Regression-Based Simulation of Anti-Poverty Policies for Uganda

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Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Providence, Rhode Island, July 24-27, 2005

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Introduction

Poverty has increased in Subsaharan Africa over the past two decades both in absolute terms and as a share of the world's total poor. The number of persons estimated to be living on one dollar a day or less in Subsaharan Africa increased from 164 million in 1981 to 314 million in 2001 (World Bank, 2004). Over the same period, poverty in Subsaharan Africa as a share of world poverty rose from 11.3 percent to 28.5 percent. By 2015, one in every two poor persons in the world will live in Subsaharan Africa, compared to one in five in 1990 and one in ten in 1980.[1]

To measure poverty rates, African governments and multilateral aid organizations have devoted much effort and expense to the implementation of periodic household surveys. Poverty estimates derived from household surveys are used as performance criteria by the World Bank in aid negotiations with Heavily Indebted Poor Countries (HIPC).[2] Beyond the measurement of poverty rates, the household survey data now available in many Sub-saharan African countries represents a rich source of data for analysis of the poverty impacts of domestic policies. In this paper, we utilize a regression model and data from the 2002/2003 household survey in Uganda to analyze the poverty alleviation potential of anti-poverty strategies.

Poverty-Focused Planning in Uganda

The objective of the Poverty Eradication Action Plan (PEAP) formulated by the Government of Uganda (GOU) is to reduce poverty to 10 percent by 2017. According to the Uganda Ministry of Finance, Planning, and Economic Development (2004), the purpose of the PEAP is to provide an "overarching strategic framework and to guide public action to

reduce poverty." In particular, the plan is intended to provide guidance to Parliament, line ministries, and foreign donors. The PEAP was developed by the Ministry of Finance, working with officials from various government ministries, civil society, and foreign aid donors. A variety of methods, many of them based on expert judgment elicited through consultative processes, were used to develop the PEAP strategies.

According to the 2003 annual report of the PEAP, Uganda has fallen short of its poverty reduction goals (International Monetary Fund, 2003). The report focuses on the continuing poverty gap between rural and urban areas and between the war-torn Northern region and the rest of the country. The report calls for more *ex ante* analysis of the poverty-alleviation effects of alternative growth strategies and for greater *ex post* use of quantitative indicators of inputs and outcomes.

To meet the need for more *ex ante* evaluation of alternative poverty alleviation strategies in Uganda, we developed a regression model of household income and poverty and used the parameter estimates to simulate the impacts of various strategies on the national poverty rate. This modeling framework is intended to provide analytical insights to supplement the information gathered during the consultative planning process of the PEAP.

Household Survey and Estimation of Poverty Line

The Uganda National Household Survey (UNHS) is conducted every two years by the Uganda Bureau of Statistics (UBOS) and is used by the Ministry of Finance, Economic Development, and Planning to estimate the official poverty rate. Poverty rate estimates at national and regional levels since 1992 are shown in Table 1. Based on the 2002/2003 UNHS data, the estimated national poverty rate is 37.7 percent. This represents a four percent increase in poverty compared to the previous survey (1999/2003), raising concerns in Uganda about the adequacy of existing antipoverty strategies.

The 2002/2003 UNHS survey covered all of Uganda except for a small area representing less than two percent of national population.[3] The household survey has four modules: socioeconomic, labor force, informal sector, and community. The informal sector module provides information on household and non-household enterprises in rural areas and household enterprises in urban areas.[4] Informal sector activities included in the survey are (1) livestock, poultry, bee-keeping, and fishing; (2) forestry; mining, quarrying, and manufacturing; (3) hotels, lodges, and eating places; and (4) trade and services. The survey was conducted over the period May 2002 to April 2003.

A two-stage sampling design comprising Enumeration Areas (EAs) and households was used by UBOS (2003). At the first stage, 972 EAs (565 rural, 407 urban) were identified. Population estimates for EAs were developed from the 2002 Population and Housing Census. In most instances, EAs are identical to the Local Council 1 (LC1) level of government. At the second stage, 10 sample households were drawn from a listing of households in each EA. Each of the 56 districts in the country is treated as a stratum and divided into three sub-strata: rural, district town, and other urban areas. Some sub-populations, such as urban residents and the unemployed, were over-sampled to ensure that selected activities and issues were covered.

In addition to the household survey, a community-level survey was conducted in each enumeration area (Local Council 1). Respondents were local officials. The primary focus of the community survey was public and private services and community projects.

Some of the original 9711 household observations in the UNHS 2002/2003 data were incomplete. After dropping incomplete observations and outliers, we were left with 9096 observations for use in the analysis. Descriptive statistics from the survey are presented in Table 2. Means in the table are weighted to reflect the population of Uganda rather than the survey sample. For binary variables (0,1), the mean indicates the population proportion. For

example, the mean of "sex of household head" (0 = male, 1 = female) is 0.25, implying that 25 percent of households are headed by females.

The poverty line used in calculating the official poverty rate in Uganda is based on the shilling value of a basket of food that meets a caloric standard.[5] Many bundles with differing compositions would provide the caloric minimum. The particular bundle used by UBOS in the poverty rate calculation is the average bundle consumed by the poorest 50 percent of Ugandans. The market value of this food basket is calculated using region-specific prices. Non-food expenditures are added to the poverty-line consumption bundle based on estimates derived from the non-food consumption of households at the poverty line (Ravallion and Bidani, 1994).

Conceptual Framework

Our objective is to explain the cross-sectional variation in total consumption and poverty across households. We define poverty as the inability of a household to achieve a given level of consumption, including the consumption of purchased items, home-produced (subsistence) items, and items received as gifts. According to microeconomic theory, total consumption (income) is a function of factor endowments, factor productivity, and prices. Relevant endowments include human capital, physical capital, social capital, and land. Public capital (schools, healthcare facilities, roads) also affects total consumption and can be viewed either as a distinct factor of production or as a contextual force that affects the productivity of private endowments. For this study, we group consumption-relevant endowments into three categories: household characteristics (h), village characteristics (v), and regional characteristics (r). Current household consumption per adult equivalent (c) then is viewed as a function of these three sets of characteristics:

$$c = f(h,v,r)$$

Guided broadly by microeconomic theory, we selected explanatory variables deemed exogeneous to current consumption. The following household characteristics were selected: age of household head, educational attainment of household head, household size by age cohort, economic sectors in which household members are active, employment type (formal or informal), relative importance of agriculture as a source of household income, and presence or absence of a household non-crop enterprise.

Household returns to land, human capital, and physical capital are affected by the proximate economic and social environment. This environment was viewed as consisting of the local community (Local Council 1) and the region of the country where the household is located. Local services and community projects may affect the productivity and, ultimately, the consumption of the household. Some local services are produced by local governments and have a public-goods nature, though they may not be pure public goods, while other services (such as telephone) are provided by private vendors. The community characteristics we selected are village electrification, distance to health facilities and schools, proximity to input vendors, existence of a road, existence of telephone facilities, and availability of credit without collateral.

Regional characteristics that span many communities may also affect consumption. Potentially important regional characteristics that may affect household consumption include climate, topography, existence and density of transportation and communications networks, and population density. In practice, we were unable to obtain reliable data for most regional characteristics and therefore account for regional differences using a simple set of dummy variables.

Empirical Model

The following linear regression model of consumption was estimated:

$$c_i = \alpha + \gamma' \mathbf{x}_i + \theta' \mathbf{z}_i + \mu_i$$

where, for the ith household, c_i is consumption per adult equivalent, $\mathbf{x}_i$ is a vector of household characteristics, $\mathbf{z}_i$ is a vector of community characteristics, and μ_i is a normally distributed random error term with mean of zero. The model is in the spirit of the static poverty profile models described in Ravallion (1998) and is similar to total consumption regressions estimated in numerous previous studies (for example, see Mukherjee and Benson, 2003).[6]

The dependent variable (c_i) was constructed using procedures similar to those employed by UBOS for calculation of the official consumption-based poverty rate (Appleton, 1999, 2001). The UNHS survey provides information on 145 household consumption items, summarized in Table 3. Major consumption categories are food and related items, non-durable goods and frequently-consumed services, and semi-durable and durable goods and services. Food consumption includes purchased items consumed at home, purchased items consumed away from home, home-produced items that are consumed within the household, and items received as gifts. Items in the latter two categories are valued at market prices. Food expenditures, except for bottled beverages, and imputed values of subsistence consumption were adjusted for regional price differences, using price indices calculated by UBOS. Non-consumption expenditures, such as taxes, pensions, remittances, gifts, and funeral expenses, are excluded. Daily consumption values were summed across all consumption categories for each household and then divided by the number of adult equivalents in the household. No temporal price adjustments were made in the data since the national rate of inflation was very low (3.5 percent per annum) during the survey period, and the analysis does not involve comparisons over time.

Six models were estimated: one for the nation, four for rural regions (Central, East, North, West), and one for all urban areas combined. All models have the same variables with the exception of the urban model where the agricultural variables were dropped. The model

was estimated using weighted least squares with robust variance (White, 1980). Population weights indicating the number of households in the full population represented by each household in the sample are used. The population weights improve the efficiency of the point estimates ($\hat{\beta}$). The use of a robust variance procedure is desirable because the survey sample is intentionally drawn from clusters (enumeration areas), and therefore the standard assumption of independence of observations is violated. If an ordinary variance-covariance matrix were estimated in this case, the standard errors would likely be biased and inappropriate inferences might be drawn.

Econometric Results

The model is estimated in semi-log form. Therefore, the coefficient indicates the percent change in the dependent variable (daily consumption per adult equivalent) as a result of a unit change in the independent variable. The results are presented in Table 4. The R^2 indicator of goodness of fit ranges from 0.46 to 0.28.

Household Characteristics. Age of household head is not statistically significant in the national equation. It is possible that older age is not associated with declining household consumption because as individuals get older they may accumulate productive assets that offset the physical productivity of the individual. In the regional equations, age of head of household is statistically significant only in the West Rural region, where the older the household head, the higher the level of consumption (significance is at five percent level). The age-consumption relationship in the West Rural region is nonlinear, as indicated by the negative and statistically significant coefficient on age squared. However, the coefficient on age squared is extremely small, indicating that the age-consumption relationship is almost linear.

The gender of household head is and negative statistically significant at the one percent level in the national equation. On average, consumption in female-headed

households is 8.7 percent lower than in male-headed households. Gender is statistically significant in two of the five regions, East Rural and North Rural. The largest impact is in the North Rural region, where female-headed households consume16.9 percent less than male-headed households after controlling for other factors.

Household size has a large impact on consumption. Because the productive capacity of household members varies over the life cycle, we disaggregate households into age cohorts. The 18-to-59 age cohort is further broken down into gender categories. In the national equation, coefficients for all cohorts are statistically significant and negative, implying that larger households are poorer on average.[7] Among the age groups, an additional person age nine and younger brings about the greatest marginal reduction in consumption (20.8 percent) because they contribute little or nothing to production. Even in the productive years of 18-59, however, an additional person lowers consumption (14.0 percent for males, 15.0 percent for females), implying great inefficiency in labor usage. A similar relationship between household size and consumption obtains at the regional level where coefficients for the two child categories (age 9 and young, and age 10-17) are negative and statistically significant in all regions. Coefficients on the regional adult categories are all negative, with the exception of the 60-and-older variable in the Central Rural region, though some coefficients are not statistically significant. The "consumption penalty" for large households is greatest in the North Rural and Urban regions, probably due to a civil war that has waged in the north for nearly two decades and to high unemployment levels in urban areas.

Educational attainment of household members has a large impact on household consumption. The number of adults age 25-59 with a primary school certificate has a positive and statistically significant impact on household consumption. Results for the national and four rural equations indicate a 24-25 percent consumption increase if households add one more female adult who completed primary school, while in urban areas, the increase

is 17.1 percent. The consumption gain from primary education is lower for males than for females. Adding one more adult male with primary school education increases consumption by 11.1 percent in the national equation and by 7.9 percent to 17.6 percent in the regional equations. The higher return to primary education for females as compared to males may be due in part to the dampening effect of education of females on fertility rates.

The number of adults who have completed A-level secondary school is statistically significant and positive in the national equation. On average, adding one more female adult with A-level education raises consumption by 20.8 percent while adding one more male adult with this level of education raises consumption by 27.9 percent. In the regional equations, the sign on the number of females holding an A-level certificate is positive and significant in two regions and insignificant in three regions. The consumption boost from secondary schooling of females is higher in urban compared to rural areas with the exception of the North Rural region, where the consumption gain from female schooling is 72.6 percent. This enormous gain from schooling may be due to the interaction of civil war and gender. Because of violence aimed at women and children, it is likely that many women with A-level education have left the region, and those living in the region are likely to be working for international non-governmental organizations (NGOs) at salaries above the national average for A-level graduates. For males, the consumption effect of secondary schooling is positive and significant in all regions.

University education boosts household consumption by more than 50 percent. In the national equation, the marginal effect of another person with a university diploma is a consumption increase of 54.4 percent for females and 56.9 percent for males. No attempt was made to estimate the effect of university education on households in the rural regions because households with degree-holding members are non-existent or extremely small in

number. In urban areas, the consumption effect of university education is 64.7 percent for females and 67.3 percent for males.

Sector of employment affects the level of household consumption. To control for the total number of workers while examining the differential impacts of the sector of employment, we include three variables, representing the number of usually-employed household members working in the primary (agriculture, fisheries, forestry, and mining), secondary (manufacturing), and tertiary (services, commerce, various professions, and government) sectors.[8] The coefficient on primary-sector employment is negative and statistically significant in all equations, national and regional. The interpretation is that the return to primary-sector employment is lower than the return to secondary- and tertiary-sector employment. The coefficient on secondary sector employment is negative and significant in the national, West Rural, and Urban equations. This implies that the return to employment in the secondary sector is lower than the returns averaged across primary and tertiary sectors. Manufacturing in Uganda is rudimentary and production is primarily for the national market, so it is not surprising that wages of secondary-sector workers are relatively low. The coefficient on tertiary-sector employment is positive and statistically significant in all equations except West Rural and Urban, implying that the return to tertiary-sector employment is higher than returns averaged across primary and secondary sectors. The relative impact of tertiary-sector employment depends on location. In urban areas, the impact of tertiary employment is neutral, perhaps because the vast majority of urban tertiary-sector jobs, even those that constitute "usual employment," are relatively menial and have wages below the average local (urban) wage. In contrast, the marginal impact of tertiary-sector employment in three of the four rural regions is positive and significant, perhaps because "usual employment" in the tertiary sector is relatively rare in rural areas, and the few tertiary-sector jobs that constitute "usual employment" in those areas typically involve skilled

occupations (public administration, health, or education) for which earnings exceed the average local (rural) wage.

The number of household members with formal employment is statistically significant and positive. Adding one more household member employed in the formal sector increases household consumption by 13.5 percent in the national equation and up to 22.6 percent in the regional equations. Separating the effects of education from the effects of formal sector employment is difficult because upper secondary or university education is generally a prerequisite for formal employment in Uganda. Therefore, the coefficients on secondary and university education are undoubtedly picking up some of the difference in consumption between households with formally-employed members and those with none.

Dependence of the household on agriculture as the primary source of income is positive and statistically significant in the national equation and two of the regional equations (East Rural and North Rural). At the national level, consumption in households that rely on agriculture as their major income source is 4.1 percent higher than in households who dominant reliance is not on agriculture. Among the regions, the East Rural region registers the highest consumption gain from reliance on agriculture (9.7 percent).

Land area cultivated per capita by the household is statistically significant and positive in the national equation and three of the rural regions (Central, East, and North) . The land constraint is most binding in the East Rural region, where an increase of one acre per member of the household would increase household consumption by 15.8 percent. This corresponds with the general perception in that region that land is scarce. West Rural is the only region where the land variable is not statistically significant, suggesting that the aggregate amount of arable land is not a constraining factor in household consumption there.

The per capita value of livestock is positive and statistically significant in the national equation. On average in Uganda, increasing the value of livestock holdings by one million

shillings (equal to the price of three to five head of local-breed cattle) per member of the household would increase household consumption by 4.7 percent. At the regional level, the livestock variable is positive and statistically significant in two of the rural regions (North and West). In the North, increasing the value of livestock holdings by one million shillings is associated with a consumption increase of 89.3 percent. This large impact may be due to economic anomalies arising from the civil war in that region, reflecting a relationship between livestock holding and consumption unique to that region. The war has made cattle there rare and expensive, and the few households able to retain livestock are likely to have an unusually high level of consumption (and security of personal property) related to administrative or military privilege and not causally related to cattle holdings.

Household-based non-crop enterprise activity is statistically significant and positive in all equations, national and regional. In the national equation, enterprise activity boosts consumption by 16.3 percent. The West Rural region, where reliance on agriculture was not statistically significant, registers the greatest increase (25.9 percent) in consumption from non-crop enterprises. The East Rural region, which gained the most from reliance on agriculture, gains the least (10.5 percent) from non-crop enterprises.

Community Characteristics. The presence of electricity at the Local Council 1 (LC1) level of government is statistically significant and positive in the national and urban equations. The result from the national equation suggests that living in a community where electricity is available raises consumption by 19.6 percent. This boost in well-being may be due to an increase in commerce and rudimentary manufacturing, creating jobs directly and indirectly and generating earnings that accrue even to household with no electricity. In the rural equations, village electrification is not statistically significant.

Distance of the community from schools and health services is negative and statistically significant in the national equation and three of the regional equations, suggesting

that proximity to community services is important. This variable measures the average distance in kilometers from the center of the community to public and private schools and public and private health care facilities (see Table 2 for details). Reducing the distance by one kilometer is associated with a consumption increase of 0.8 percent in the national equation and with an increase of 0.7 percent to 1.0 percent increase in the regional equations in which the coefficient was statistically significant.

The presence of at least two markets or outlets for the sale of agricultural produce within five kilometers from the center of the community is positive and statistically significant in three of the rural regional equations (East, North, and West) but not in the national equation. The availability of such an outlet is associated with a consumption boost of 9.1 to 17.6 percent.

The presence of a place to make paid telephone calls within two kilometers of the community center is positive and statistically significant in the national and urban equations. The consumption boost associated with phone service is 9.2 percent in the national equation and 23.9 percent in the urban equation.[9] Phone service, like electricity, is a facilitator of economic activity. For example, Uganda's national agricultural commodity information service uses telephones to gather and disseminate daily information on the price and availability of a wide range of agricultural commodities, probably leading to an increase in market transactions. In urban areas, also, phone service is used heavily in a wide range of economic activities. It is possible, however, that the phone service variable in our model picks up the effect of various unspecified urban characteristics that are associated with but not caused by phone service.

The presence of a road within one kilometer of the community center is statistically significant only in the East Rural equation, where the boost in household consumption in communities with a road is 8.3 percent. Inadequacy of the road network is widely believed to

be a constraint on development in Uganda, and it is surprising that roads are not statistically significant in the other equations. This is a binary variable based on a definition so broad that 86.8 percent of communities reported having a road. All routes ranging from unmaintained, dirt feeder roads to paved, all-weather roads where included in the single question dealing with roads in the household survey. Given its crudeness, this variable should not be interpreted as measuring the effects of good roads. We retain this variable in the regression on the assumption that any bias in the other coefficients resulting from ignoring roads is less if the variable is included rather than dropped.

The presence of a source of credit without collateral within ten kilometers of the community center is positive and statistically significant in the national equation and two of the regional equations (North Rural and Urban). In Uganda, such a source of credit is typically a microfinance institution or program. Presence of a non-collateral credit source is associated with an 8.3 percent increase in consumption in the national equation, 13.0 percent in the North Rural equation, and 9.4 percent in the Urban equation. Like village electrification and phone service, credit is a facilitating factor that enables other economic activities.

Anti-Poverty Policy Simulations

Using the parameter estimates from the regression models, we simulate the effects of changes in policy-related exogenous variables. The results of these simulations are presented in Table 5. The effect on consumption is reported in terms of percentage change in consumption as compared to the actual situation in 2002/2003. The reported change in poverty is the number of percentage points by which the poverty rate changes as compared to the official poverty rate in 2002/2003. The poverty rate is computed using the "p0" headcount of poverty measure developed by Foster, Greer, and Thorbecke (1984):

$$p0 = \sum_i \max(1 - c_i / z), 0)^0$$

where c_i is daily consumption per adult equivalent and z is the poverty line.

Simulation 1: Expanding Community Electrification. In this experiment, we examine the income and poverty effects of providing electricity in all communities where it did not exist in 2002/2003. Electrification, especially in rural areas, is very expensive. The simulation model can be used to predict the benefits of such a change. Benefits to household income and, consequently, national income could then be compared to the cost of implementing universal electrification to determine the merits of such a policy.

Community electrification is a binary variable in our model. Introducing electricity in all communities involves changing this binary variable to a value of one for every community in which it is zero in the UNHS data. We estimate that electrifying all communities that currently have no electricity would increase average household consumption by nine percent. Due to the increase in consumption, the poverty rate in the country would fall by 11.8 percent. In other words, from the 200-2003 poverty rate of 37.7 percent, the new rate would be 25.9 percent. In reality, is unlikely that the entire country would be electrified simultaneously. We simulate the extreme case here, however, to demonstrate the importance of electrification. For policy purposes, where policymakers face inevitable budget constraints, it would be an easy matter to the scale down the scope of electrification so that only a portion—say, ten percent--of communities would be electrified in any given period of time. Net benefits of alternative geographically targeted electrification schemes could also be estimated and the policies with the greatest net benefits could be selected.

Simulation 2: Reducing Distance to Community Services. Reducing the distance to vital health services and schools is likely to have two effects. First, improved access to these services increases the productivity of households as less time is wasted in transit. Second,

consumption of these services is likely to increase which would raise the level of human capital and household productivity.

We estimate that cutting the distance from the center of the community to schools and health facilities throughout the country would increase average household consumption by 1.6 percent. The poverty rate would decline by 1.8 percent.

Simulation 3: Improving Access to Inputs Markets. Reducing the distance to markets and outlets that sell inputs would also increase the productivity of the household and, at the same time, would lower cost of acquiring inputs. Consumption of inputs is likely to rise as the effective price of inputs falls.

We estimate that providing at least two outlets or markets to buy inputs within 5 kilometers of the community center in all communities where such facilities do not exist would increase average consumption by 1.6 percent and would lower poverty by 2.0 percent.

Simulation 4: Improving Access to Telephones. Improving access to telephone service would similarly increase household productivity, lower the cost of the service, and increased consumption of telephone services. We estimate that providing phone service within 2 kilometers of all communities in Uganda where such service does not currently exist would increase average consumption by 2.7 percent and would lower poverty by 3.5 percent.

Simulation 5: Improving Access to Roads. Proximity to roads improves the productivity of households and lowers the cost of acquiring inputs and transporting products to market. We estimate that building a road within one kilometer of every community in Uganda that does not currently lie this close to a road would increase average consumption by a half of one percent and would lower poverty by eight tenths of one percent.

Simulation 6: Improving Access to Credit Without Collateral. Making credit without collateral available to households has the potential to increase the productivity of poor

households. Credit would facilitate the purchase of inputs for existing productive activities, and it could also make it possible to start new activities, such as home-based enterprises.

We estimate that making a source of credit not requiring collateral available within 10 kilometers of all communities where it is currently not available would increase average consumption by 4.7 percent and would lower poverty by 4.8 percent.

Simulation 7: Reducing Average Family Size. The addition of children in households that are close to the subsistence level is likely to reduce per capita consumption of the household. Children do not become economically active until they are older and require a substantial amount of resources. We estimate that consumption per adult equivalent would rise by 11.2 percent and the national poverty rate would fall by 10.4 percent if household size were reduced by one child in each household that currently has children.

Simulation 8: Increasing Secondary School Completion by Females. Schooling increases human capital and therefore typically increases productivity and income. For females, schooling also tends to lower fertility rates. We estimate that completion of secondary school by one addition female in every household would raise consumption per adult equivalent by 18.9 percent and would lower the national poverty rate by 13.8 percent.

Simulation 9: Increasing Secondary School Completion by Males. We estimate that adding an additional male secondary school graduate in each household would increase consumption per adult equivalent by 17.4 percent and would lower the national poverty rate by 11.2 percent.

Simulation 10: More Formal Employment. Formal employment in Uganda typically brings higher returns to labor and greater income stability than self-employment. We estimate that if one additional member of each household were employed in the formal sector consumption per adult equivalent would increase by 23.9 percent and the national poverty rate would fall by 15.6 percent.

Simulation 11: More Microenterprises. Small enterprises allow the household to make better use of its resources, especially labor, and to diversify its sources of income. We estimate that starting a non-crop enterprise in every household that does not currently have one would raise consumption per adult equivalent by 7.2 percent and reduce the national poverty rate by 5.0 percent.

Simulation 11: Expanding Area Under Cultivation. Uganda appears to have plenty of land under cultivation, at least in the aggregate. We estimate that increasing land cultivated per capita by 0.25 acres in all household that are currently engaged in crop agriculture would increase consumption per adult equivalent by only 0.4 percent and would reduce poverty by the same percent.

Conclusion

In this paper, we investigated factors affecting total household consumption and poverty in Uganda using household survey data. Our analysis indicates that household wellbeing can be improved by expanding education at all levels (primary, secondary, and university), expanding formal employment, increasing the number of microenterprises, reducing the average household size, expanding the number of schools and health facilities so that distance to these facilities is reduced, and by providing electricity, marketing outlets, credit, and telephone service in more communities.

To help policymakers assess the effects of particular policies on the national poverty rate, we developed a simulation model from our regression estimates. The simulations translate the regression results into a form that policymakers can readily understand. In further analysis, we intend to calculate the costs of policy implementation so that alternative solutions for poverty alleviation can be ranked according to their net benefits.

References

Appleton, Simon. 1999. "Poverty Reduction During Growth: The Case Of Uganda, 1992-2000."

_____. 1999. "Changes In Poverty In Uganda, 1992-1997." Mimeo, Centre for the Study of African Economies, Oxford University, Oxford, United Kingdom.

Foster, J. J. Greer, and E. Thorbecke. 1984. "A Class of Decomposable Poverty Measures." *Econometrica* 52, 761-765.

International Monetary Fund. 2003. "Poverty Reduction Strategy Paper Annual Progress Report." IMF Country Report 03/301. Washington, DC.

Muhherjee, Sanjukta and Todd Benson. 2003. "The Determinants of Poverty in Malawi, 1998." *World Development* 31(2), 339-358.

Ravallion, Martin. "Poor Areas." Chapter 3 in Aman Ulhah and David E.A.Giles, eds., *Handbook of Applied Economic Statistics*. New York: Marcel Dekker, Inc., 1998.

_____ and Benu Bidani. 1994. "How Robust is a Poverty Line?" *World Bank Economic Review* 8(1): 75-102.

Uganda Bureau of Statistics. 2003. "Uganda National Household Survey 2002/2003: Report on the Socio-Economic Survey." UBOS, Entebbe, Uganda.

Uganda Ministry of Finance, Planning, and Economic Development. 2004. "PEAP Revision." << http://www.finance.go.ug/peap_revision/>>. Accessed April 28, 2004.

White, H. 1980. "A Heterskedasticity-Consistent Covariance Matrix Estimator and A Direct Test for Heteroskedasticity." *Econometrica* 48: 817-830.

World Bank. 2004. *World Development Indicators*. Washington, D.C.

World Health Organization. 1985. "Energy and Protein Requirements." WHO Technical Report Series no. 724. Geneva.

Table 1: National and Regional Poverty Rates in Uganda, 1992-2003

	1992	1997	1999/2000	2002/2003
National	55.7	44.4	33.8	37.7
Rural	59.7	48.7	37.4	41.7
Urban	27.8	16.7	9.6	12.2
Central rural	54.3	34.5	25.2	27.6
Central urban	20.8	11.8	6.1	7.8
East rural	60.8	56.8	36.7	48.3
East urban	40.4	25.2	17.1	17.9
West rural	54.3	44.0	27.4	32.7
West urban	28.9	19.7	5.7	16.9
North rural	73.0	61.8	65.4	65.0
North urban	55.2	34.0	28.6	31.4

Source: Uganda Bureau of Statistics (2003)

Table 2: Variables in the Uganda Household Consumption Model

Household Characteristics					
Variable	*Description*	*Mean*	*Standard deviation*	*Minimum*	*Maximum*
lntotcexp	Natural log of household consumption per adult equivalent	7.12	0.79	4.24	12.57
hdage	Age of hh head	38.45	13.92	17.00	90.00
hdsex	Sex of hh head (0=male, 1=female)	0.25	0.45	0.00	1.00
size9	Number of individuals in hh aged 9 or younger	1.85	1.59	0.00	13.00
size10_17	Number of individuals in hh aged 10-17	1.09	1.36	0.00	14.00
sizef18_59	Number of females in hh aged 18-59	1.08	0.67	0.00	8.00
sizem18_59	Number of males in hh aged 18-59	0.92	0.73	0.00	7.00
size60	Number of individuals in hh 60 or over	0.15	0.42	0.00	4.00
schmax	Maximum educational level attained by any adult aged 20-59 in hh (0=no schooling, 1=completed P4, 2=completed P7 or J3, 3=completed S4, 4=completed degree)	2.29	1.00	0.00	4.00
schfs	Number of adult females who completed senior secondary school	0.01	0.10	0.00	2.00
schms	Number of adult males who completed senior secondary school	0.02	0.14	0.00	3.00
indp	Number of usually-employed hh members with primary industry occupation	1.16	1.12	0.00	9.00
inds	Number of usually-employed hh members with secondary industry occupation	0.13	0.39	0.00	6.00
indp	Number of usually-employed hh members with tertiary industry occupation	0.57	0.78	0.00	6.00
empformal	Number of hh members with formal employment	0.11	0.37	0.00	4.00
agdep	Is agriculture the main source of hh earnings? (0 = no, 1 = yes)	0.33	0.46	0.00	1.00
landcultpc	Per capita land cultivated by hh (acres)	0.42	1.91	0.00	166.67
lvaluepc	Per capita value of livestock owned by hh (thousands of Uganda shillings)	48.54	475.89	0.00	24800.00
ent	Does hh have a non-crop enterprise? (0 = no, 1 = yes)	0.62	0.49	0.00	1.00

Community Characteristics					
elect	Is electricity available in LC1? (0 = no, 1 = yes)	0.34	0.49	0.00	1.00
disser	Mean distance in kilometres to nearest services (government primary school, private primary school, government secondary school, private secondary school, government health centre, government hospital, private or NGO clinic, pharmacy)	8.55	8.06	0.00	109.00
mkt	Are there at least two outlets/markets to buy inputs within 5 km from center of the community? ? (0 = no, 1 = yes)	0.64	0.48	0.00	1.00

Table 2 (continued)					
phone	Is there a place to make paid calls (phone booth, mobile phone) within 2 km of village center? (0 = no, 1 = yes)	0.36	0.49	0.00	1.00
road92to02	Was there a feeder road / rural access road / all-weather road passing within 1 km of village center in 1992, 1996, 2002? (0 = no, 1 = yes)	0.78	0.39	0.00	1.00
creditnocoll	Is there a source of credit not requiring collateral within 10 kms from village center? (0 = no, 1 = yes)	0.33	0.48	0.00	1.00
agproj	Were there ag-related projects (demonstration gardens, improved varieties/new crops, improved agricultural techniques) in community in last 3 years? (0 = no, 1 = yes)	0.45	0.50	0.00	1.00
animalproj	Were there animal-related projects (livestock improvement, poultry/bird, animal vaccination) in community in last 3 years? (0 = no, 1 = yes)	0.83	0.34	0.00	1.00

Table 3: Categories, Number of Items, and Expenditure Period of Household Expenditures in the Uganda National Household Survey

Category	Number of Items	Expenditure Period
Food, beverages, and tobacco	61	Last 7 days
Non-durable goods and frequently purchase services	41	Last 30 days
Semi-durable and durable goods and services	43	Last 365 days

Source: Uganda Bureau of Statistics (2003)

Table 4: Regression Results from Uganda Household Consumption Model

	Nation	Central Rural	East Rural	North Rural	West Rural	Urban
Age of head of household	0.0003	-0.005	-0.008	-0.003	0.017**	0.005
Age squared of head of household	$-2.7e^{-5}$	$1.6e^{-5}$	$8.2e^{-5}$	-1.2^{-5}	$-2.0e^{-4}$**	$6.2e^{-5}$
Gender of head of household (0 = male, 1 = female)	-0.087***	-0.055	-0.092**	-0.169***	-0.014	0.005
Number of members age 9 and younger	-0.208***	-0.154***	-0.139***	-0.227***	-0.224***	-0.298***
Number of members age 10 to 17	-0.178***	-0.118***	-0.121***	-0.229***	-0.203***	-0.278***
Number of female members age 18 to 59	-0.150***	-0.063	-0.071	-0.180***	-0.187***	-0.259***
Number of male members age 18 to 59	-0.140***	-0.058	-0.096***	-0.242***	-0.166***	-0.246***
Number of members age 60 and older	-0.076**	0.005	-0.148***	-0.120*	-0.011	-0.184***
Household size squared	0.008***	0.004***	0.006***	0.013***	0.011***	0.013***
Number of adult females with primary school certificate	0.249***	0.246***	0.248***	0.241***	0.240***	0.171***
Number of adult males with primary school certificate	0.111***	0.079*	0.102***	0.176***	0.108***	0.123***
Number of adult females with A-level certificate	0.208**	-0.137	-0.232	0.726*	0.156	0.351***
Number of adult males with A-level certificate	0.279***	0.483***	0.312**	0.237*	0.141*	0.336***
Number of females with university diploma	0.544***	-	-	-	-	0.647***
Number of males with university diploma	0.569***	-	-	-	-	0.673***
Number of members working in primary industry	-0.094***	-0.054*	-0.073**	-0.090***	-0.080***	-0.078**
Number of members working in secondary industry	-0.064***	-0.012	-0.013	0.054	-0.091*	-0.085**
Number of members working in tertiary industry	0.055***	0.088**	0.103**	0.172***	0.033	0.025
Number of members with formal employment	0.135***	0.118*	0.087	0.226**	0.095*	0.179***
Is agriculture the main source of earnings (0 = no, 1 = yes)	0.041*	-0.053	0.097**	0.085*	0.030	-
Per capita land cultivated by household (acres)	0.025***	0.078***	0.158***	0.145***	0.023	-
Per capita value of livestock of household (million Ushs.)	0.047***	0.002	0.045	0.893**	0.046**	-
Does household have non-crop enterprise? (0 = no, 1 = yes)	0.163***	0.157***	0.105***	0.107**	0.259***	0.198***
Is electricity available in LC1? (0 = no, 1 = yes)	0.196***	0.087	0.101	0.167	0.100	0.148*
Mean distance of LC1 to school and health facilities (kms)	-0.008***	-0.009*	-0.007***	-0.001	0.001	-0.010**
Outlets for ag produce w/i 5 kms of LC1? (0 = no, 1 = yes)	0.036	-0.017	0.104**	0.176***	0.091**	-
Paid phone calls w/i 2 kms of LC1? (0 = no, 1 = yes)	0.092**	0.073	-0.015	-0.098	-0.010	0.239**
Road w/i in 1 km of LC1? (0 = no, 1 = yes)	0.025	0.062	0.083**	-0.033	0.058	0.137
Credit w/o collateral w/i 10 kms of LC1? (0 = no, 1 = yes)	0.083***	0.014	-0.037	0.130**	0.016	0.094*
Intercept	7.483***	7.571***	7.214***	7.193***	6.992***	7.524***
R2	0.46	0.35	0.28	0.40	0.31	0.45
N	9096	1396	1467	989	1382	3862

Table 5: Simulation Results Using Predictions from the National Model

Poverty Alleviation Strategy	Percentage Change in Consumption Per Adult Equivalent	Change in Poverty Rate
Electrify communities not currently electrified	9.0	-11.8
Halve the distance to community services	1.6	-1.8
Create at least two outlets/markets to buy inputs within 5 km from center of community in all communities where this does not currently exist	1.6	-2.0
Create place to make paid phone calls within 2 km of village center in all villages where this does not currently exist	2.7	-3.5
Build road within 1 km of village center in all villages where this does not currently exist	0.5	-0.8
Source of credit not requiring collateral made available within 10 kms from village center where this does not currently exist	4.7	-4.8
Reduce household size by one child in all households that already have at least one child	11.2	-10.4
Increase number of adult females who have completed secondary school by one	18.9	-13.8
Increase number of adult males who have completed secondary school by one	17.4	-11.2
Increase number of household members with formal employment by one	23.9	-15.6
Each household now without a non-crop enterprise starts one	7.2	-5.0
Increase per capita land cultivated by 0.25 acres in each household that is currently cultivating	0.4	-0.4

Endnotes

[1] The 1981 and 2001 figures on absolute poverty in Sub-saharan Africa are from Table 1d, p. 3, in *World Development Indicators 2004* published by the World Bank. Africa's share of world poverty for 1981 and 2001 were calculated by the authors from poverty counts presented in that table. The prediction regarding Africa's share of world poverty in 2015 is from a World Bank press release dated April 23, 2004.

[2] For example, since 1980, the World Bank has had a Living Standards Measurement Project to assist national governments in the design and implementation of household surveys (http://www.worldbank.org/lsms/).

[3] Pader District and parts of Kitgum and Gulu districts were excluded because of insurgency in those areas.

[4] A household enterprise is defined by UBOS as a business managed by the household and lacking a fixed location outside the household. A non-household enterprise is a business with a fixed location outside the household. Non-household enterprises in urban areas were covered by a separate UBOS survey, the Census of Business Establishments.

[5] UBOS uses a caloric standard recommended in a 1985 World Health Organization report. The standard varies by age and sex. For example, the daily minimum number of calories for males ages 18-29 is 3,025.

[6] Our model is similar to equation 3 on p. 72 of Ravallion though, in addition to using continuous geographic variables at the community level, we also include dummy variables to capture broad differences at the regional level.

[7] Household size squared was also included in the analysis to allow for the possibility of a nonlinear relationship between consumption and household size. As shown in Table 4, the squared household size term is positive and statistically significant at the one percent level in all equations, national and regional, implying a nonlinear relationship. It is not possible to compute the net effect of household size and household size squared in the models presented here since households are disaggregated by cohort. Therefore, to assess the extent of nonlinearity, we ran a separate regression with aggregated households into a single category, while all other variables remained the same. The household size coefficients for the national equation are as follows: household size (-0.193, significant at one percent level), household size squared (0.009, significant at one percent level), combined size and size squared (-.185 and significant at one percent level). Thus, the nonlinearity in the consumption-household size relationship is slight.

[8] "Usually employed" includes both paid and self-employed workers who were employed during at least five of the previous 12 months.

[9] Phone service is not universally available in Uganda even in urban areas. At the time of the survey, 80.1 percent of the urban communities (LC1 level) and 13.7 percent of the rural communities had paid phone service.