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Agricultural efficiency, malaria incidence and health expenses among Ugandan farmers

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Introduction

The linkage between farmer's status and agricultural efficiency has received a great deal of attention from both health and agricultural literatures. Illness and death from malaria, tuberculosis and other diseases affect negatively agricultural production through loss of labor, productive adults' knowledge, and assets to cope with illness. Hawkes and Ruel (2006) argue that in agricultural communities, poor health reduces income and productivity. Audibert and Etard (2003) observed a 26 percent increase in labor productivity from control of schistosomiasis in rice-growing areas in Mali. In Kenya, Fox et al. (2004) found that HIV-positive workers plucked between 4.1 and 7.9 kilograms per day less tea leaves, used significantly more sick leave and other leave days, and spent many more days doing less strenuous tasks.

Unlike previous studies, using household agricultural production framework, we introduce an explicit health production function that accounts for households own health expenses disaggregated into consultation, medicine, and hospitalization. We use a non-parametric method to estimate agricultural efficiency, therefore avoiding the issue of identification of the correct household agricultural production function. In addition, the approach by Simar and Wilson (2007) that is followed in this paper accounts for bias induced by serial correlation among farmers. A Tobit model with endogenous health production function is used to simultaneously estimate the impact of malaria incidence on agricultural efficiency as well as expected effects of subtypes of households' health expenses on malaria incidence

Analytical Framework

We assume that each farmer chooses optimal level of agricultural staple (C_a), market purchased good (C_m), and leisure (C_l) to maximize his utility

$$U=U(C_a, C_m, C_l) \quad (1)$$

under the following cash constraint

$$p_m C_m = p_a(Q_a - C_a) - w(L - L_f) - w_x X + E \quad (2)$$

where, p_m is the price of purchased good; p_a, price of agricultural staple; Q_a: farmer's production; w: market wage; X: variable inputs (e.g. fertilizer) with price w_x; E: non-labor income (remittance, social transfer, etc.); L is the total labor input and L_f the family labor. Effective family labor is expressed as follows:

$$L_{fe}=m(s)L_f \quad (3)$$

where m is a measure of farmer's efficiency, with $0 \leq m < +\infty$, and s represents incidence of a given sickness. It follows that farmer's production is

$$Q_a=Q(X, L_{fe})=m(s,k)Q(X,L_f) \quad (4)$$

The efficiency index, m, is estimated using DEA approach as in Simar and Wilson (2007).

Empirical Model

Given endogeneity of malaria incidence, we use an IV-Tobit of the following form

$$m^*_{1i}=s_{2i}\theta+z_{1i}\Upsilon+u_i$$

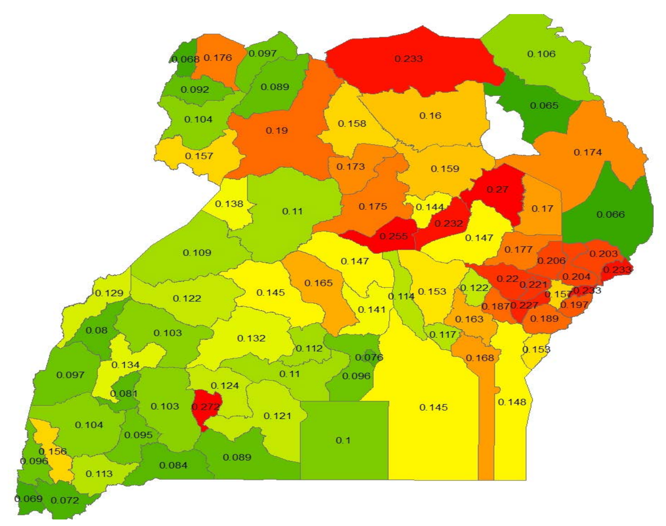
$$s_{2i}=z_{1i}\pi_1+z_{2i}\pi_2+v_i$$

where s_{2i} is a 1xp vector of endogenous malaria incidence, and $m^*_{1i}=m_{1i}$ if $1 \leq m_{1i}<+\infty$; z_{1i} is a $1xk_1$ vector of exogenous variables; z_{2i} is a $1xk_2$ vector of additional instruments; (u_i,v_i)~N(0).

Data

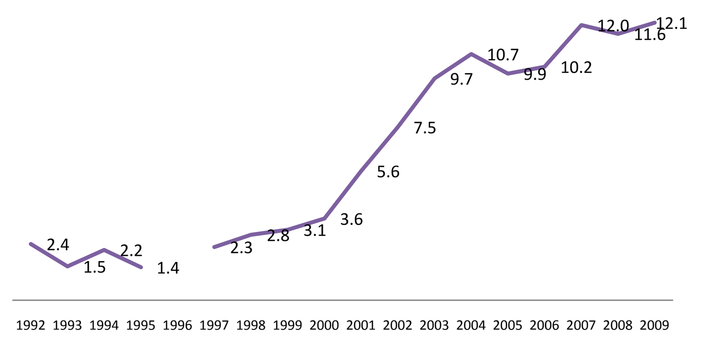
Data are from the Ugandan National Household Survey 2005–2006, which covered about 7,400 nationally representative households. This is a comprehensive survey with five modules: socioeconomic, agriculture, community, market, and qualitative. It includes data on production and sales of different crops. The dataset also includes a total of 35 health sector attributes over more than 600 communities.

Map 1: Spatial distribution of Malaria incidence



Source: Wielgosz et al. (2010).

Figure 1: Trend of malaria cases in Uganda (million)



Source: Authors', data from World Malaria Report (2010)

According to Lindsay and Martins (1998), local land use changes and agro-forestry expansion in Uganda has led to rising malaria incidence. They argue that the east African highlands had been relatively malaria free until the expansion of agro-forestry in the last fifty years and the introduction of parasite carrying labor from lowland areas. Using the Ugandan 2005/2006 household survey, the mapping confirms the relatively high malaria incidence in eastern Uganda.

Malaria is the leading cause of morbidity and mortality in Uganda, more than any other single disease and is still a major public health problem with annual estimates of 10 to 12.1 million clinical cases in 2009, the world's highest malaria incidence. Malaria is endemic in over 95% of the country (Fig. 1).

Estimation Results

Estimation results in Table 1 suggest that marginal increase in the index of malaria incidence is expected to reduce agricultural efficiency by 0.07; in other words, ten percent increase in malaria incidence will decrease efficiency by 1.5 percent. Our findings also confirm the significant impact of health variables such as distance to health facility and health expenses on malaria incidence. One percent increase in the distance to the nearest health facility is expected to increase malaria incidence by 6.9 percent. With respect to health expenses, our results suggest a negative and significant impact of all subtypes of health expenses on malaria incidence. Ten percent increase in consultations fees, medicine expenses, and hospitalization expenses is expect to reduce malaria incidence respectively by 54.7 percent, 1.9percent, and 11.9 percent. This translates into 0.4 percent, 0.01 percent and 0.1 percent increase in agricultural efficiency. However, there are thresholds beyond which health expenses start improving farmers' health status and subsequently agricultural efficiency. These optimal expenses are 122,277 Ushs, 140,617 Ushs and 193068 Ushs respectively for consultation, medicine and hospitalization. In addition to assessing the impact of malaria incidence on efficiency, our estimations also yield other interesting results. For instance, we found evidence of female farmers being more efficient than male by 39.5 percent. Moreover, farmers who have been visited at least once by an extension agent appear more efficient (by 13.9 percent) than those who were not. Agricultural efficiency is geographically heterogeneous with the Northern region being the most efficient and the western region lagging behind.

Figure 2: Health expenses as share of ag revenue (%)

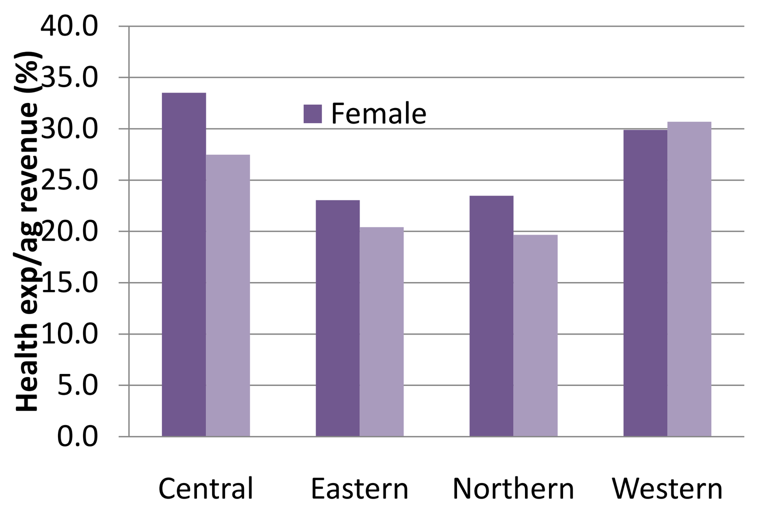


Figure 4: Efficiency and malaria incidence

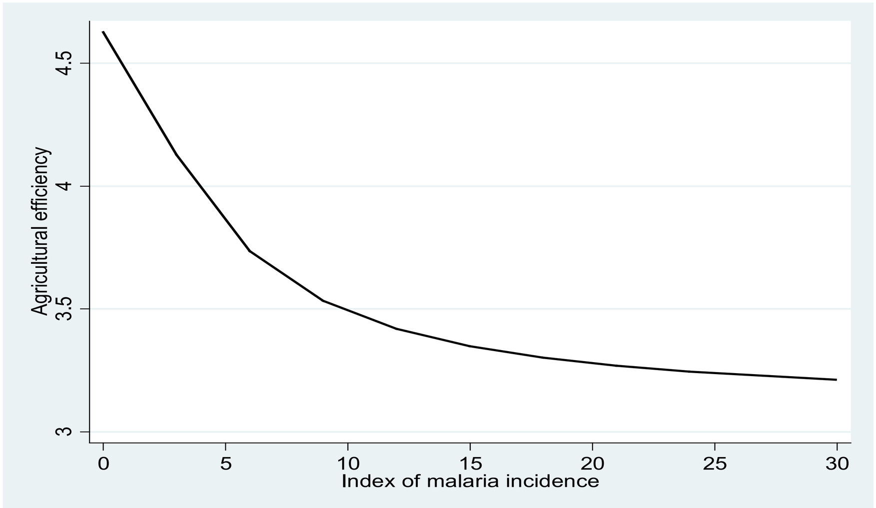


Figure 3: Composition of households expenses (%)

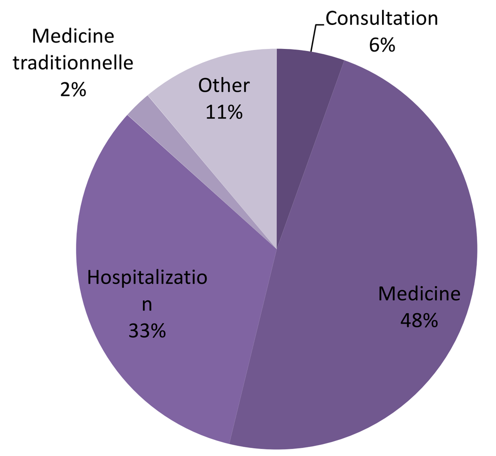


Table 1: Estimation results

	Coefficient	SE
Efficiency		
Index of malaria incidence	-0.0695[b]	0.0347
Household size	-0.2030[a]	0.0259
Gender (1 if male)	-0.3967[a]	0.1506
Age (years)	-0.0370	0.0237
Age squared	0.0004	0.0002
Received extension training (1 if received, 0 otherwise)	0.4873	0.3454
Member of farmer association (1 if member, 0 otherwise)	0.2707	0.4352
Visit from extension (1 if visited, 0 otherwise)	0.8327[a]	0.3025
Regional fixed effects (Default is central region)		
Eastern	0.2652	0.1836
Northern	1.3520[a]	0.1919
Western	-1.0741[a]	0.1905
Intercept	5.1523[a]	0.7034
Malaria incidence		
Household size	0.2086[a]	0.0157
Gender (1 if male, 0 otherwise)	0.1089	0.0970
Age (years)	-0.0231	0.0152
Age squared	0.0002	0.0002
Received extension training (1 if received, 0 otherwise)	0.1324	0.2221
Member of farmer association (1 if member, 0 otherwise)	-0.3852	0.2806
Visit from extension (1 if visited, 0 otherwise)	-0.4572[b]	0.1942
Distance to the closest health facility (km)	0.0559[a]	0.0033
Number of nurses (1,000)	0.0796	0.0655
Consultation fees (10,000 ugandan shelling)	-1.6835[a]	0.0558
Medecine expenses (10,000 ugandan Shelling)	-0.3617[a]	0.0266
Hospitalization expenses (10,000 ugandan Shelling)	-0.5410[a]	0.0235
Regional fixed effects (Default is central region)		
Eastern	0.3674[a]	0.1175
Northern	-0.5412[a]	0.1251
Western	0.4247[a]	0.1221
Intercept	1.4019[a]	0.4517

Note: a,b means significant at 1% and 5% respectively; SE=standard error

Conclusions

Overall, the results point to the possibility of minima levels beyond which health expenses start improving farmers' health status and subsequently agricultural efficiency. These cut-off points can be used by policymakers to determine the optimal level of health transfers to farmers in order to increase agricultural efficiency. Most of sub-Saharan African countries are under strong pressure to directly address widespread poverty. This pressure has been heightened through the need for meaningful progress toward achieving Millennium Development Goals (MDGs). Since most of these countries operate under tight budget constraints, the only option that remains is to devise strategies that maximize the contribution of social services to labor productivity in agriculture and the rural economy. It is therefore of critical importance to devise strategies on how to maximize the impact of social expenditures such as health through optimal allocation across sub-types of services.

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