty patterns in the nationwide panel sample. Section 5 presents the estimation strategy used to derive statistical inferences about the importance of these various factors associated with changes in poverty status over time. Section 6 reports the main findings, while Section 7 discusses the implications for the rural investments, programs, and policies designed to reduce rural poverty.

2. POVERTY TRENDS IN KENYA

Economic growth and poverty rates appear to have been generally inversely correlated over the past two decades in Kenya. In the 1990s, the Kenyan economy was in clear decline and poverty rates rose from 40 to 48% in the early 1990s, to 56% by 1997 (Figure 1). From the early 2000s up to 2007, however, the Kenyan economy showed signs of improvement. The economy's growth rate rose from -0.3% in 2000 to 7.1% in 2007. Even though poverty rates have declined during this period, they remain pervasively high. According to the 2005/06 Kenya Integrated Household Budget Survey (KIHBS), implemented by the Kenya National Bureau of Statistics (KNBS), national absolute poverty declined from 52.3% in 1997 to 45.9% in 2005/06 (Table 1).¹ Over the same period, absolute rural poverty declined from 52.9 to 49.1% while urban absolute poverty declined from 49.2 to 33.7%. The national food poverty rate declined from 48.3 to 45.8%.² Rural food poverty declined from 50.7 to 47.2% while urban poverty increased from 38.3% in 1997 to 40.5% in 2006.

There are important regional differences in poverty (Table 2). North Eastern and Coast provinces registered the highest food poverty rates of 66 and 63.5% respectively in 2005/06. Even though North Eastern province had the highest proportion of people living in poverty, it is sparsely populated and largely pastoral, and hence the causes of poverty there are different from the agriculture-based regions. The agricultural productive region of Central Province had the lowest poverty rates at 31.4%.

Figure 1. National GDP and Agricultural GDP Growth Rates in Kenya



Data Source: Republic of Kenya, Economic Surveys (various issues).

Note: A new System of National Accounts (SNA) was introduced in 2003 that captures activities in some fast growing sub-sectors that were ignored by the old SNA.

¹ The 2005/06 poverty lines in monthly adult equivalent terms were estimated at KSh.1562 and KSh.2913 for rural and urban areas respectively.

² KIHBS estimated the food poverty lines in monthly adult equivalent at KSh.988 and KSh.1474 for rural and urban areas respectively.

Table 1. National Poverty Rates in Kenya (1997 and 2005/06)

	Poverty Measure	WMS III (1997)			KIHBS (2005/06)		
		Adult Equivalent	Households	Individuals	Adult Equivalent	Households	Individuals
Rural	Food	50.7	43.4	50.6	47.2	38.5	47.2
	Absolute	52.9	46.4	53.1	49.1	42.0	49.7
	Hardcore	34.8	30.1	34.9	21.9	18.0	22.3
Urban	Food	38.3	32.4	38.4	40.5	31.2	40.4
	Absolute	49.2	43.5	50.1	33.7	27.4	34.4
	Hardcore	7.6	5.9	7.7	8.3	5.9	8.3
National	Food	48.3	41.6	48.9	45.8	36.7	45.8
	Absolute	52.3	45.8	52.6	45.9	38.3	46.6
	Hardcore	29.6	26.2	30.5	19.1	14.9	19.5

Source: Republic of Kenya 2007

Table 2. Rural Food Poverty in Kenya by Region 2006

Province	Headcount ($P_{\alpha=0}$)	Poverty Gap ($P_{\alpha=1}$)	Severity of Poverty ($P_{\alpha=2}$)	Contribution (%)
Central	31.4	9.3	4.1	9.6
Coast	63.5	21.9	10.5	9.6
Eastern	45.2	15.8	7.6	18.8
North Eastern	66.0	24.9	12.3	4.3
Nyanza	46.0	15.7	7.4	14.8
Rift Valley	49.5	17.5	9.1	28.0
Western	51.1	17.4	8.0	15.0
Total-Rural	47.2	16.2	7.9	100

Source: Republic of Kenya 2007

Note: The poverty indices are the Foster Greer Thorbecke (FGT) (Foster et al. 1984) indices:

$$P(\alpha) = \frac{1}{N} \sum_{i=1}^N \left[\frac{(z - Y_i)}{z} \right]^{\alpha} I(Y_i < z) \text{ where } Y_i \text{ is the household per adult equivalent income, } z \text{ is the}$$

poverty line and α is a measure of poverty aversion.

Reducing rural poverty has been a central policy concern in Kenya. To enable the government to better understand the causes of poverty, the government of Kenya developed the poverty reduction strategy paper (PRSP) in 2001 (Republic of Kenya 2001). The PRSP was a product of broad-based and in-depth consultations among key stakeholders and in particular the poor. It outlined the priorities and measures necessary for poverty reduction and economic growth. The PRSP was central to the development of a pro-poor and pro-growth Medium Term Expenditure Framework (MTEF) budget system that started in fiscal year 2000/01. The MTEF budget aimed at improving the quality of expenditure and shifting of resources towards pro-poor activities and programs.

In 2003, a new government, the National Rainbow Coalition (NARC), came into power and continued economic recovery process and poverty reduction initiatives by preparing a broad nationwide development framework, the Economic Recovery Strategy for Wealth and Employment Creation (Republic of Kenya 2003). Among other pro-poor programs, the government initiated free primary education, the Constituency Development Fund (CDF), and the local authorities transfer fund (LATF). Unlike previous government development

funds, CDF and LATF resources are transferred directly to constituencies and local authorities, respectively, which are tasked with managing the funds and determining how they will be spent through consultative processes with communities. There is some evidence of improvement in rural households' proximity to some publicly provided services and infrastructure since the implementation of the CDF in 2003 (Chamberlin and Jayne 2009). Recently, the government launched Kenya Vision 2030, a long-term development plan (Republic of Kenya 2008). The Vision proposes a variety of pro-poor investments especially in the health and education sectors.

3. A DESCRIPTION OF THE DATA

The study draws from both longitudinal and retrospective *life history* survey data sets. We utilize a balanced panel of 1,275 rural households interviewed in 1997, 2000, 2004, and 2007 by the Tegemeo Institute, a national policy institute of Egerton University. The four surveys were implemented under the Tegemeo Agricultural Monitoring and Policy Analysis Project between Tegemeo Institute and Michigan State University. A stratified sampling technique was used to take into account the ecological diversity inherent in the country. All the districts were classified into eight agro-regional zones. Agro-regional zones bring together areas with similar agro-climatic conditions, agricultural activities, and rural livelihoods. Using standard proportional sampling aided by national census data, farm households were sampled randomly from 24 districts. Two districts were excluded from this analysis because they are largely pastoral. Households found to own over 20 acres of land were also excluded from the analysis to retain the focus on the smallholder sector.

As mentioned earlier, households' poverty status is based on observing the value of a household's assets in each survey and comparing the changes over time. The list of productive assets consistently collected and valued in each of the four surveys includes ploughs, tractors and draft animal equipment, carts, trailers, cars, trucks, spray pumps, irrigation equipments, water tanks, stores, wheelbarrows, combine harvesters, donkeys, bulls, chickens, goats, sheep, calves, cows, pigs, turkeys, and ducks. Recent studies in the poverty literature (e.g., Barrett and Swallow 2006; Carter and Barrett 2006; Krishna 2004) argue that the value of assets more accurately measures wealth than income or consumption, as it is less susceptible to random shocks, and is likely to be a more stable indicator of household welfare. This is especially true in regions where rain-fed agriculture is a major source of annual income and where weather-induced fluctuations in annual income are high. However, we did compare income-based measures with asset wealth and found the within-year Spearman R^2 correlation to range from 0.49 in 1997 to 0.56 in 2007 (all statistically significant at 0.05), indicating a fairly strong degree of consistency between the two indicators.

The computed household asset values were deflated using the Kenya consumer price index (CPI) with 2007 as the base year.³ Figure 2 shows density curves of changes in households' asset values between 1997 and 2007, while Table 3 presents information on the distribution of assets and income across the various survey years for the entire sample. Figure 3 shows density curves of changes in households' asset values between 1997 and 2007 specifically for households owning at most four acres of land. As shown in Table 3, the mean value of household assets, after accounting for inflation, rose by 32% over the period of 1997-2007 from Kenyan Shilling (KSh) 71,000 to KSh 94,000. However, looking at the distribution of changes in household assets across the sample, we can see that between each period, 25% or more of the households experienced a decline. In all the other periods, however, at least 50% of the sample was accumulating asset wealth, and for the top 10% of farmers in each year (the 90th percentile as reported in Table 3), asset accumulation was quite substantial, averaging KSh 50,000 (roughly US\$600) between periods.

³ The Kenya National Bureau of Statistics (KNBS) is in the process of revising its methodology for deriving the Consumer Price Index (CPI) and upon its release, the study will be updated to take account of the new historical measures. It is envisioned that the rate of CPI growth over certain parts of the 1997-2007 period will be lower under the new method, which would indicate a slightly higher rate of asset and income growth than that reported in this draft version.

Figure 2. Change in Households' Asset Value between 1997 and 2007, Tegemeo Rural Farm Panel Households (N=1262)

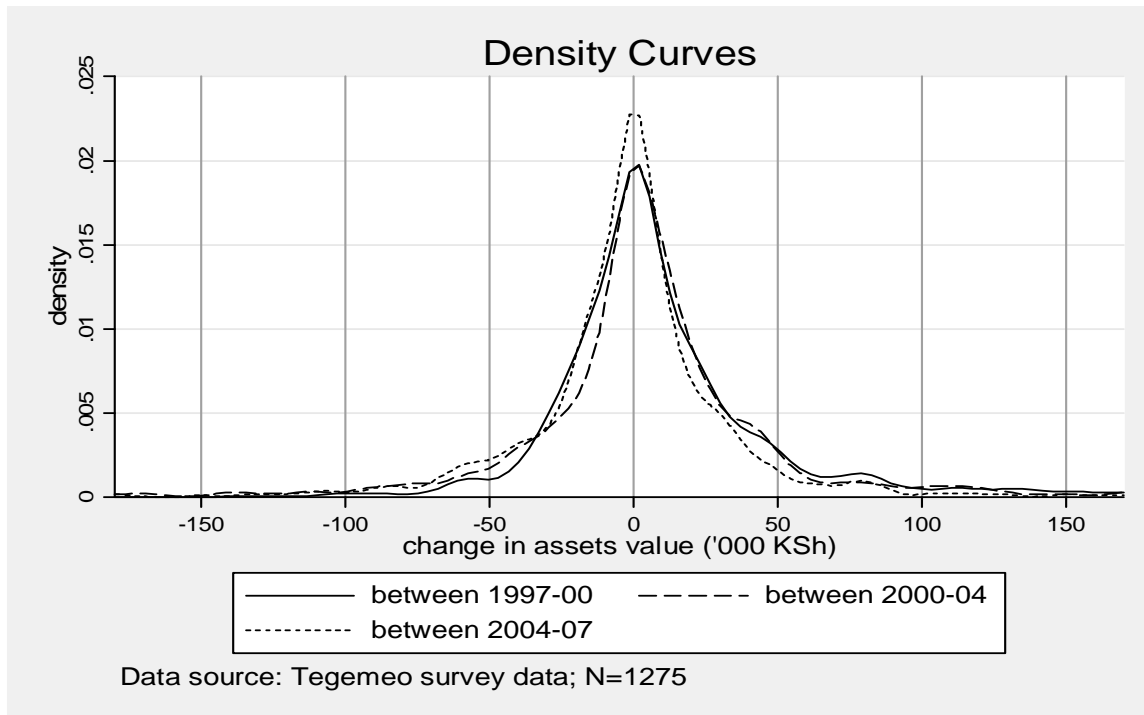


Figure 3. Change in Assets Value of Households with Four Acres and Less between 1997- 2007, Tegemeo Rural Farm Panel Sample [N=774]

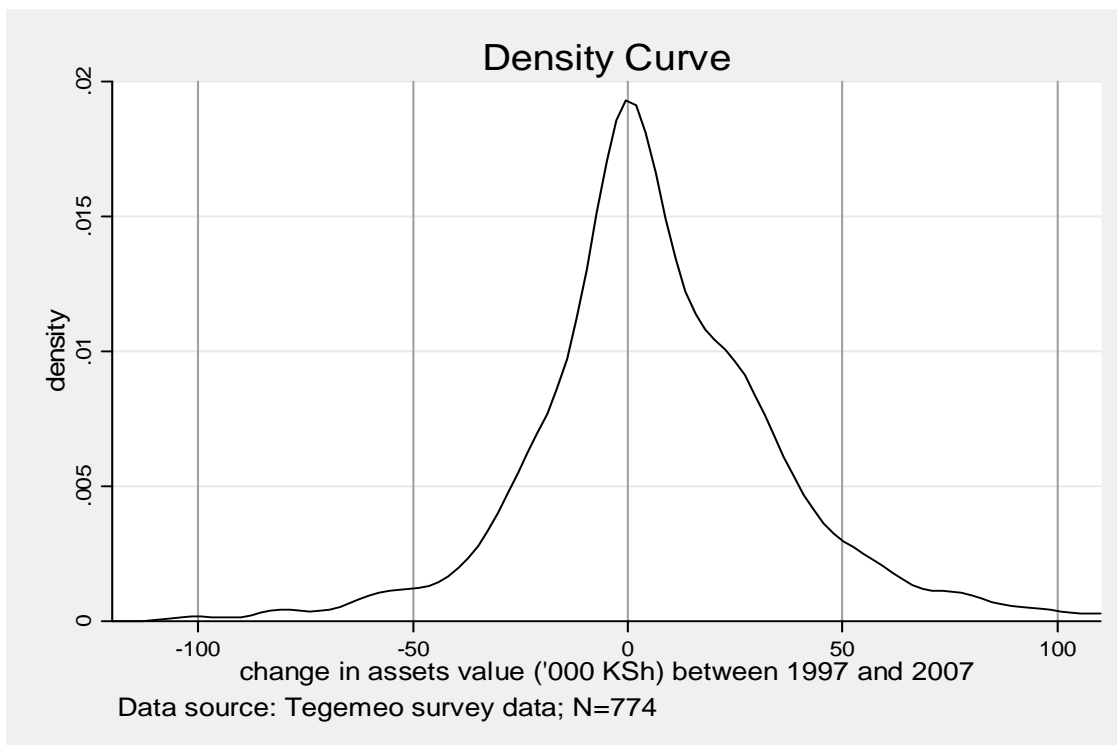


Table 3. Household Real Assets and Real Incomes in '000KSh. [N=1275]

	mean	Value at household distribution percentiles				
		10	25	50	75	90
Households' assets by year						
_1997	71.01	2.82	13.00	31.67	63.52	120.38
_2000	82.93	2.85	13.07	33.88	79.02	171.85
_2004	90.23	3.92	16.47	38.58	82.17	190.48
_2007	93.81	4.28	17.51	37.53	82.53	177.27
Household assets by headship gender						
_1997 female headed	44.08	2.36	8.41	24.66	50.85	100.90
male headed	76.50	3.11	14.36	32.93	66.51	128.86
_2000 female headed	45.24	1.19	7.20	21.77	51.09	104.53
male headed	87.96	3.17	13.69	35.26	80.48	180.48
_2004 female headed	50.29	2.13	9.83	28.42	54.37	99.17
male headed	100.37	5.54	18.18	42.70	90.00	213.17
_2007 female headed	55.53	1.87	10.70	28.22	54.45	120.83
male headed	105.59	6.14	19.35	40.65	86.62	208.13
Changes in household assets						
_between 1997 and 2007	22.80	-32.41	-10.33	5.05	28.84	74.77
_between 1997 and 2000	11.93	-27.15	-10.67	2.20	22.44	61.45
_between 2000 and 2004	7.30	-42.25	-11.15	2.37	21.06	51.67
_between 2004 and 2007	3.58	-43.39	-15.12	-0.15	12.60	39.02
Households' real incomes						
_1997	114.76	13.98	33.64	74.65	146.40	247.14
_2000	129.24	20.07	44.01	86.88	158.75	269.02
_2004	126.60	20.28	42.33	71.22	159.61	274.80
_2007	113.75	24.99	43.46	76.27	136.50	245.82

Data Source: Tegemeo Survey Data 1997, 2000, 2004, 2007.

Finally, households were stratified into wealth terciles (or thirds) for each year, yielding three relative poverty rankings: very poor, moderately poor and non-poor. This procedure is conducted in each year (1997, 2000, 2004, and 2007), revealing the path of each household's relative welfare. This study focuses on the four specific poverty mobility groups, which are:

- i) the chronically poor (those in the bottom tercile in each of the four years);
- ii) descending households (those in the *top* in 1997 and *bottom* in 2007);
- iii) ascending households (those in the bottom in 1997 and top in 2007); and
- iv) consistently non-poor (those in the top in each of the four years).

Of the 1,275 households in the sample, 165 are identified as chronically poor, 46 have fallen into poverty (the descenders), 49 have climbed from poverty (the ascenders) and 207 are consistently among the wealthiest households. Ascending households' wealth is 906% higher in 2007 than in 1997 on average. Conversely, descending households' wealth was 1,202% higher in 1997 than in 2007, on average. Section 4 reports some of the basic characteristics of these four groups and their bivariate associations with indicators of access to markets and infrastructure. See Burke and Jayne (2008) for a more detailed examination of these households and their spatial characteristics.

Retrospective life history surveys were conducted in 2008. Based on the four household groupings from the nationwide sample as defined above, we conducted in-depth retrospective surveys and life history interviews from a selected sub-set of households in three of the four categories (the ascenders, the descenders, and the consistently relatively well-off households). No life history interviews were conducted of the chronically poor. The selection of households was confined to those owning four acres or less, a situation characterizing over 90% of Kenya's smallholder sector. We imposed this land limit on households to be included in the retrospective surveys because of the desire to identify processes associated with poverty reduction that could be applicable to the vast majority of rural households in Kenya for whom the escape from poverty cannot occur through major *extensification* of farm production. We also checked income changes for these households and found a high degree of correlation⁴ between changes in income and asset wealth, after excluding several households from participation in the retrospective surveys based on inconsistencies. After imposing these conditions on the sample, we randomly selected more than half of the remaining ascenders (those rising out of poverty) and descenders (those falling into poverty) contained in the full sample for participation in the retrospective surveys.

Table 4a. Households' Real Asset Values and Real Incomes in '000KSh [N=78]

Status	Survey year	Mean	Value at i th percentile in distribution of households				
			p10	p25	p50	p75	p90
Real asset values							
Descenders	_1999	73.87	50.25	58.25	65.85	88.00	107.65
	_2000	54.22	10.72	21.35	39.10	62.02	110.97
	_2004	45.03	7.40	15.40	38.40	47.70	72.65
	_2007	19.75	2.60	13.25	20.00	26.30	29.00
Ascenders	_1999	14.96	0.27	3.26	10.45	15.80	29.18
	_2000	53.75	2.14	14.80	31.43	57.62	112.78
	_2004	74.46	12.85	23.50	42.43	101.00	204.83
	_2007	115.89	63.75	71.70	82.43	139.20	219.20
Non-poor	_1999	210.22	91.08	105.50	125.65	254.60	534.00
	_2000	245.53	95.50	113.50	154.00	333.50	468.50
	_2004	199.31	92.60	95.50	196.85	239.50	367.00
	_2007	386.47	136.45	165.30	211.00	440.00	687.20
Real incomes							
Descenders	_1999	90.53	11.14	37.73	75.40	137.28	175.14
	_2000	138.80	21.06	71.94	101.06	184.59	271.92
	_2004	67.01	11.79	30.22	53.06	78.86	146.83
	_2007	54.61	14.83	30.02	49.40	66.77	98.46
Ascenders	_1999	95.79	27.89	42.90	71.88	130.55	188.03
	_2000	115.47	28.16	36.53	87.04	140.61	232.83
	_2004	143.91	28.34	53.47	94.32	142.02	377.76
	_2007	117.07	32.73	46.61	68.86	131.27	256.73
Non-poor	_1999	180.79	59.03	83.30	148.77	264.60	303.73
	_2000	294.31	107.04	154.57	223.37	355.45	503.05
	_2004	246.93	64.96	126.72	193.75	330.15	466.14
	_2007	169.30	62.39	85.30	140.63	249.28	286.04

Data Source: Tegemeo Survey Data 1997, 2000, 2004, 2007.

⁴ Spearman R² of 0.17 (between 1997 and 2000), 0.25 (between 2000 and 2004), 0.16 (between 2004 and 2007), and 0.30 (between 1997 and 2007).

Overall, 84 households (27 ascenders, 27 descenders, and 30 consistently successful farmers) were selected to conduct in-depth retrospective life history surveys. The ascenders and descenders came from the extreme left and right tails of the distribution represented in Figure 3. The non-poor group came from around the centre of the distribution (household that maintained relatively high asset values throughout the panel period but did not experience enormous changes in asset holding). Table 4a presents the real asset values and incomes for households in each category over the four survey years.

As another cross-check on the nationwide survey data, enumerators printed out graphs plotting the changes in each household's asset wealth from 1997 to 2007 on a piece of paper and asked household respondents during the retrospective surveys whether their households' welfare status followed the general pattern shown on the graphs. During this process, it was found that five households that had been classified as descenders were families that considered themselves to be at the *winding up* stage of their life cycles. At the beginning of the panel, they had relatively high asset values but had transferred assets or sold them to raise school fees for their grandchildren during subsequent interview years. In their view, they were not poor by any standards and were excluded from subsequent analysis. Results are reported for the remaining 78 households (30 ascenders, 25 descenders, and 23 consistently successful farmers).

The retrospective life history survey obtained information about parents' family conditions and history, kinship ties, inter-generational transfers, shocks, gender-related factors, other aspects of household composition, and key investment decisions made that had long-term influences on households' current wealth and productivity conditions. Data was elicited using a structured questionnaire, life history interviews, and focus group discussions. The life histories brought in useful qualitative insights into asset holding and poverty dynamics.

4. CONCEPTUAL FRAMEWORK

Conventional cross-sectional household surveys are of limited help in analyzing household welfare dynamics because of their inability to measure changes in household wealth over time and the factors affecting such dynamics. Cross-sectional studies typically find that farm household income or consumption is highly correlated with landholding size, other productive assets, the use of improved farm technologies, and employment in gainful non-farm jobs. Yet such studies cannot trace the direction of causality (that is, whether households choosing to use improved farm technologies become wealthy, or are wealthy farmers more able to use improved technologies). There is increasing evidence that the current wealth status of households and differences in wealth between households within a community can be partially attributed to temporally remote factors (e.g., inheritance at the time the household was formed). Even a decade-long study is unable to fully trace out the sequence of how household decisions affect subsequent household welfare because information is missing on household decisions, shocks, and basic characteristics at the time the household was formed, which may exert strong effects on the path of household asset accumulation over time. Retrospective surveys probing into conditions of the parents' households and inter-generational transfers may enable researchers to understand more comprehensively the effects of such temporally remote factors. Therefore, the combining of retrospective life history information with conventional panel data survey information may permit both a fuller understanding of the range of near-term and temporally remote factors influencing wealth accumulation as well as reducing the severity of the omitted variable sources of bias in the coefficient estimates of conventional survey-based studies of poverty mobility and wealth generation.

We start conceptually with the possibility that a household's asset holding dynamics in any given year is a function of household demographic factors, as well as prior idiosyncratic factors, the household's socio-economic environment, including spatial factors such as agro-ecological conditions and access to markets, and intergenerational factors, including differences across households in the extent to which they receive asset transfers from their parents, and other parental decisions.

4.1. Household Demographic Factors

Changes in household composition (size, dependency ratios, and headship gender) through births, marriage, divorce, abandonment, death, and migration may affect households' physical asset holding. Table 4b shows the effect of changes in gender of the household's headship on the household assets. Previous studies in Ethiopia and South Africa reveal that household headship gender influences economic well-being, and that female-headed households are more likely to be disadvantaged (Posel 2001; Fafchamps and Quisumbing 2005). Hence a descent into poverty could result from a change in the gender of the household head resulting from the death of the male head, which in Zambia has been linked to the risk of losing land assets at some point in the future (Chapoto, Jayne, and Mason forthcoming). However, it is unclear whether this trend holds up in Kenya, particularly since much of the country follows a matriarchal social structure (Burke, Jayne, and Wooldridge 2010).

Also included under demographic factors are households' dependency ratios and social capital connections. Families with higher child-to-adult ratios usually face greater difficulty in accumulating assets relative to other households. Raising children entails costs that affect

Table 4b. Change in Household Assets by Change in Headship Gender in ‘000KSh.
[N=1275]

		Value at Household Distribution Percentiles					
		Mean	10	25	50	75	90
1997 to 2000	From male to female	-12.86	-70.47	-27.23	-7.76	2.22	33.83
	Female consistently	2.97	-23.96	-10.11	1.11	18.54	30.50
	Male consistently	12.01	-28.70	-10.84	2.20	23.67	66.14
2000 to 2004	From female to male	30.71	-21.02	-6.67	5.36	24.19	83.23
	From male to female	4.62	-38.69	-11.15	1.69	13.13	33.70
	Female consistently	9.58	-26.39	-8.46	0.51	18.27	41.45
2004 to 2007	Male consistently	7.30	-46.45	-13.02	2.71	22.02	55.86
	From female to male	8.84	-31.34	-14.68	6.50	62.66	85.10
	From male to female	-10.23	-58.17	-18.75	-4.05	5.15	35.52
	Female consistently	2.15	-33.38	-12.08	0.31	9.30	23.45
	Male consistently	4.76	-44.78	-15.45	-0.23	14.62	44.47
	From female to male	0.06	-16.70	-13.35	-5.46	15.29	27.92

Data Source: Tegemeo Survey Data 1997, 2000, 2004, 2007.

savings and asset holdings. Social capital is also an important factor determining access to land and other assets. Jayne et al. (2008) show that households in which the male head is related by blood to the local headman have an average of 0.4 hectares more land, other factors constant, than other households in Zambia’s smallholder farming sector.

Expenditure on children’ education represents an investment that may cause a reduction in current wealth but promises to raise household income and wealth at some point in the future. Access to education appears to be positively correlated with household wealth in the full nationwide sample. Table 5 classifies divisions, an administrative unit smaller than districts but larger than locations, into three groups:

- i) divisions where more than 75% of the heads have some formal education (indicating relatively good access to education);
- ii) those where between 50 and 75% have some formal education; and
- iii) those where fewer than half of all household heads have any education (indicating relatively bad access).

When examining these classifications in the context of poverty groups, one would expect to find the chronically poorest to be disproportionately more likely to be in a division with poor access to education. Table 5 seems to support the theory that access to education is an important determinant of wealth. Notice that 23% of the chronically poorest households are in divisions where fewer than half of all heads received any formal education. This is remarkable, since the criteria for having a formal education is fairly lenient, needing only a single year to qualify. Indeed, such educationally disadvantaged divisions contain less than seven percent of the entire sample, and only two percent of the households consistently in the top wealth tercile. In absolute terms, of the 82 households located in a division where fewer than half of the household heads have formal education, 38 of them are chronically poor.

Table 5. Formal Education Prevalence (Accessibility) by Poverty Group [N=1275]

Poverty group	Share Of Household Heads in Division with At Least One Year of Formal Education			Total
	More than $\frac{3}{4}$ (good access)	$\frac{1}{2}$ to $\frac{3}{4}$	Fewer than $\frac{1}{2}$ (bad access)	
	Share of poverty group (%)			
Chronically poorest	59%	18%	23%	100%
Falling into poverty	74%	17%	9%	100%
Rising from poverty	78%	14%	8%	100%
Consistently non-poor	68%	30%	2%	100%
Others	82%	14%	4%	100%
Total sample	76.2%	17.4%	6.4%	100%

Data Source: Tegemeo Survey Data 1997, 2000, 2004, 2007.

The plight of the chronically poor in the full sample is further evident when we consider the prevalence of a higher degree of education (more than eight years). Nearly 70% of the chronically poorest households are in a division where very few (less than one in four) household heads have more than eight years of education. This is a disproportionate share, compared with only 21% of the consistently wealthy and 42% of the sample as a whole living in a division lacking such higher education. Altogether, these results suggest that access to an education, particularly a higher education, is an important factor determining wealth. However, access to education is not correlated with whether a household climbs out of or descends into poverty. These two groups have roughly the same characteristics with regard to the percentage of household heads in the division with at least one year of formal education.

4.2. Shocks

Shocks deplete household assets, or predispose households to future asset depletion. Some shocks are random, such as drought, floods, and civil conflict, and have the capability of pushing households into poverty traps from which it is difficult to escape. Agricultural production involves a variety of price and yield risks, which appear to be prevalent especially for small-scale farmers in semi-arid regions. Accidents, chronic illness, death, dislocation, abandonment in old age, alcohol abuse and household disputes and breakdown can destabilize a household asset holding (Bird and Shinyekwa 2004). Earlier studies have shown that poorer households are more vulnerable to adverse shocks than are wealthier households (Glewwe and Hall 1998; McPeak and Barrett 2001). Little et al. (2002) argues that while poor households' tend to sell their assets in response to shocks, their relatively wealthier counterparts maintain a higher asset base by keeping their assets off a devalued market and by purchasing the devalued assets from poorer households. These findings suggest that households' initial conditions largely determine the effects of a random shock on future assets and livelihoods.

4.3. Access to Markets and Infrastructure

Proximity to markets and infrastructure influences households' asset holding. Access to infrastructure enhances households' access to input and product markets and may also influence the type of agricultural activity in which households engage (Zezza et al. 2007). Greater access to infrastructure implies reduced time and distance to urban centers. Households with greater access to electricity, water, communication, roads, and other forms of infrastructure will have a broader range of economic opportunities.

Table 6. Poverty Mobility Groups by Initial Distance to Motorable Road [1275]

Motorable road quartile	Poverty Mobility Group				
	Chronically poorest (n=165)	Falling into poverty (n=46)	Rising from poverty (n=49)	Consistently non-poor (n=207)	Other (n=808)
Nearest (< .1km)	12.1%	19.6%	18.4%	31.9%	19.6%
Mid-near (.1 to .25km)	20.0%	17.4%	32.7%	30.9%	30.3%
Mid-far (.25 to 1.5km)	40.6%	37.0%	24.5%	25.6%	27.8%
Furthest (>1.5km)	27.3%	26.1%	24.5%	11.6%	22.3%
Total	100%	100%	100%	100%	100%

Data Source: Tegemeo Survey Data 1997, 2000, 2004, 2007.

The full household sample provides mixed evidence of the importance of initial access to roads in influencing subsequent household wealth trajectories. Table 6 segregates each poverty group according to their mean distance to the nearest motorable road (i.e. a paved or unpaved road suitable for a motor vehicle). Nearly two-thirds of the non-poor households are less than a quarter of a kilometer from such a road. Conversely, 68% of the chronically poorest households are farther than 0.25km. It is also interesting to note in Table 6 that 63% of descending households are farther than the median distance from a motorable road. However, only half of the ascending households are located in the two quartiles of lowest distance to a motorable road. There appears to be little contemporaneous bi-variate correlation between households either rising from or falling into poverty and their distance to roads. This issue is explored in more detail through multivariate analysis.

4.4. Household History and Inheritance

Family history may be a good predictor of household's current asset holding. The transfer of physical assets from parents to their children has been shown to influence the younger generations' future livelihoods and economic productivity (Quisumbing 2007; Moore 2004). The transfer of assets from one generation to the next may depend on the number of potential recipients of the parents' assets. For this reason, factors such as the number of male (female) children of the parent's family in patrilineal (matrilineal) inheritance systems may influence the current asset position of the households in our sample.

Quisumbing explains various channels through which intergenerational transfers take place. These channels include family decision to invest in their children's human capital (schooling, child health, and nutrition); decisions regarding transfers of assets that enable young families to form a new productive unit as children get married; and finally decision regarding the transfer of remaining assets to children as parents' age and eventually die. Particular categories of people are excluded from opportunities to accumulate wealth through inheritance, most notably women and children, because in many African setting women and children do not have secure property rights (Cooper 2008). Male siblings are often favored in some communities while females have a lesser claim on parental resources, including education in certain cases (Garg and Morduch 1998; and Morduch 2000).

The availability of resources and inter-household competition has been theorized to significantly influence asset inheritance. Large family sizes represent severe competition for family resources especially with regard to investment in human capital (education and health) and transfer of physical assets. However, even though access to education is a function of

household resources, Quisumbing (2007), assert that it is to a great degree a function of individual child's ability to do well academically. A child's birth order also comes into play. First-borns may have an advantage compared to other children in terms of schooling. Later-born children tend to face greater competition for parental resources. However, when the parents age or die, the first-borns tend to take up the responsibility of providing for their younger siblings, including paying for their education, which may affect negatively their ability to accumulate assets for their own families later.

5. ESTIMATION STRATEGY AND EMPIRICAL MODEL

To evaluate the determinants of household asset (y_{it}) holding dynamics we use panel data to estimate an unobserved effects model that takes the form:

$$y_{it} = \alpha_i + X_{it}\beta + \mu_{it} \quad (1)$$

where X_{it} is a vector of time-varying and time-constant explanatory variables; α_i represents the unobserved, time-constant heterogeneity that affect y_{it} ; and μ_{it} is the error term. If the model outlined in equation 1 represents the true data generating mechanism, then the existence of correlation between independent variables and unobserved heterogeneity, if uncontrolled for, would result in inconsistent estimates in applied research. With panel data, there are two popular methods for estimating this model, fixed and random effects, each with their own benefits and costs. The main drawback of the random effects estimator is that it relies on the fairly strong, and in our case infeasible, assumption that the unobserved heterogeneity is uncorrelated with any of the observed independent variables. The fixed effects estimator relaxes this assumption, but at the cost of not being able to include any time constant covariates, such as the initial condition variables obtained in our follow-up interviews.

To overcome these shortcomings of both fixed and random effects estimators, Mundlak (1978) and Chamberlain (1984) propose a framework known as the *correlated random effects estimator* (CRE) or the Mundlak-Chamberlain device. In this approach, rather than assuming the unobserved and observed explanatory variables are uncorrelated, α_i is modeled and the correlation is assumed to take the form:

$$\alpha_i = \delta + \bar{X}_i + \zeta_i, \quad \zeta_i | X_i \sim N(0, \sigma_\zeta^2) \quad (2)$$

where \bar{X}_i represents the time-averaged value of X_{it} over the various panel periods. The main benefits of the CRE estimator are that (1) it controls for unobserved time-constant heterogeneity, and (2) because the assumption on the correlation between the covariates and unobserved heterogeneity is modeled, the random effects estimator is applied, which allows also the measurement of the effects of time-invariant independent variables.

In this paper, we therefore use the CRE estimator to model the correlates of household asset holding. The dependent variable y_{it} is the log physical asset value (in KSh) in each panel survey wave calculated as described in Section 3. While some explanatory variables may affect asset stocks contemporaneously, most of the variables are expected to influence asset stocks after a lag. For example, distances to infrastructure facilities and shock variables such as adult mortality are assumed to impact on the households' asset stocks after a lag. Thus, the time varying explanatory variables are all lagged by one panel period.

The explanatory variables include the following:

a. *Demographic Variables*: Household demographics include a set dummies variables capturing the gender of household headship (1: male headed; 0: female); the household head's age (in years) and household size; household members' educational status (no education, some primary and primary, some secondary and secondary, and post secondary education). For all these variables, we also include their respective averages over the various survey waves. A time-constant variable capturing the number of spouses of the initial household head is included.

b. *Household History and Inheritance*: To account for human resource inheritance from the previous generation, a set of dummy variables representing different levels of education attainment by the households' heads are included. A set of dummies to capture the birth order of the initial household head are also included. For initial male heads, we include number of his father's spouses and brothers, the value (in KSh) of inheritance received from parents before the start of and during the panel, and the main occupation of the initial household head father. As a proxy to the households' level of social capital, the number of years in the current settlement is included.

c. *Shocks*: We include variables to capture number of household members who died and who were chronically ill before the start of the panel (1997) and during the panel period. The value of aggregate loss (KSh) as result of other shocks such as fire accidents, loss of property due to theft, court cases, extortion/conning, floods, drought, famine and witchcraft before and during the panel is as also included.

d. *Distance to Infrastructure*: Distance to the nearest water source, electricity supply and motorable road is included as proxies to capture the level of infrastructural development.

e. *Spatial and Time Variables*: To account for geographical locations of the households, a set of dummy variable representing different agro ecological zones are included.

6. FINDINGS

6.1. Descriptive Results

This initial section discusses bivariate relationships as a prelude to the econometric findings. Table 7 indicates a clear relationship between asset wealth and gender of the household head. The majority (over 90%) of non-poor households were consistently headed by males over the panel period. Among the ascending group, the proportion with male heads rose from 83% in 1997 to 93% in 2007. For various reasons, there seems to be an advantage for households with male heads. Among the descending group, the proportion of households headed by males plummeted from 88% in 1997 to 56% in 2007. As shown earlier in Table 4b, a switch in household headship from male to female (often associated with mortality or divorce) is associated with a decrease in assets and thus may potentially trigger households' descent into poverty. The descending group also had fewer initial members in 1997 compared to the ascenders and non-poor households.

Surprisingly, the ascenders had higher dependency ratio compared to the descenders (Table 7). Dependency ratio is measured as the number of individuals aged below 15 or above 64 divided by the total number of individuals in the household. The non-poor group however maintained low dependency ratio through the panel survey years. Generally, the dependency ratio seems to be descending across all the groups over the panel period partly due to the aging of the panel sample. Households whose heads in the initial survey year were polygamous were more likely to have higher dependence rates than other households.

Non-poor households maintained a high proportion of members with post-secondary education (15%) and a low proportion of members with no formal education (9%) over the panel period (Table 7). In this group, the proportion of members without formal education dropped from nine percent in 1997 to about one percent in 2007 while the proportion of individuals with post-secondary education increased from 7% in 1997 to 22% in 2007. The proportion of members with post-secondary education remained low throughout the panel period for both ascenders and descenders. Other studies indicate that the success of education in reducing poverty hinges on participants excelling beyond secondary schools and acquiring skills that are in demand on the job market (Muyanga, Ayieko, and Bundi 2007).

Characteristics pertaining to the initial household head and his family's characteristics are presented in Table 8. While most of the initial household heads had only completed primary education, some heads in the non-poor (17%) and ascenders (7%) groups had attained post-secondary education (Table 8). The descending group had the highest proportion of heads (16%) without formal education and none of the heads in this group had attained post-secondary education. In most cases, the educational attainment of the household head is not only determined by the motivation of the individual but is also largely based on the commitment of the head's parents to finance school fees over a sustained period. The impacts of education on current household assets hence largely reflect long-standing investments by the previous generation.

The male household head in the descending group had two wives on average in 1997 compared to the male heads in the ascending and non-poor categories who had one wife (Table 8). By contrast, the fathers of the household heads in the current sample had two wives on average in all groups. This finding could be interpreted as follows: having many dependents to support and more complex inter-household issues to manage may adversely affect the accumulation of wealth, whereas such conditions in the prior generation do not affect wealth dynamics in the current generation. Contrary to our expectation, the number of

male siblings of the initial household head is not correlated with changes in household asset wealth. However, a substantial proportion of the descending households seem to have been headed by first borns (Table 8).

Table 7. Evolution of Household Demographic Variables over the Panel Period

	Descenders [25]	Ascenders [30]	Non-poor [23]
Age of the household head (years)	56.90	52.85	55.40
_age in 1997	52.48	46.77	50.78
_age in 2000	56.44	51.10	52.78
_age in 2004	58.48	54.93	57.39
_age in 2007	60.20	58.60	60.65
Household size	6.56	7.86	7.09
_household size in 1997	6.96	7.33	7.39
_household size in 2000	7.76	8.67	8.65
_household size in 2004	6.24	7.97	6.65
_household size in 2007	5.28	7.47	5.65
Dependency ratio	0.40	0.47	0.31
_dependency ratio in 1997	0.46	0.56	0.41
_dependency ratio in 2000	0.39	0.46	0.30
_dependency ratio in 2004	0.44	0.44	0.27
_dependency ratio in 2007	0.32	0.44	0.27
Male headed households (proportion)	0.74	0.92	0.92
_gender in 1997	0.88	0.83	0.91
_gender in 2000	0.88	0.97	0.96
_gender in 2004	0.64	0.93	0.91
_gender in 2007	0.56	0.93	0.91
Members with no education (proportion)	0.17	0.15	0.09
_proportion in 1997	0.22	0.19	0.10
_proportion in 2000	0.17	0.20	0.13
_proportion in 2004	0.26	0.19	0.13
_proportion in 2007	0.04	0.03	0.01
Members with primary education (proportion)	0.59	0.62	0.43
_proportion in 1997	0.63	0.59	0.54
_proportion in 2000	0.61	0.59	0.43
_proportion in 2004	0.56	0.61	0.37
_proportion in 2007	0.54	0.67	0.39
Members with secondary education (proportion)	0.19	0.16	0.29
_proportion in 1997	0.13	0.19	0.29
_proportion in 2000	0.21	0.20	0.32
_proportion in 2004	0.16	0.12	0.29
_proportion in 2007	0.24	0.14	0.27
Members with post secondary education (proportion)	0.03	0.04	0.15
_proportion in 1997	0.02	0.02	0.07
_proportion in 2000	0.01	0.01	0.12
_proportion in 2004	0.02	0.08	0.20
_proportion in 2007	0.05	0.05	0.22

Data Source: Tegemeo Survey Data 1997, 2000, 2004, 2007.

Table 8. Characteristics Pertaining to the Initial Household Head

	Descenders [25]	Ascenders [30]	Non-poor [23]
Number of wives of initial household head	1.64	1.37	1.13
Number of wives of the father of the initial hh head	1.52	2.17	1.57
Father of initial head had some formal education (%)	16	30	26
Number of brothers from same mother	3.96	4.27	3.74
Number of brothers in extended family	7.68	8.70	7.30
<i>Order at birth among brothers (%)</i>			
_first born	52	43	30
_second born	20	27	30
_third born	16	10	22
_other	12	20	17
<i>Order at birth among other siblings (%)</i>			
_first born	28	17	22
_second born	16	30	13
_third born	32	20	22
_other	24	33	43
Father's land holding size (acres)	23.01	39.78	23.66
_father's land (acres /wife)	15.47	20.51	18.66
_father's land (acres/both)	6.23	15.72	6.70
_father's land (acres/both) (extended family)	3.19	4.44	3.79
Land inherited from parents (acres)	3.01	3.83	4.92
Education attainment of 1997 initial hh head (%)			
_no formal education	16	3	4
_primary or some primary education	48	67	43
_secondary or some secondary education	36	23	35
_post secondary education	0	7	17
Estimated value of inheritance ('000 KSh)	581.18	626.39	1,188.86
_as proportion of assets value	14.30	12.82	7.15
_as proportion of income	7.04	5.74	4.81

Data Source: Retrospective Survey 2008.

Findings in Table 8 also indicate that the landholding sizes of the household heads' fathers were substantially smaller among the descending group than among the ascenders. This result holds no matter whether the fathers' landholding size is defined per wife of the household head's father, per brother or per extended family male siblings of the initial household head. The relevance of examining land per brother is that in patrilineal inheritance systems, the amount of land a person receives, and can potentially pass on to his sons (which include the current heads of households in this sample), is a function of the number of the person's brothers. On average the fathers of the household heads in the 1997 survey had about 40 acres in the ascenders' group, 23 acres among the descenders; and 24 acres in the non-poor group. When we consider land inherited from the previous generation, the descenders inherited the least (Table 8). The non-poor group inherited on average 4.92 acres from the previous generation, the ascenders 3.83 acres, which is 27% more land than the 3.01 acres inherited on average by the descenders. During the retrospective life history survey, an effort was made to list and value households' inheritance of assets from the previous generation (Table 8). In absolute terms, the non-poor households inherited much more than either the ascenders or descenders, but the descenders inherited the least.

Moreover, despite starting out with virtually twice as much through inheritance as the other two other two groups, the non-poor households' value of asset inheritance was lowest as a proportion of 2007 asset wealth and income, indicating that household's that started their early stages with relatively high asset levels were much more able to develop a solid future wealth accumulation trajectory. These findings point strongly to the importance of inter-generational transfers in influencing poverty and livelihood outcomes in the current generation of smallholder farmers.

Table 9 presents findings on shocks experienced by the households ten years before the panel period started in 1997. Information on these prior shocks was collected in the retrospective life history interviews in order to measure the potential effects of temporally remote occurrences on the subsequent trajectory of household wealth accumulation. The descenders appear to have suffered more from prior shocks related to death, chronic illness and other shocks. These households lost 16% of their members due to death compared to 10% among the ascenders over the 10-year period prior to the panel period. The non-poor sample experienced no mortalities during this period. Similarly, 24% of the members in the descending families experienced chronic illnesses between 1987-97 compared to only 7 and 9% in the ascender and non-poor groups. Chronic illnesses include sicknesses such as cancer, tuberculosis, and HIV/AIDS. The descenders also had a particularly high proportion of household heads suffering from chronic illnesses. Household heads are in most cases the breadwinners and are in a better position to protect household assets from encroachment by others. Chronic illness not only results in increased medical bills but also reduced incomes that could affect household asset holding. About 16% of household heads in the descending group experienced chronic illness in the 1987-97 period, compared to 9% of the heads in the non-poor group, while none of the heads of ascender households suffered from chronic illness from 1987-97. When we consider the estimated expenditure of chronic illnesses, the descending families on average spent KSh 20,930 while the non-poor and the ascender families spent KSh 2,830 and KSh 14,780 respectively in the ten-year period before 1997. These findings suggest a major correlation between household members' ability to stay healthy and their subsequent ability to accumulate assets over time and rise out of poverty. This relationship is examined in more detail in the multivariate analysis that follows.

Perhaps surprisingly, prior losses from other shocks such as floods, fire, accidents, and theft tended to affect the non-poor and the ascenders more than the descenders families. This may be because random shocks that affect all households equally would have the greatest

Table 9. Shocks Experienced In the Last 10 Years before the Panel Period

	Descenders [25]	Ascenders [30]	Non-poor [23]
Members died (% within the household)	16	10	00
Members chronically illness (% within the household)	24	07	09
Head chronically ill (% within the group)	16	00	09
Expenditure on chronic illness ('000 KSh)	20.93	2.83	14.78
_as a proportion of assets value	0.47	0.06	0.11
_as proportion of income	0.22	0.02	0.05
Estimated loss from other shocks ('000 KSh)	4.40	17.00	18.50
_as a proportion of assets value	0.10	0.43	0.14
_as a proportion of income	0.03	0.20	0.08

Data Source: Retrospective Survey 2008.

monetary impact on households that are relatively well off to begin with. However, this finding could also occur if some of the shocks, such as theft, are non-random and more likely to afflict better-off households.

Next, we turn to shocks experienced during the 1997-2007 panel period (Table 10). The descenders once again experienced more household heads' deaths (28%) while the ascenders experienced only a few deaths (3%) over the panel period. The fact that the descenders incurred the greatest proportion of deaths both prior to the 1997-2007 period as well as during it is consistent with the premise that communicable diseases are at play: infection of one adult leads to subsequent illness and/or death among other adults. The descenders suffered considerably from household heads' deaths throughout the panel period (12% between 1997 and 2000; 12% between 2001 and 2004; and 4% between 2005 and 2007). By contrast, only 3% of household heads died over the entire 10-year period within the ascenders category. These findings illustrate the relationship between household asset accumulation and current and prior health status.

The descenders also suffered more from chronic illness than the ascenders. On average, the descenders had about 15% of their members chronically ill while the winners had 13%. The non-poor had 16% of their members chronically ill. However, when we look at the estimated expenditure on chronic illness over the panel period the non-poor category appears to have spent double the amount spent by the losers and winners. This may represent the tendency for wealthier households to afford to spend more on treatment. Caregiving may also be taken on disproportionately by relatively well-off families that are better able to handle such adversities. Therefore, although chronic illness is more likely to afflict the descenders, it is the ascenders and non-poor who spend more on health care.

Table 10. Shocks Experienced by the Households during the Panel Period

	Descenders [25]	Ascenders [30]	Non-poor [23]
Deaths of household head over the panel period (% within the group)	28	3	22
_between 1997-2000	12	0	9
_between 2001-2004	12	0	0
_between 2005-2007	4	3	13
Household members died (% within the household)	16	10	20
_between 1997-2000	16	03	22
_between 2001-2004	16	07	09
_between 2005-2007	16	10	20
Members chronically ill (% within the household)	15	13	16
_between 1997-2000	04	07	26
_between 2001-2004	12	03	04
_between 2005-2007	28	30	17
Estimated expenditure on chronic illness ('000KSh.)	11.16	11.03	23.56
_between 1997-2000	1.2	1.13	17.43
_between 2001-2004	2.12	0.33	1.52
_between 2005-2007	7.84	9.57	4.61
Estimated loss resulting from other shocks ('000KSh.)	15.24	61.73	51.32
_between 1997-2000	7.08	17.43	21.30
_between 2001-2004	0	3.80	18.72
_between 2005-2007	8.16	40.5	11.30

Data Source: Retrospective Survey 2008.

Table 11. Evolution of Distances to Input Markets and Infrastructural Facilities over the Panel Period

	Descenders [25]		Ascenders [30]		Non-poor [23]	
	<i>Mean</i>	<i>SE</i>	<i>Mean</i>	<i>SE</i>	<i>Mean</i>	<i>SE</i>
Distance to nearest fertilizer seller (km)	3.32	0.74	4.08	0.75	4.06	1.00
_distance in 1997	4.81	1.12	5.24	1.21	6.11	1.52
_distance in 2000	3.72	1.07	4.65	0.74	4.17	0.96
_distance in 2004	2.44	0.39	3.49	0.70	2.45	0.54
_distance in 2007	2.32	0.38	2.93	0.35	3.52	0.98
Distance to motorable road (km)	1.02	0.35	1.04	0.38	0.68	0.28
_distance in 1997	1.30	0.58	1.47	0.67	0.44	0.20
_distance in 2000	1.37	0.47	1.19	0.40	1.14	0.43
_distance in 2004	1.12	0.26	0.73	0.19	0.58	0.14
_distance in 2007	0.28	0.08	0.77	0.24	0.55	0.34
Distance to tarmac road (km)	5.84	0.88	4.66	0.94	4.97	0.93
_distance in 1997	5.79	0.88	5.65	1.25	4.41	0.85
_distance in 2000	5.77	0.80	4.11	0.74	4.92	0.85
_distance in 2004	6.36	0.95	4.20	0.93	5.20	1.05
_distance in 2007	5.43	0.87	4.66	0.83	5.35	0.95
Distance to piped water (km)	3.86	1.17	2.75	0.75	2.71	1.12
_distance in 1997	6.07	1.53	3.92	1.21	4.56	1.77
_distance in 2000	3.03	1.13	2.26	0.52	1.45	0.60
_distance in 2004	4.58	1.37	2.39	0.71	2.90	1.31
_distance in 2007	1.77	0.65	2.42	0.56	1.93	0.80
Distance to a health centre (km)	2.89	0.45	3.71	0.75	2.94	0.49
_distance in 1997	3.41	0.41	6.66	1.96	3.48	0.60
_distance in 2000	2.67	0.46	2.75	0.37	3.61	0.64
_distance in 2004	2.27	0.36	2.69	0.31	2.09	0.28
_distance in 2007	3.19	0.57	2.73	0.34	2.59	0.44
Distance to utilizable electricity (km)	3.03	0.71	2.81	0.53	1.72	0.41
_distance in 1997	5.55	1.51	4.12	0.92	1.77	0.29
_distance in 2000	3.03	0.62	2.87	0.53	1.98	0.53
_distance in 2004	1.62	0.27	2.02	0.27	1.77	0.44
_distance in 2007	1.92	0.45	2.22	0.38	1.35	0.39
Distance to public telephone (km)	2.91	0.46	2.99	0.39	2.70	0.52
_distance in 1997	3.86	0.59	3.87	0.54	2.92	0.60
_distance in 2000	3.00	0.44	3.05	0.39	2.59	0.56
_distance in 2004	2.50	0.43	2.43	0.27	2.61	0.44
_distance in 2007	2.26	0.37	2.62	0.34	2.67	0.48
Distance to extension advice (km)	4.36	0.72	5.27	0.86	4.65	0.78
_distance in 1997	4.52	0.63	5.49	0.62	4.87	0.66
_distance in 2000	4.92	0.73	6.05	1.04	5.75	1.15
_distance in 2004	3.86	0.80	4.02	0.71	4.18	0.72
_distance in 2007	4.14	0.72	5.52	1.08	3.79	0.60

Data Source: Tegemeo Survey Data 1997, 2000, 2004, 2007.

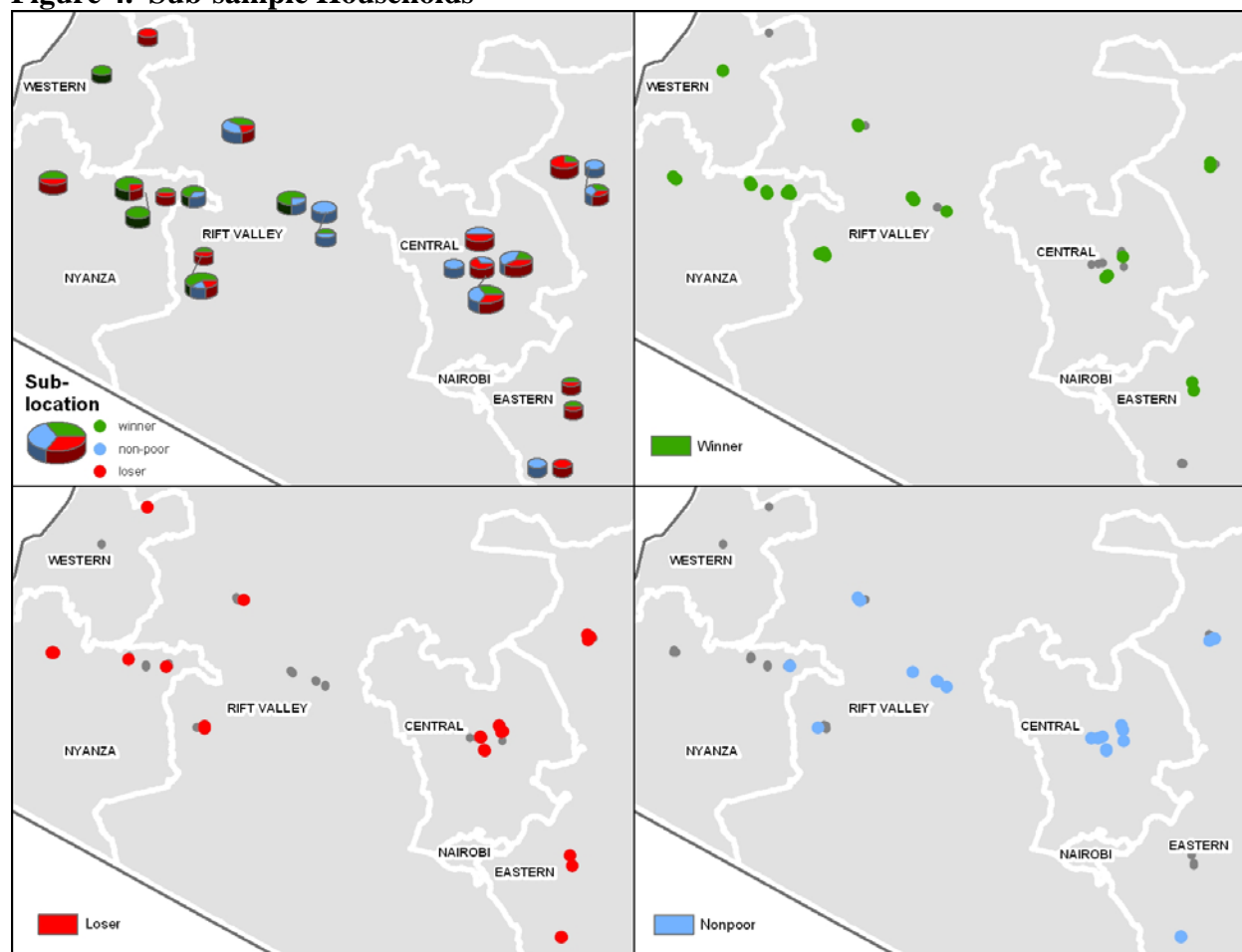
Distances to services and infrastructural facilities are shown in Table 11. There has been a slight decrease in distance to fertilizer retailers, electricity, motorable roads, and telephone services for all groups over the panel period. Distance to a tarmac road on average has

remained the same for each category over the panel period. In general, the non-poor group has the best access to infrastructure and services while the descenders are somewhat farther away from these basic services. However, the direction of causality between household wealth and access to infrastructure and services cannot be established except through the dynamic multivariate approach in the following section.

Results from the spatial analysis are presented in Figure 4. While poverty incidences vary somewhat across regions, with particular regions exhibiting high poverty incidences, the ascender and descender households tend to be relatively equally scattered across districts and agro-ecological zones. This finding is not consistent with earlier studies that found evidence of high geographic concentration in the location of the households entering into and escaping from poverty (Barrett et al. 2006; Kristjanson et al. 2004).

In the retrospective life history survey, reasons as to why households sold major assets over the panel period were elicited (Table 12). Reasons for asset disposal varied across the three welfare categories with school fees cutting across the categories. The descenders cited pressing social needs such as school fees (44%), medical bills (24%), and need to buy food (16%) as the critical reasons that forced them to sell assets. The ascenders mentioned school fees (30%), culling (13%), food (10%), and buying other assets (10%) as the most important reasons. Even though the non-poor cited school fees (22%) as one of the reason as to why they sell assets, other non-pressing needs such as culling the stock (26%) and disposing off assets no longer needed (13%) were mentioned.

Figure 4. Sub-sample Households



Data source: Tegemeo Survey Data 1997, 2000, 2004, 2007.

Table 12. Source of Finance for Asset Acquisition and Reasons for Asset Disposal

	Descenders [25]		Ascenders [30]		Non-poor [23]		Total
	<i>Count</i>	<i>%</i>	<i>Count</i>	<i>%</i>	<i>Count</i>	<i>%</i>	<i>Count</i>
Source of finance							
_farm output	12	48	15	50	16	70	43
_off-farm earning	3	12	10	33	7	30	20
_savings	2	8	6	20	4	17	12
_proceeds from asset sale	1	4	4	13	1	4	6
_pension/gratuity	1	4	1	3	3	13	5
_other	5	20	6	20	2	9	13
Reasons of asset disposal							
_school fees	11	44	9	30	5	22	25
_culling/destocking	2	8	4	13	6	26	12
_medical bills	6	24	3	10	2	9	11
_buy food	4	16	0	0	0	0	4
_buy other assets	2	8	3	10	0	0	5
_no longer needed	0	0	1	3	3	13	4
_other	2	8	2	7	4	17	8

Data Source: Retrospective Survey 2008.

Finally, we examine trends in agricultural land, input use, and production over time among the three groups (Table 13). Several patterns stand out. First, the ascenders were more likely to accumulate and cultivate land over the 10-year panel period. By contrast, the descenders lost land; the mean land owned among descenders was 3.03 acres in 1997, but this declined to 2.50 acres by 2007. Their area cultivated also declined over this period from 2.44 to 1.92 acres. The consistently non-poor owned and cultivated considerably more land than either the ascenders or descenders. On the surface, these patterns point out the importance of land in contributing to asset wealth, but both land owned and land cultivated appear to be related in numerous cases to the health status of family members and the avoidance of other unanticipated shocks that can force households to sell or loan out land and other assets.

Perhaps surprisingly, the descender households were more likely to use fertilizer, used fertilizer more intensively, and were more likely to receive agricultural credit in all four survey years than the ascenders (Table 13). These findings indicate that increased fertilizer use and access to credit are not necessarily preconditions for farm households to rise out of poverty, nor do relatively high fertilizer use rates ensure that households will not descend into poverty. Furthermore, high fertilizer use rates are only profitable if accompanied by optimal use of the other inputs and adequate rainfall. The relationship between land cultivated and asset wealth appears to be very strong in the case of both ascenders and descenders. Descender households also experienced a significant decline in livestock income over the 10-year panel period. In 1997, mean household livestock income was higher among the descender group than among the non-poor, but by 2007 livestock income among the descenders fell by 78% while staying roughly constant for the consistently non-poor. The decline in livestock assets among the descenders was often accompanied by illness and the need for pay for medicines and caregiving as well as the need for pay for food.

Table 13. Trends in Input Use, Land Owned and Cultivated, and Access to Farm Credit, 1997-2007

	Survey	Fertilizer use (%)	Fertilizer application rate (kg/acre)	Manure use (%)	Acres owned	Acres cultivated	Received credit (%)	Planted one or more cash crops (%)
Descenders	1997	0.69	65.73	0.31	3.03	2.44	0.54	0.31
	2000	0.81	76.83	0.81	3.17	2.67	0.69	0.62
	2004	0.81	69.47	0.81	3.17	2.20	0.50	0.50
	2007	0.88	66.91	0.73	2.50	1.92	0.54	0.54
	average	0.80	69.73	0.66	2.97	2.31	0.57	0.49
Ascenders	1997	0.47	37.06	0.20	2.16	1.84	0.30	0.27
	2000	0.60	39.32	0.53	4.17	3.25	0.37	0.43
	2004	0.70	48.97	0.67	4.17	3.78	0.30	0.47
	2007	0.77	44.81	0.67	5.34	3.11	0.43	0.47
	average	0.63	42.54	0.52	3.98	2.99	0.35	0.41
Non-Poor	1997	0.92	113.26	0.46	3.14	3.41	0.63	0.33
	2000	0.96	97.29	0.79	6.96	6.07	0.58	0.54
	2004	0.96	86.95	0.92	6.96	4.57	0.42	0.54
	2007	0.96	69.19	0.96	10.20	4.42	0.67	0.50
	average	0.95	91.67	0.78	6.81	4.62	0.57	0.48
Overall	1997	0.67	69.24	0.31	2.74	2.51	0.48	0.30
	2000	0.78	68.90	0.70	4.68	3.91	0.54	0.53
	2004	0.81	67.03	0.79	4.68	3.50	0.40	0.50
	2007	0.86	59.30	0.78	5.88	3.12	0.54	0.50
	average	0.78	66.12	0.64	4.50	3.26	0.49	0.46

Data Source: Tegemeo Survey Data 1997, 2000, 2004, 2007.

6.2. Findings from Correlated Random Effects Model

The results from the correlated random effects estimation of the factors determining household asset dynamics are presented in Table 14. Summary statistics of the variables used in the econometric analysis are found in Appendix 1. For each CRE specification, we run three alternate models for the three welfare dynamics groups (ascenders, descenders and non-poor). In all the three models, the time-varying explanatory variables are lagged using the prior survey periods values.

We highlight seven key findings across the models and then discuss them in more detail below: (1) the role of head of household's demographic characteristics in differentially affecting wealth accumulation; (2) distance to infrastructural facilities; (3) the role of unexpected one-off setbacks, in particular the death and sickness of adult members; (4) family history and inter-generational transfers; and (5) social capital and connections. The three models were also re-estimated with lagged household income as explanatory variable (results not reported). Granger-causality tests of household income and assets had showed that current income is a statistically significant predictor of future asset wealth. Feedback effects from asset wealth to future income were also strong. Evaluated at mean real income levels, a 10% increase in current income is estimated to result in a 1.24% increase in the next period's asset wealth.

Table 14. Estimation Results from Correlated Random Effects Model of Determinants of Household Physical Asset between 1997 and 2007 (Dependent Variable Is Log of Real Household Asset Values, Explanatory Variables Are Lagged One Period)

VARIABLES	Descenders		Ascenders		Non-poor	
	Coef.	ρ -score	Coef.	ρ -score	Coef.	ρ -score
Time-varying variables						
<i>Demographic and economic variables</i>						
Gender of hh head (1=male; 0=female)	1.100	0.03	1.249	0.05	-0.377	0.35
Age of the household head in year	0.011	0.24	0.116	0.06	0.129	0.00
Household size	-0.116	0.53	-0.081	0.02	0.019	0.78
<i>Education level of hh head (base=no education)</i>						
Primary	-0.302	0.65	0.284	0.67	0.155	0.67
Secondary	-0.338	0.47	0.391	0.80	0.277	0.63
Post-secondary	-0.963	0.38	1.494	0.40	0.611	0.17
<i>Proportion of household member with (base: no education)</i>						
Primary education	-1.504	0.68	1.003	0.24	-0.709	0.12
Secondary education	2.164	0.12	0.745	0.67	-0.667	0.56
Post-secondary education	4.359	0.17	-0.729	0.83	-0.262	0.51
Household land holding size (acres)	0.003	0.98	-0.023	0.83	0.001	0.99
Distance to markets, infrastructure and services						
Distance to fertilizer seller (Km)	0.017	0.78	0.002	0.94	-0.021	0.46
Distance to motorable road (Km)	-0.053	0.42	-0.171	0.66	0.006	0.92
Distance to water source (Km)	-0.078	0.16	-0.103	0.51	-0.043	0.16
Distance to healthcare services (Km)	-0.262	0.01	-0.024	0.29	-0.029	0.51
Distance to nearest extension service (Km)	-0.065	0.55	-0.012	0.93	-0.005	0.92
Shocks						
Number of deaths	-0.305	0.68	0.259	0.68	0.034	0.91
Number of individual chronically sick	0.571	0.14	-1.263	0.10	-0.142	0.41
Estimated loss as result of other shocks ('000KSh)	-0.006	0.42	0.002	0.26	0.000	0.85
Household time-constant variables						
Number of deaths before 1997	-7.070	0.00	0.415	0.62	-	-
Number of members chronically ill before the 1997	0.955	0.17	-0.672	0.74	3.501	0.14
Estimated loss as result of other shocks before 1997	-0.595	0.00	-0.022	0.00	-0.006	0.53
Number of wives of the initial household head	-2.926	0.00	-0.078	0.72	-6.556	0.00
Demographic/economic characteristics of prior						
Number of brothers of the initial household head	-1.852	0.00	0.075	0.68	-2.204	0.01
Occupation of father of the initial household head	-9.712	0.00	-1.522	0.03	-2.830	0.00
Land inheritance of the initial household head	3.288	0.00	0.211	0.00	0.171	0.00
Order of the head among other male siblings (1=first born; 0=other)	2.136	0.11	-0.274	0.59	-4.874	0.00
Number of years in the current settlement	0.078	0.00	0.001	0.85	0.062	0.00
Constant	43.979	0.00	17.930	0.07	46.897	0.00
Observations	75		90		69	
Number of households	25		30		23	
R^2	0.70		0.52		0.86	

Note: ρ -score is the measure of statistical significance; coefficients at $\rho < 0.10$ or better are highlighted in bold.

6.2.1. The Role of Head of Household's Demographic Characteristics in Differentially Affecting Wealth Accumulation

Male-headed households are more successful at accumulating assets. A change from female to male headship is associated with more than a doubling of the household's asset wealth especially for ascenders and descenders. This finding confirms the earlier bivariate finding that the majority of households descending into poverty over the panel period experienced a change in headship gender from male to female. This finding attests to the often-devastating long-term negative impact of widowhood, separation, or abandonment of females by their spouses on household assets dynamics.

Asset accumulation is an increasing function of the age of the household head. Asset accumulation is positively related to the age of the household head. Among the non-poor and the ascending households, an increase in the age of the household head by one year increases household asset holding by about 12%. The square of the age, which was meant to control for life cycle effects, was not statistically significant and thus was dropped.

Relatively small households are successful in asset accumulation. Asset accumulation is inversely related to household size. An increase in household size by an additional person reduces asset holding by about eight percent for the ascending group. Similarly, the number of wives of the initial household head influenced asset accumulation. Households whose initial head had more than one wife experienced a decline in asset wealth during the panel period. This finding was particularly valid to the non-poor and the descending households. The decision by the initial household head to marry an additional wife reduced household assets by more than 100% over the panel period, possibly due to dowry payments and increased competition on family resources. Results from the descriptive analysis indicated that in situations where the initial household head was polygamous, the household was more likely to have a high dependency ratio.

6.2.2. Reduced Distances to Infrastructural Facilities Increase Households Assets Accumulation

Increased distances to healthcare services is associated with a decline in asset wealth for the descending group. An increase in distance to the nearest healthcare facility by a kilometer reduces household asset holding by 26%. A joint test of significance for all distance to infrastructural facilities emerged statistically significant for the descending group.

6.2.3. Unexpected Health Setbacks Matter

Deaths and chronic illness had significant negative impacts on changes in households' asset wealth. For example, the death of an adult member during the panel period reduced household asset holding seven fold for the descending households. Chronic sickness by a household member reduces household asset holding by more than 100% among the descending households. While deaths adversely affect households' labor force, chronic illnesses drain household assets as well. As shown in Table 12, a sizeable number of the descenders cited asset selling to pay for medicines, medical bills, and caretaking. We are not in a position to evaluate whether these shocks are completely random or whether there are attributes of afflicted household members that are correlated with the occurrence of such shocks. However, prior research has shown that disease-related chronic illness and mortality

are indeed correlated with particular household characteristics (Gillespie 2006; Chapoto and Jayne 2008) such as educational attainment, initial wealth, and mobility. These results emphasize the importance of staying healthy over the long run and avoiding debilitating diseases in reducing rural poverty rates. Similarly, loss from other shocks such as fire accidents, loss of property due to theft, court cases, extortion/conning, floods, drought, famine, and witchcraft in the decade prior to the start of the initial survey in 1997 affected negatively the descending and ascending households' accumulation during the panel period.

6.2.4. Demographic/Economic Characteristics of Prior Generation Influence Asset Accumulation

The number of brothers of the initial household head affected the current household's asset accumulation. Having many brothers represent intense competition for the prior generation's resources. Having an additional brother for the initial household head decreased asset accumulation for the current household by more than 100%. This finding was valid especially for the non-poor and the descending households. The economic position of the father of the current household head also significantly influences the future trajectory of the current household's asset accumulation. If the father of the initial household head derived most of his income from non-farm activities such as business, the household experienced a more than 100% increase in assets over the 10-year panel period compared to other households. While non-farm income is an indication of income diversification and ability to cope with agricultural income risks, non-farm income also is a proxy for social status of the previous household and, thus, may explain other benefits that trickled down to the current households that were not captured by other variables in the survey instrument.

Land inheritance of the initial household head influenced asset accumulation positively. A quick look at the coefficients in the three regressions reveals that land inheritance influenced the descendents to larger extent. This result confirms the descriptive finding that the descending households inherited less land from their parents. Similarly, the rank at birth among the male siblings of the initial household head affected current households' asset accumulation among the non-poor households. Households headed by first borns experienced a decline in asset wealth over the 10 years panel period.

6.2.5. Social Capital and Connections

The length of time the household has stayed in the current location matters. The length of duration in the current settlement is an indicator of social capital acquisition and connections that impact on the ability of a household to accumulate assets. An additional year in the current settlement increases asset accumulation by about six and eight percent for the descending and non-poor households, respectively. Social capital has been shown to be an important factor determining access to land (Jayne et al. 2008) and welfare more generally (Robison, Siles, and Schmid 2002).

7. CONCLUSIONS AND IMPLICATIONS FOR RURAL DEVELOPMENT STRATEGIES

This paper identifies the factors associated with farm households rising out of poverty and descending into poverty in Kenya between 1997 and 2007. The study is motivated by the need for a better micro-level understanding of the factors enabling rural households in Sub-Saharan Africa to escape from poverty and raise their living standards. The study uses households' physical asset holdings as the main measure of welfare, which is considered a more stable and accurately measured indicator of current welfare than income or consumption.

Using a nationwide balanced panel of 1,275 farm households in 22 districts in Kenya interviewed in 1997, 2000, 2004, and 2007, we find that a relatively small fraction of the sample experienced either an appreciable improvement or decline in their asset wealth over the 10-year period. Over 70% of the sampled farm households are in roughly the same wealth position as they were 10 years earlier, although more households experienced an increase in asset wealth than those experiencing a decline. Evidence also points to a decline in poverty rates, which is consistent with Government of Kenya findings of declining national poverty rates over the same general period.

Roughly 11% of the sampled households experienced a substantial improvement in asset wealth between 1997 and 2007. The study results indicate various attributes associated with the three welfare categories.

For the ascending households, the following factors mattered: gender and age of the household head; household size; number of wives of the initial household head; chronic illness during the panel period; loss as a result of other shocks; and prior generation factors such as the main occupation of the father to the initial household head and the amount of land inherited by the household head from parents.

The descenders were associated with the following factors: gender of the household head; number of wives of the initial household head; distance to the nearest health care facility; deaths before 1997; loss as a result of other shocks; prior generation factors such as number of brothers of the initial household head, main occupation of the father to the initial household head, the amount of land inherited by the household head from parents; and the duration in the current settlement.

For the non-poor households the following attributes played a role: age of the household head; number of wives of the initial household head; prior generation factors such as number of brothers of the initial household head, rank at birth of the initial household head, main occupation of the father to the initial household head, land inheritance of the initial head from parents; and the duration in the current settlement.

Households headed by a male adult are considerably more likely to enjoy an upward asset wealth trajectory over time than a household headed by a woman is. Households in this sample in which the head of household switched from a man to a woman usually experienced a subsequent decline in their asset wealth. This appears to be due to a variety of factors, including men's ability to protect the household against encroachment on assets such as land, and men's greater likelihood of being eligible to participate in outgrower schemes and other potentially lucrative activities (see Doss and Morris 2001; Doss 2006). Relatively small households and those that are headed by relatively aged heads seemed to enjoy an upward

wealth trajectory over the panel period. Households whose initial household head had fewer wives also tended to accumulate assets. Similarly, households successfully accumulating assets and rising out of poverty were more likely to have remained healthy and were not adversely affected by mortality. A significant minority of households incurred the death or chronic illness of an adult member, which is associated with a major decline in household animal and asset holdings. Even adult mortality experienced before the start of our panel period in 1997 adversely affects asset wealth in the 1997-2007 period, indicating the persistence of mortality effects.

Households that enjoyed a large land inheritance from the prior generation tended to accumulate assets. Similarly, household history seemed to matter: the duration of time the household has spent in the current settlement influences wealth accumulation. This represents social capital accumulation and connections. The economic status of the father of the initial household head had a positive impact on the current generation's asset accumulation, reflecting the importance of intergenerational wealth transfers.

A major finding of this study is that households' welfare pathways are not only a function of the households' idiosyncratic factors (such as unanticipated chronic illness or death) but that intergenerational factors also play an important role. In one way or another, the previous generation's inability to accumulate assets and transfer them to the next generation to prepare it to effectively meet challenges faced during adulthood contributes to the persistence of poverty. This finding is not surprising, but it does underscore the difficulty of achieving rapid poverty reduction in rural and largely agrarian societies without a sustained source of income and productivity growth for at least several generations. Agriculture remains the most likely engine that could catalyze such long-term growth processes in rural Kenya given the fact that agriculture constitutes the main source of livelihoods for the majority of rural households. It is noteworthy that households falling into poverty experienced a decline in the amount of land they owned and cultivated over the 10-year panel period, while household rising out of poverty more than doubled their landholding size, and cultivated 70% more land in 2007 than in 1997. In addition, the consistently non-poor owned and farmed more land in every survey year than either the ascenders or descenders. Perhaps surprisingly, descender households were more likely to use fertilizer, used fertilizer more intensively, and were more likely to receive agricultural credit in all four survey years than the ascenders.

These findings indicate that increased fertilizer use and access to credit will not ensure that farm households are able to rise out of poverty. The productive use of these inputs will of course support income growth and poverty reduction, but if households cannot productively use these inputs, the reverse may be true. Other research evidence indicates that smallholders' ability to productively utilize modern agricultural inputs are related to public investments in improved crop science, viable extension systems to transfer agronomic and management knowledge to farmers, and investments in physical infrastructure to raise the returns to using purchased inputs (Mellor 1976; Byerlee and Eicher 1997; Alston et al. 2000; Evenson 2001). Combined with the findings highlighted earlier regarding the importance of individuals' health status in future asset growth, the findings of the study broadly support the perspective that an effective rural productivity and poverty reduction strategy will feature a synergistic range of public investments in health, education, and agriculture that work together to stimulate transformative economic growth processes.

APPENDIX

Appendix Table A1. Variables Used in the Econometric Analysis

Variable	Mean	Value at Percentile in Distribution				
		10 th	25 th	50 th	75 th	90 th
Time varying- over the panel (97, 00, 04)						
Household size (number)	7.54	4.00	6.00	7.00	9.00	11.00
Gender of head (1=male; 0=female)	0.88	0.00	1.00	1.00	1.00	1.00
Household head education						
No formal education (1=yes; 0=no)	0.12	0.00	0.00	0.00	0.00	1.00
Some primary/primary (1=yes; 0=no)	0.52	0.00	0.00	1.00	1.00	1.00
Some secondary/secondary (1=yes; 0=no)	0.26	0.00	0.00	0.00	1.00	1.00
Post secondary (1=yes; 0=no)	0.10	0.00	0.00	0.00	0.00	1.00
Household members' education- proportion with:						
No formal education	0.18	0	0	0.16	0.29	0.40
Some primary/primary	0.55	0.25	0.4	0.57	0.71	0.83
Some secondary/secondary	0.21	0	0	0.20	0.33	0.50
Post secondary	0.06	0	0	0.00	0.08	0.20
Distance to infrastructure (Km)						
Motorable road	1.04	0	0.07	0.40	1.00	2.50
Water	3.08	0	0	0.550	3.500	9.000
Electricity	2.74	0.10	0.50	2.00	3.00	5.00
Land size (acre)	3.67	0.62	1.50	3.00	4.70	8.00
Time constant						
Number of years in the current settlement	84.97	35	53	109	109	109
Number of wives of initial household head	1.38	1	1	1	1	2
Initial head was a first born (1=yes; 0=no)	0.42	0	0	0	1	1
Estimated value of inheritance before the panel ('000KSh)	778	0	160	400	1200	2028
Estimated value of inheritance over the panel ('000KSh)	120	0	0	0	0	250
Shocks						
Number of deaths before the panel (per household)	0.09	0	0	0	0	0
Number of chronically sick before the panel (per household)	0.13	0	0	0	0	1
Estimated loss from other shocks before the panel ('000KSh)	19.86	0	0	0	15	68
Number of deaths over the panel (per household)	0.15	0	0	0	0	1
Number of chronically sick over the panel (per household)	0.14	0	0	0	0	1
Estimated loss from other shocks over the panel ('000KSh)	12.66	0	0	0	0	25
Previous generation						
Number of wives of initial household head's father	1.78	1	1	1	2	3
Main source of income of initial household head's father						
Farming	0.74	0	0	1	1	1
Business	0.12	0	0	0	0	1
Formal/salaried employment	0.14	0	0	0	0	1
Initial household head's father land size (acres/initial head male siblings)	10.02	1.25	2.40	5.10	8.33	17.00

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