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Livestock, Activity Choices and Conflict: Evidence from Burundi

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Abstract: Standard economic risk theory postulates that in the absence of credit markets, wealthier households will engage in higher-risk, higher profit activities to generate income while poor households will specialize in low-risk activities with low returns. The rationale is that wealthier households can deplete savings when things go wrong whereas poor household cannot. This theoretical argument has been tested for several countries and is generally validated by the data. However, existing studies on the relation between savings and activity choices implicitly assume that savings are certain or risk-free. This study suggests that explicitly allowing household savings or assets to be risky can yield results that differ considerably from the pattern predicted by the standard theoretical model. Using data from the 1998 household priority survey in Burundi, we estimate the relationship between household savings (livestock) and choices of income-generating activities (risky vs. less-risky activities). We exploit the fact that surveyed households in certain regions in Burundi were exposed to a relative higher level of risk and uncertainty due to the civil war preceding and during the time of the survey. We find that in general household savings exercise their usual risk-taking effect, though that this effect disappears and even reverses for households in the conflict affected regions. In those regions, wealthier households do not reduce allocation to low-risk low-return activities. We argue that this finding can probably (in part) explain the massive increase in poverty in the provinces exposed to the war during the 1990-1998 period. In this fashion, we argue that a type of 'productive social safety net', as recently discussed in the development literature, could possibly be an effective policy measure to lower the increased asset risk induced by conflict.

Keywords: Assets, risk, conflict, activity choices, Africa, Burundi

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1. Introduction

It is well documented that rural households in developing countries face considerable risk in their generation of income, an inevitable consequence of engaging in rainfed agriculture on increasingly degraded soils[1]. The extent to which an adverse income shock translates into consumption shortfalls depends, among others, on the savings of the household and the existence and functioning of insurance and credit markets. If these markets are absent or imperfect, households have to deplete accumulated savings to maintain their consumption. Households without sufficient savings are in these circumstances faced with declining consumption levels, causing them to fall into poverty or become even poorer.

In most of the developing world, formal credit and insurance markets are imperfect or even absent (see for example Hoff and Stiglitz (1990)). In these cases, households try to self-insure through the accumulation of savings or through informal insurance mechanisms at the village - or kinship level. The effectiveness of these informal insurance strategies has been widely studied, and generally it is concluded that these offer a limited insurance only against idiosyncratic income risk[2]. Savings on the contrary can provide an effective insurance against both idiosyncratic and non-idiosyncratic risk and can be de-accumulated to smooth consumption in situations when households are precluded from doing any borrowing at all (i.e. in the absence of credit markets; see Deaton (1990)).

A very relevant form of liquid savings and insurance substitute in many developing countries is the accumulation of livestock (see, for instance, Binswanger and McIntire (1987)). Livestock is a popular productive asset with high expected returns through offspring, sale or consumption of dairy products and use in farming systems. Moreover, livestock can be accumulated (bought) in good times and depleted (sold) in bad times for the purpose of consumption smoothing. A large body of mainly anthropologic and economic literature investigates this proposition, and it is generally found that sales of livestock indeed play a crucial role in maintaining consumption

[1] See, among others, Dercon (1996), Dercon (1998), Czukas et al. (1998) and Alderman and Paxson (1992) for an overview of existing literature.

[2] Since informal credit is mostly limited to transactions within villages or kinship groups or within limited geographic areas, this kind of credit cannot insure against shocks that are covariate, such as weather shocks or pests. See for instance Udry (1990) for Northern Nigeria and A. Siamwalla et al. (n.d.) for rural Thailand.

following an adverse income shock (see for instance Rosenzweig and Wolpin (1993) for India and Swinton (1998) for south-central Niger)[3].

This ex post *risk coping* potential of livestock also influences the ex ante *risk management* choices households make to reduce total income variability[4]. The hypothesis is that households with considerable savings will choose a portfolio of income generating activities that is more risky (and also has a higher expected return) than households with little or no savings, since the former households can deplete their assets to maintain their consumption when things turn out bad. The poorer households will choose a low risk (low return) portfolio, because they do not dispose of sufficient assets for ex post risk coping. This kind of behaviour, albeit logical from the poor farmer's point of view, would in the long-run lead to a permanent poverty trap, with poor households engaging in low-risk low-return activities and wealthier households specialising in higher risk, higher return activities, allowing them a further accumulation of productive assets over time.

Dercon (1996) for example examines the impact of the level of livestock holdings on crops choices by rural households. Using data from Western Tanzania, Dercon indeed finds that households with lower livestock values allocate a larger share of their land to a low risk low return crop compared to households with higher livestock holdings[5]. In an earlier study on India, finds that asset-poor households devote a larger part of their land to safer crops compared to their wealthier counterparts.

One could ask the question whether this relation between savings and activity choices holds if savings are very risky or uncertain[6]. In poor rural regions where household savings consist for the largest part of their livestock holdings, intense violent conflict can make savings very uncertain since animals can easily be stolen or

[3] A recent study by Czukas et al. (1998) for Burkina Faso however suggests that livestock transactions are less important for consumption smoothing than is often assumed.

[4] Alderman and Paxson (1992) consider 2 broad classifications of risk mitigating strategies: risk management and risk coping. Risk management concerns the ex ante actions by households to reduce total income variability (for example, crop and field diversification, off-farm work,. . .), while risk coping concerns the ex post strategies to deal with an adverse income shock (for example, the sale of liquid assets).

[5] Dercon considers the proportion of land allocated to sweet potatoes to be a proxy for the low risk, low return activity choice, and the proportion allocated to paddy rice as the higher risk, higher return choice.

[6] This question is very relevant, since approximately one third of the world's population lives in poor conflict-affected countries, with two thirds of these people residing in rural areas (calculation in Bruck (2004))

killed. In other words, following the theoretical argument of Deaton (1991), do wealthier households still take more risks in their income-process if the basis of their wealth is risky or uncertain? Rural Burundi is an obvious empirical setting to examine this question given the fact that households in certain regions of the country were exposed to a higher degree of risk due to the higher intensity of the civil war, both before and during the time of the survey (October 1998 – March 1999). Using this differential intensity of the war across regions to proxy differences in riskyness of household savings, we estimate the relation between household assets and household activity choices. The empirical results suggest that when assets are risky, the theoretical relationship between savings and activity choices does not hold, that is, wealthier households do not reduce allocation to low risk low return activities when their wealth is uncertain. This result is found to be robust to different specifications of 'safe' and 'risky' activities.

This paper proceeds as follows: section 2 offers a brief overview of climate and agriculture in Burundi, and gives descriptive data on the relationship between welfare, livestock holdings and activity choices, while section 3 sketches the theoretical model developed by Deaton (1991) and adapted by Dercon (1996). In this section, we will consider the theoretical implications of explicitly assuming the assets to be risky. Section 4 deals with potential identification problems while section 5 presents the empirical analysis. The final section concludes.

2. Livestock and Activity Choices in Rural Burundi

Burundi is a small, landlocked and mountainous country in Eastern Africa, bounded on the north by Rwanda, on the east and south by Tanzania, and on the west by Lake Tanganyika and the Democratic Republic of Congo. The country has a high tropical climate, on the whole temperate and even cold, with a large number of micro-climates and considerable variation between years. Burundi can be divided in 11 agro-ecological zones (Tessens, 1989). These zones differ by average temperature, altitude and rainfall (see table 1), with the biggest difference occurring between the Imbo Ruzizi plain (average annual temperature of 23.9 °C and 957.8 mm rainfall) and the Mugamba ridge in the north west of the country (average temperature of 16.2 °C and annual average rainfall levels around 1668 mm). Since the onset of the civil war in October 1993, GDP fell an average of 3% annually, resulting in a cumulative decline

of 30% over the 1993-2004 period. Income per capita is estimated to amount 83$ in 2004 vs. 214$ in the early years of the 1990s (IMF, 2007).

Although rural households in Burundi manage a portfolio of activities to generate their income, subsistence agriculture remains the dominant economic activity for the bulk of the population. Main food crops grown are bananas, beans, sweet potatoes and cassava, with the latter three accounting for over 50% of total dietary energy supply. Coffee is by far the most important cash crop, accounting for approximately 80 to 85% of total exports in 1998 (FAO, 2005). Livestock is widely held in rural Burundi and represents the principal form of capital accumulation for farmers (Cochet, 2004)[7]. However, as shown by table 2, the livestock sector suffered heavy losses since the onset of the civil war in 1993, mainly due to theft, pillaging and illegal exports (FAO, 1997)[8].

To test the hypothesis stated in the introduction to this paper, we will use data on rural households available from the 1998 Priority Survey (The Republic of Burundi, 1998). During this survey, a total of 6668 households were interviewed, of whom 3908 lived in rural areas. In the remainder of this section I will use this sample data to sketch the observed relationship between livestock holdings and activity choices of households. Table 2 shows livestock holdings, activity choices and income shares across welfare groups. Generally speaking, the rearing of livestock is rather widespread, with over 63% of all sampled households holding any livestock[9]. The average size of livestock holdings however is relatively small, with only 3.6 heads per household. The average value of livestock holdings amounts to 60925 BIF or 136$ in 1998 prices (using the 1998 official exchange rate of 1USD = 447.8BIF). To stratify the sample according to poverty status, we estimated an absolute poverty line using consumption data available from the same survey. Assuming a required nutritional intake of 2500 calories per adult equivalent per day, we estimate a rural poverty line (allowing for non-food requirements as well) of 8174 BIF per adult equivalent per

[7] ISABU, the national institute of agronomics in Burundi, describes livestock as 'un carnet d'épargne' (a savings account) for rural farmers.

[8] In our sample, 19,8 % of household reported having lost livestock this way during the 12 months preceding the survey.

[9] Excluding rabbits from the calculations presented in table 3, only 55.5% of rural households own any livestock. A demographic household survey carried out by the United Nations Population Fund in 2001 estimates this percentage at 62.8 before the crisis and 53.8 in 2001, which indeed suggests a loss of livestock during the crisis.

month[10]. As expected, livestock ownership corresponds with welfare levels: almost 70% of non-poor households own any livestock, while this figure drops to 60.7% for the poor households. The average value of livestock amounts to 216$ for richer households and 103$ for poorer ones. These values can be used to proxy household savings.

The figures in table 2 show substantial differences in activity choices and income shares across rural households. A relatively higher number of richer households engage in the production of food crops, cash crops and home-brown beer. Those households also engage relatively more in livestock rearing and non-farm self employment in family-run enterprises. Poor households rely relatively more on unskilled off-farm agricultural wage employment to complement their farm livelihoods. Following the empirical regularity, wealthier households engage in a higher number of activities to generate income than poorer ones (see for instance Barrett, Reardon and Webb, 2001). The production and sale of food crops, cash crops and beer account for over 60% of total income both for poor and non-poor households. The relative importance of those activities does not differ significantly across welfare groups. Wealthier households gain a higher proportion of their income through the sale of livestock and livestock products and through running small commercial enterprises. Unskilled agricultural labour is twice as important in generating income for poor households as it is for non-poor households.

The patterns observed in table 3 can to a large extent be explained by the differential ability of rural households to cope with risk ex post. Wealthier households' superior risk-coping skills (through higher savings) make that those households choose different income-generating activities ex ante. In short, relative to poor households, wealthier households can choose a portfolio of activities that is more risky but also has a higher expected return. In table 3, this translates to wealthier households engaging relatively more in production of cash crops and in non-farm self employment and relatively less in low-paid unskilled agricultural wage labour. As in most of rural Africa, the cultivation of cash crops (which for Burundi essentially reduces to the cultivation of coffee) is considered relatively risky by rural households given the considerable investment and the long time-lags between planting and harvesting the coffee trees (usually some three years). This is compounded by

[10] Expressed in constant October 1998 prices. This translates to 18,25 $ in 1998. For all calculations, consult Bundervoet (2006).

uncertainty over future price levels which can turn out for the best (high world prices for coffee within 3 years) or for the worst (low world prices for coffee). Unskilled off-farm agricultural wage employment is a (very) low return activity in rural Burundi given the surplus of unskilled labor in the rural labor market. This activity can be considered very 'safe', since no investments need to be done and no barriers of entry need to be overcome. This kind of wage labor provides rural households with a relatively certain, though low, income. For instance, in a survey of the African rural labor market, Reardon (1997) observes that the farm labor market pays low wages and is therefore relegated to poor households. On the other hand, self employment in small family-run enterprises can be relatively lucrative but demands relatively high capital investments. The existence of entry barriers combined with constrained access to credit tend to exclude the poorer households from this activity (for evidence, consult Dercon, 1998; McPeak and Barrett, 2001; Woldenhanna and Oskam, 2001).

The figures in table 2 concern all sampled households in rural Burundi[11]. The goal of this paper however, is to examine whether the relation between savings and activity choices changes when or where household savings are considered (by the household) to be highly risky and uncertain. To test this hypothesis for Burundi, we exploit the fact that not all regions of the country were equally exposed to the conflict. A mass of evidence suggest that three north-western provinces were particularly affected by the conflict, both before and during the time of the survey: Bubanza, Bujumbura rural and Cibitoke[12]. These provinces were among the richest before the conflict and experienced a dramatic decline in real consumption levels during the

[11] These sampled households represent 14 rural provinces. 1 rural province, Makamba, was not included in the 1998 survey due to widespread insecurity.

[12] Chrétien and Mukuri (2000) provide an exceptionally rich and detailed account of the spatial and temporal evolution of the conflict between its onset in October 1993 and its official end with the signing of the Arusha Peace Agreements in August 2000. Relevant reports of the UN Security Council are S/1996/660 and S/1996/682. A report by Human Rights Watch calls Bubanza, Cibitoke and rural Bujumbura *'provinces of persistent insecurity'* (Longman, 1998). There is also quantitative evidence that shows the exposure to the conflict of these provinces. A document by the Food and Agricultural Organization (FAO) says that out of an estimated total population of 6 200 000 in 1998, 572 462 people or 9% were living in regroupment camps (FAO, 1998). Officially, these camps were set up by the government to protect the Hutu population from the Hutu rebel factions. In reality, the Hutu population was forced into the camps to prevent them from providing support to armed rebel groups. Camps were set up in those provinces where rebel activity was extensive and clashes were regular. The regrouped population amounted to 10% in Bujumbura Rural, 22% in Cibitoke and 54% in Bubanza (FAO, 1998). Overall, these three provinces (out of a total of 16) accounted for over 47% of total regrouped population. Further, a 2002 demographic survey carried out by the United Nations Population Fund asked each respondent whether or not his/her parents were killed during the civil war (1994-2001). Within the three civil war provinces, the proportion of respondents of whom at least one parent was killed amounted to 12.4% in the 1994-1998 period and 6.0% in the 1997-1998 period. For the rest of the rural provinces, these figures were 3.9% and 0.8%, respectively (United Nations Population Fund, 2002).

1993-1998 period. One paragraph of the Interim Poverty Reduction Strategy Paper of November 2003 is worth quoting to support our point: "*[...] the provinces that have seen the highest increase in poverty are those that suffered most from the conflict [...]. Many provinces that were doing relatively well in 1990 found themselves with higher poverty levels following the crisis: the provinces of Bubanza, Cibitoke and Bujumbura Rural fell from fifth, first and fourth place, respectively, in 1990 [...] to places 14, 12 and 8 in the national ranking for 1998, with poverty levels of between 50 and 75 percent.* (The Republic of Burundi, 2003). In short, although every province was at some point and to some extent affected by the war, the particularly high intensity of the war in the three mentioned provinces makes it plausible (or at least not particularly far-stretched) to assume that households in those provinces explicitly took account of the heightened insecurity when choosing income-generating activities.

Table 3 connects households' wealth and welfare levels with activity choices and income shares in the civil war regions. By and large, the patterns in table 3 are not strikingly different from those in table 2: non-poor households have higher-valued livestock holdings and engage more, relative to poor households, in food crop production, off-farm self employment and livestock rearing, and less in unskilled wage employment and beer production. Wealthier households also engage in more activities than poor households. If any, the most striking difference when comparing tables 2 and 3 is that unskilled agricultural wage employment in the civil war regions is as important in generating income for non-poor households as it is for poor households. Note that we cannot compare *levels* of activity choices and income shares across the war and non war region since the data lack the panel dimension that would make this possible. Rather, the goal is to examine whether the observed *relation* between savings and activity choices differs across the regions. So far, the descriptives presented in tables 2 and 3 offer little support for this hypothesis.

In the preceding discussions we have implicitly assumed that a situation of intense violent conflict makes household livestock holdings (their savings) rather uncertain, since livestock can easily be pillaged or killed. How realistic is this assumption for rural Burundi? As evidenced by table 4, the livestock sector suffered heavy losses over the 1990-1998 period with a drop in the aggregate number of tropical livestock units of 23%. This decline is predominantly due to theft, pillaging and illegal exports during the war (FAO, 1997). The burden of this decline was not shared evenly across regions. Table 5 shows the evolution of livestock holdings at the

household level between 1993 and 1998 for the war and non war provinces. The figures come from two distinct household surveys and as such the surveyed household in the two time periods are not (necessarily) the same. Yet both surveys are nationally representative and should give a fairly reliable image of the evolution of household livestock holdings. We observe that households in both the war and the non war provinces suffered on average heavy losses in livestock holdings, but that the average loss in the war provinces (3.25 TLU) is more than twice as high relative to the loss in the other provinces (1.52). Moreover, while households in the war provinces had significantly higher livestock holdings *before* the war, this was no longer the case in 1998 (5 years into the conflict). In short, the war had a large negative impact on household livestock holdings, especially in those provinces that were most exposed to the conflict[13]. Hence, it is reasonable to assume that livestock was a highly uncertain asset during Burundi's civil war.

3. Theoretical framework

To explain risk-taking behaviour by households on the basis of their asset holdings, we will use a model of consumption under liquidity constraints developed by Deaton (1991) and adapted by Dercon (1996). For the sake of simplicity, we will assume that the household can choose between two income-generating activities with different mean returns and different degrees of risk. The household allocates its total available labour time (L) to these two activities, according to its own objectives. A priori, we expect households with considerable asset holdings (i.e. with considerable options for ex-post risk coping) to invest a higher proportion of their labour time in the riskier activity that also has the higher expected returns, while households without any assets would specialize in the low-risk low return activity.

To capture this in a stylized fashion, let p_t be the proportion of labour allocated to the low-risk activity in period t, r_1 the return per unit of labour allocated to activity 1 (the low-risk activity) and r_2 the return per unit of labour allocated to the second

[13] Interviews with civilians confirm the extensive looting of cattle during the war. While the regular government forces are well-known for their indiscriminate killings and brutal repression, pillaging of cattle is by far the greatest complaint civilians make against the various rebel forces. A commonly held belief about the rebel factions is: "*They pillage, but they do not kill*" (HRW, 1998, p. 81). Since the bases of the two main rebel factions were located in the three provinces (or just on the other side of the border in D.R.C.) that are labelled 'war-provinces' in this paper, it is no surprise that livestock looting was particularly widespread in these regions.

activity. Income in period t from pursuing activity 1 is given by $p_t Lr_1$, and is assumed to be certain (Dercon, 1996). Returns from the second activity however are risky, and equal $(1 - p_t)Lr_{21}$ with a probability of q and $(1 - p_t)Lr_{22}$ with a probability of (1 - q). Dercon (1996) further assumes that $r_{21} < r_1 < r_{22}$ and that the expected return per unit of labour allocated to the second activity, $E(r_2) = qr_{21} + (1 - q)r_{22}$ is greater than r_1[14]. Each household maximizes intertemporal expected utility given by

$$u = E_t \sum_{t=0}^{T} (1+\delta)^{-t} c_t^{\rho} \qquad (1)$$

where T is the time horizon of the household, δ its rate of time preference, c_t its consumption in period t and $(1-\rho)$ the (constant) coefficient of relative risk aversion. We assume that $\rho < 1$, that is, the households are considered to be risk-averse.

Dercon (1996) first considers the case in which the household has no access to credit or assets. Consumption in each period simply equals income, and the maximization problem becomes

$$\max u = E_t \sum_{t=0}^{T} (1+\delta)^{-t} \left[p_t Lr_1 + (1 - p_t) Lr_2 \right]^{\rho} \qquad (2)$$

It can be shown that, if the first-order condition of this problem holds with strict equality, the household will find the optimal allocation of labour to activity 1 as

$$p_t = \frac{B}{D(r_1 - r_{21}) + (r_{22} - r_1)} \qquad (3)$$

with

$$D = \left(\frac{(1-q)(r_{22} - r_1)}{q(r_1 - r_{21})} \right)^{\frac{1}{(1-\rho)}}$$

and

$$B = r_{22} - Dr_{21}$$

From these results, it can easily be seen that households diversify by allocating some labour to the safe activity. The greater the riskyness of the second activity (which

[14] Otherwise, no risk-averse farmer would choose to cultivate the risky crop, see Newberry and Stiglitz (1981).

would mean a larger spread between r_{22} and r_{21}), the larger the risk premium and the larger the labour allocation to the safe activity and vice versa.

Dercon continues by introducing the possibility of savings. These can be accumulated in good times and de-accumulated when times are bad. In this situation, the problem becomes

$$\max u = E_t \sum_{t=0}^{T} (1+\delta)^{-t} c_t^{\rho} \quad (4)$$

subject to

$$A_{t+1} = (1+i)(A_t + y_t - c_t) \geq 0 \quad (5)$$

$$y_t = p_t Lr_1 + (1-p_t) Lr_2 \quad (6)$$

where A_t is the total stock of liquid assets at the beginning of period t and i the certain rate of return on savings. In this situation, the household has to make two decisions based on the current income outcome y_t and its present asset holdings A_t: how much to consume in period t, and what proportion of total labour time to invest in the safe activity in the coming period (p_{t+1}) (Dercon, 1996). This proportion can be found as

$$p_{t+1} = \frac{B}{D(r_1 - r_{21}) + (r_{22} - r_{1)}} - \frac{(D-1)A_{t+1}}{L\left[D(r_1 - r_{21}) + (r_{22} - r_1)\right]} \quad (7)$$

with B and D defined as above. From this equation it can be seen that households with larger asset holdings and thus more available means for consumption smoothing will, ceteris paribus, choose to invest less time in the low-risk activity, consequently, more in the high-risk one.

Both in the Deaton (1991) model as in Dercon (1996), all the uncertainty is focussed on income y_t. What would happen to the result if we introduced some degree of risk or uncertainty in the liquid asset A? Suppose that there is a probability of the asset being stolen or killed, and that the household explicitly takes this probability into account when determining p_{t+1}[15]. In this case, the expected asset stock in period t + 1 becomes

$$E(A_{t+1}) = (1-l)(1+i)(A_t + y_t - c_t) + l(1+i)\left[(1-z)(A_t + y_t - c_t)\right] \quad (8)$$

[15] We believe this assumption can be plausible in circumstances of intensive violent conflict.

with l being the probability and z the proportion of productive assets being stolen or killed. These two variables are to be determined by the household. If l = 0, the household assumes no risk in the asset; $E(A_{t+1}) = A_{t+1}$ and nothing changes in equation 7. Whenever l and consequently also z become strictly positive, $E(A_{t+1})$ becomes smaller than A_{t+1}, the more so the higher the values of l and/or z. Consequently, the household will limit its reduction in allocation to the safe activity induced by the asset holdings when the risk associated with the asset increases. In this situation, the proportion of labour allocated to the safe activity in period t + 1 is given by

$$p_{t+1} = \frac{B}{D(r_1 - r_{21}) + (r_{22} - r_{1)}} - \frac{(D-1)\left[(1-l)(1+i)(A_t + y_t - c_t) + l(1+i)(1-z)(A_t + y_t - c_t)\right]}{L\left[D(r_1 - r_{21}) + (r_{22} - r_1)\right]} \quad (9)$$

which will be higher compared to p_{t+1} in equation 7. In the next section, we will test if there is empirical support for the theoretical implication of equation 9.

4. Identification and Econometric Specification

To identify the effect of the conflict on the relation between savings and activity choice, we will compare provinces that have received the 'civil war-treatment' (that were most exposed to the war) with provinces that have not[16]. In other words, we will simply exploit the differential exposure of the provinces to the war. In its most simple form, the econometric specification is:

$$P_{ij} = \beta_0 + \beta_1 savings_i + \beta_2 (savings_i * CivilWar\,\mathrm{Re}\,gion_j) + \alpha_j + \varepsilon_{ij} \quad (10)$$

that is, labour allocation to a low-risk low-return activity by household i in province j (P_{ij}) is explained by household savings, a set of household characteristics and province fixed-effects (α_j). In this specification, the coefficient β_1 measures the effect of savings on allocation to a safe activity for the regions not exposed to the war, while ($\beta_1 + \beta_2$) estimates the effect of savings in the war provinces. If the coefficient β_2 is

[16] This is of course a simplification as all provinces were to some extent affected by the conflict. However, as mentioned in section 2, the intensity of the war differed considerably across regions, and we select only the provinces that were most exposed to the war and its consequences.

statistically significant, the impact of savings on activity choice is different in the war regions.

There are several problems that complicate the identification of the effect of the war. The first problem concerns the counterfactual question: Would the relation between household savings and household choices of income-generating activities be consistent with theory if the war provinces had not received the 'treatment' (i.e. the war)? It is possible that, for whatever reason, the war provinces are distinct from the other provinces, which makes that the relation between savings and activity choices would be different in those former provinces anyway. Although there is no way of providing a conclusive answer to this given the absence of available datasets preceding the war, it is hard to find a convincing reason why it would be. One could potentially argue that if the war provinces were very poor (with very low asset levels) to begin with, then the usual savings-activity choice nexus would not exist since households in those provinces would most likely engage in low-risk low-return activities given the absence of sufficient means to smooth consumption ex post. However, table 6 already demonstrated that households in the war provinces had significantly *higher* pre-war asset levels compared to the other provinces. In table 6, we further compare the war and non-war provinces along observable dimensions. We see that the war provinces were actually the richest before the war (pre-1993), both in terms of consumption and asset (livestock) holdings. Given that the savings-activity choice nexus is in fact an asset accumulation process, one could argue that this mechanism must have been particularly important in the war provinces before the war[17]. In sum, there seems to be no a priori reason to believe that the war provinces would be different than the others with respect to the impact of savings on activity choices. However, in the empirical analysis we will control for any unobservable provincial differences by adding province fixed effects.

A second problem concerns the possible breakdown of normal economic activity during wartime. Of particular concern is the existence and functioning of local markets. If those markets do not function anymore or function poorly due to the heightened insecurity, then households have no incentive to produce for the market. In those circumstances, it is possible that households, even those with considerable savings, would simply engage in the production of low risk food crops for own

[17] This is of course entirely hypothetical.

consumption. In this case, we would not observe the hypothesized relation between savings and risk taking, but this would not be due to the riskyness of savings but rather to the absence of markets. In the analysis, we will control for this possibility by adding a variable capturing differential access of households to markets.

5. Empirical Analysis

5.1. Savings and Activity Choices

In this section, we will estimate equation using several alternative outcome variables to proxy labour allocation to safe or risky activities. At the outset of this section, we have to mention that the analysis suffers a drawback resulting from data limitations. To examine household labour allocations to different income-generating activities, ideally we should dispose of detailed data on labour input. That kind of data is however very rarely collected during surveys. Therefore, we will use the relative income share of each activity as a proxy for activity-specific labour input. Although activity-specific labour inputs will in general not correspond to activity-specific income shares *within* households, comparing those income shares *between* households will generally reflect differences in activity-specific labour inputs. To see this, consider a hypothetical household that engages in three activities (A, B and C) to generate income. This household allocates 40% of available household labour to A, 40% to B and 20% to C. Due to differences in returns, the income shares of those activities are respectively 30%, 20% and 50%. Now consider an otherwise identical household that allocates 50% of available labour to A, 30% to B and 20% to C. Their income shares amount to 40%, 10% and 50%. This hypothetical example shows that although higher activity-specific labour allocations are not necessarily associated with higher activity-specific income shares within households, relatively higher activity-specific labour allocations will correspond to relatively higher activity-specific income shares when comparing between households[18].

In section 2 we argued that unskilled agricultural wage employment is a very low-risk low-return activity in rural Burundi. As expected, the descriptive statistics of tables 3 and 4 showed that this activity is more important in generating income for the

[18] For this to be true, we assume that different households face similar returns to activities. This assumption is plausible for some activity choices (such as unskilled off-farm agricultural work, which is universally low-paid), but more problematic for other activities (such as sales of crops) given the poor market integration in rural Burundi.

poor than it is for the non-poor. Therefore, in a first analysis, we will use the income share of this activity as a proxy for labour allocation to a safe activity. The first column of table 7 shows the results of Tobit-estimation of equation (10) with the income share of unskilled agricultural wage employment as dependent variable[19]. The preliminary results seem to confirm the hypothesis formulated in this paper: in the non-war provinces, a *higher* value of assets per adult is associated with a *lower* income share of unskilled agricultural wage employment, consistent with the predictions of the standard theoretical model. In the war provinces however, the coefficient of assets turns *positive* and is statistically significant. The impact of savings on activity choices thus differs significantly between the war and non-war provinces. This does not change when controlling for other influences at the household level (second column of table 7).

The preliminary results of these first two analyses have to be treated with great caution. It is well-known that Tobit models are very sensitive to specification errors such as heteroscedasticity and that estimates in the presence of the latter can be severely biased (see for instance Lee and Maddala, 1985). Brown and Moffit (1983) showed that ignoring heteroscedasticity in Tobit models leads to the largest bias when truncation is extreme (when there are many zeros for the dependent variable) and/or when only the truncated sample is available for estimation (for instance, no data on the regressors when the dependent variable is zero). In our empirical application presented in table 7, truncation is not extreme but nonetheless very high (only 894 of the 3801 observations are non-zero). This is certainly a cause for concern. On the other hand, we observe the full sample –not only the truncated part- which has a large effect in stabilizing the estimates (Brown and Moffit, 1983). To examine the extent of the bias in our estimates, we perform an informal specification test by comparing the estimates of the truncated and the full sample. If the estimators are close, they are likely to be good. However, the truncated estimates amount to -0.185 for assets per capita and 0.158 for civil war*assets per capita. Comparing this with the estimates for the full sample presented in table 8 shows a large difference (-0.608 and 0.648 respectively). In short, the estimates of analyses (1) and (2) are likely to be considerably biased.

[19] Since the dependent variable is censored, OLS estimation of equation (10) would yield biased estimates of the regression parameters.

One way to solve the (severity of the) bias is to reduce the number of censored observations. Therefore, in the third analysis of table 7, we proxy household labour allocation to low-risk activities as the combined income share of unskilled agricultural wage employment and the cultivation of food crops. The sample is clearly less truncated, as 3030 household in the sample have a nonzero observation for this combined income share. The results of this specification are qualitatively similar to those of the previous analyses: *higher* asset levels are associated with a *lower* income share of low-risk activities in the non-war provinces but with *higher* 'safe' income shares in the war provinces. This seems to confirm the prediction of equation (9) that households who assume a considerable amount of risk in their assets will limit the reduction in allocation to safe activities that otherwise would have been induced by their asset levels. To test for the potential bias, we perform the informal specification test mentioned in the previous paragraph. This time the results are reassuring as the truncated estimators are relatively close to the actual estimators (truncated estimator of -0.102 for 'assets per capita' and 0.178 for 'civil war*assets per capita' compared to the actual estimators of respectively -0.114 and 0.158).

5.2. Robustness Checks: Savings and Crop Choices

To explore the robustness of the results of the previous subsection, we will now focus attention to the production of specific crops. Crop cultivation is an important activity for over 87% of households in the sample. These households have to decide on which particular crops to grow. Generally speaking, farm households in rural Burundi grow a wide array of crops to ensure subsistence at the household level and as such, specialisation into a single or a small number of crops is almost non existent (Bergen and Ndimurirwo, 1998). Despite this apparent lack of specialisation, different households will still grow different (combinations of) crops due to crop-specific features, such as the riskyness of the crop. Following standard economic risk theory, we would expect wealthier households to engage relatively more in the cultivation of higher-risk, higher-return crops, and poor households relatively more in low-risk subsistence crops.

In Burundi, cassava is considered to be a very low risk crop given its strong resistance to both extended droughts and excessive rains and the fact that it can grow on soils of poor quality (Nyabyenda, 2005). The cultivation of cassava in Burundi

plays a very important alimentary role, but its economic value is limited: cassava is a so-called '*cultures de soudure'* which serve to feed the farmer and its family during the period between two harvests. Cassava roots can be kept in the soil and harvested according to the nutritional needs of the household. As such, this crop is the pillar of food security in Burundi and acts as a relatively risk less reserve stock (see for instance Janssens (2001)). The relatively low value of cassava (both in economic and nutritional terms) can be seen in table 8 (low price, low calorific and protein composition). The observed *decrease* in the real price of cassava during the 1993-1998 period might be an indication of an increased production of this low-risk crop during the war[20]. In the subsequent analysis, we will use cassava cultivation as a proxy for investment in a low-risk crop.

In contrast to cassava, the less drought-resistant maize is considered to be a relatively risky, higher-return crop in Burundi. Although maize can be grown on practically all types of soils and on high altitudes (0 - 2500 m), its production is constrained by various requirements (Nyabyenda, 2005): First, a good harvest requires sufficient rainfall, which has to be spread evenly during the vegetation period. Long dry spells between rains considerably reduce yields and, hence, returns. Second, excessive rains inevitably destroy part of the plantation and, finally, upon maturation, maize is also seriously affected by praying birds. An additional constraint to maize production is that its cultivation requires considerable entry costs and a priori investments (fertilizers, hybrid seeds ...), for which poor farmers often lack the revenues. As can be seen in table 8, maize is a rather high value food crop: in 1993, the price of maize is 22% higher than that of cassava, while in 1998, after 5 years of civil war, this figure had risen to 58%. The observed *increase* in the real price of maize during the 1993-1998 period could indicate the abandonment of this higher-risk crop during the crisis[21]. In the subsequent analysis, we will use maize cultivation as a proxy for investment in a higher-risk crop.

[20] Although this is of course hypothetical, it nevertheless seems to be confirmed by FAOSTAT data: the total area devoted to the cultivation of cassava rose from 65000 hectares before the crisis in 1992 to 70000 in 1998. Also, the French historian Jean-Pierre Chrétien writes in relation to the crisis in Burundi (Chrétien and Mukuri, 2000): *"Negative evolutions can be observed at the production level: the cultivation of food crops has grown relative to that of coffee, the cultivation of cassava has become more important than other food crops.*"(Author's translation from French).

[21] Although this is again hypothetical, FAOSTAT data indeed shows a decline in area cultivated by maize over the course of the crisis: 124000 hectares in 1992 compared to 115000 hectares in 1998. Production of maize

Table 2 shows the fraction of households cultivating cassava and maize and the relative importance of those crops across welfare groups in rural Burundi. The figures are consistent with economic risk theory: a *higher* fraction of poor households relative to non-poor households grow cassava and a relatively *lower* fraction of poor households engage in maize cultivation. Cassava also represents a larger part in total production for poor households, while the opposite is true for maize. Similar patterns are observed in table 3, which shows the figures for the war-regions. Again, cassava is cultivated relatively more often by poor households and also represents a larger part of total production for those households. The opposite is true for maize. In short, we observe the same pattern for the war and non-war regions.

Table 9 estimates the determinants of two different but complementary aspects of the crop production decision-process. First, the probit analyses (4) and (6) estimate the determinants of the decision to grow cassava and maize, respectively. The dependent variable is a dummy that takes on one if the crop is grown by the household, and zero otherwise. Second, the tobit analyses (5) and (7) also take into account the relative importance of those crops in total crop production. Here, the dependent variable is the fraction in total production of cassava and maize cultivation, respectively. The econometric specification is similar to the one used in the previous section (equation (9)), but we add the square of *'total agricultural production'* to control for non-linear effects of production volume (or land size).

The first column of table 9 shows the determinants of the decision to grow cassava. As was expected, the per capita value of household assets has a significant negative impact on the probability that the household will grow the low-risk, low-return crop. However, the interaction of assets with the civil war-variable is *positive* and significant, meaning that the impact of assets differs significantly between the war and the non-war regions. Within the former regions, household savings seem not to exercise their usual risk-taking effect. In other words, contrary to the non-war regions, wealthier households in the war regions are not less likely to grow cassava. When we also take into account the relative amount of cassava production (column 2 of table 9), the results are broadly similar: while in general wealthier households reduce their relative cultivation of cassava, the war interaction effect is positive and significant. This suggests that in the war regions, households with more savings do

dropped from 176300 metric tons in 1992 to 131830 metric tons in 1998. This, together with the previous figures on cassava, seems to suggest that farmers reduced their allocation to the more risky crop during the crisis.

not reduce the relative production of the low-risk crop. Note that relative cassava production is lower for both female headed households and households with an educated head. We also find that total production has a quadratic effect, with relative cassava production increasing at low levels of production and decreasing with higher production levels.

The determinants of the decision to grow maize are presented in analysis (6) of table 9. The effect of household savings is now significantly *positive*: following economic risk theory, wealthier households increase relative production of a higher-risk higher return alternative. The interaction effect with war is negative, but not statistically significant. When taking account of the relative importance of maize production (last column of table 9), this interaction effect remains negative and becomes statistically significant at the 10% level. In this case, households in the 'safe' regions increase their relative production of maize as household wealth increases, whereas in the war regions they do not.

Overall, the results presented in tables 7 and 9 seem to offer support the hypothesis we wish to test in this paper and which is formalized in equation 9: in highly insecure environments where liquid assets can be very risky, households seem not to take account of their savings in determining their income-generating activities. The empirical results suggest that in those circumstances of increased (asset) risk, the economic risk association between savings and activity choices does not hold. That is, households with higher-valued assets do not reduce allocation to or investment in low-risk low-return activities when assets are risky.

This finding implies a levelling effect of conflict on household welfare. If even the wealthier households engage in low-risk low-return activities when their assets are risky, then their income and consumption should *decrease* during the course of the conflict and *converge* to the income and consumption levels of the poor. Bluntly speaking, the poor would remain poor and the non-poor would become poorer. Despite the fact that we do not have panel data to test this implication in a formal way, this is exactly what seems to have happened in Burundi between 1993 and 1998: before 1993, consumption poverty headcount in the war regions amounted to 22.4% vs. 40.5% in the non-war regions. This means that a higher fraction of households in the war regions were non-poor relative to the non-war regions. In 1998, both figures had increased to 52.5% and 53.2% respectively. This massive increase in

poverty in the war regions during the course of the conflict (over 30 percentage points) is in any case consistent with the empirical findings of this paper.

6. Conclusions

Standard economic risk theory postulates that wealthier households will engage in riskier, more profitable activities to generate income since those households can deplete savings if things go wrong. In contrast, poor households are trapped into low risk subsistence strategies to constitute a livelihood since those households cannot afford a bad income draw. The goal of this paper was to test whether this relationship between savings and activity choice holds when savings are very risky. Exploiting the differential exposure of rural households in Burundi to the civil war to proxy different risk environments, we estimate the relation between household livestock holdings (accumulated assets) and the household's 'safe' income share, that is, the fraction of income a household earns through engaging in safe, low-return activities. The results show that the effect of wealth differs significantly between the war and non-war regions: in the non-war regions where risk exposure is relatively lower, wealthier households significantly reduce the importance of low-risk low-return activities in their overall activity portfolio. In the more risky war regions however, this relationship does not exist as wealthier households do not reduce allocation to low-risk activities.

To test for the robustness of this result, we focused attention on the decision by the household whether or not to grow particular crops. Based on detailed country-specific agricultural studies, we identify cassava as a low-risk low-return crop and maize as a more profitable but also riskier alternative. Overall, the results of the crop analyses confirm the previous results: wealthier households cultivate relatively more maize and relatively less cassava, but these associations are significantly different in the war regions, where wealthier households seem not to diversify out of the low risk crop.

Several shortcomings of the study should be mentioned. These shortcomings concern the construction of the dependent variable. In the first analyses, we use the income share of low-risk activities as a proxy for labour allocation to those activities. In general, this will be valid if the returns to the different activities do not differ too much across space. Further, to proxy the importance of specific crops (maize and

cassava), we calculate the fraction of a particular crop in total production. Clearly, this is not a perfect indicator of labour or time allocation to a specific crop. While we are fundamentally interested in the relationship between asset holdings and *input* decisions (the decision of the household to allocate certain proportions of their time and labour to specific crops given the value of their assets), we in fact estimate the relationship between asset holdings and *output* outcomes, assuming crop-specific output to be a good indicator for crop-specific input.

The findings of this paper have potentially important implications for policy: if households, in the logic of this paper, do not take account of their assets in determining activity choices when assets are very risky (e.g. during conflict), one could make a strong case for the establishment of a minimum asset threshold, targeted at all households in the worst conflict-affected areas. Such a productive social safety net as recently proposed by Barrett and Carter (2006) would consist of a net asset transfer to any household whose assets fall below the established threshold due to looting or killing of livestock during the conflict. This intervention would have to take place at the time of the shock and should be sufficient to keep the household above the threshold. Such an intervention could potentially provide the conflict-affected rural households with a sense of increased economic certainty in a situation characterized by dramatically increased risk. However, in order to be more confident in the results presented in this paper, similar analyses would have to be carried out for other conflict-affected countries.

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Appendix

Tables

Table 1: Average annual rainfall and temperature in Burundi's 11 natural regions, 1960-1987 and 1998-2005.

Natural region	Avg rainfall (mm) 1960-1987	Avg number of dry months	Avg temperature (degrees Celsius)	Avg rainfall 1998-2005 (mm)
Bugesera	1000.4	3.25	21.1	1024.4
Buragane	1276.5	3.95	no observations	1344.5
Bututsi	1483.4	3.74	17.0	1260.4
Buyenzi	1348.8	3.11	19.3	1181.3
Buyogoma	1250.1	3.93	19.8	1046.6
Bweru	1228.8	3.59	19.9	1183.6
Imbo	957.8	4.12	23.9	741.6
Kirimiro	1301.8	3.49	19.2	1079.5
Moso	1184.1	3.95	21.7	1049.0
Mugamba	1668.2	2.78	16.2	1445.9
Mumirwa	1492.5	3.25	18.7	no observations

Source: Tessens (1989) and personal visit to IGEBU (Burundi Institute of Geography)

Table 2: Livestock Holdings, Activity Choices and Income Shares Across Welfare Groups

Sample means	All (N=3900)	Poor (N=2760)	Non-poor (N=1140)
Livestock Ownership (fraction yes)	0.61	0.58	0.67
Number of Heads	3.4	2.9	4.6
Value of Livestock (1998 BIF)	58393	43890	93916
Activity choice (fraction yes)			
Food crop production	0.69	0.66	0.75
Cash crop production	0.51	0.49	0.54
Beer production	0.45	0.42	0.51
Agricultural wage employment	0.23	0.25	0.17
(unskilled)	0.15	0.13	0.20
Off-farm self employment	0.16	0.13	0.21
Livestock rearing	2.67	2.54	2.99
Number of activities			
Income shares (fraction of total	0.26	0.26	0.26
income)	0.19	0.19	0.18
Food crops	0.16	0.16	0.16
Cash crops	0.10	0.12	0.06
Beer sales	0.07	0.06	0.09
Agricultural wage employment	0.06	0.04	0.08
(unskilled)			
Off-farm self employment			
Livestock and livestock products	0.62	0.63	0.59
	0.64	0.61	0.72
Crop choice (fraction yes))			
Cassava cultivation			
Maize cultivation	0.11	0.12	0.10
	0.05	0.05	0.06
Crop shares (fraction in total	1508	1288	2049
production)			
Cassava	40693	30652	65252
Maize	6798	4451	12479
Total Production (kg)			
Total income			
Total consumption expenditures			

Notes: Poor households defined as households with monthly expenditures per adult equivalent less than 8174 BIF or 18.25$ in constant 1998 prices. For full calculations, see Bundervoet (2006). Data source: The Republic of Burundi, 1998.

Table 3: Livestock Holdings, Activity Choices and Income Shares Across Welfare Groups for Civil War-Region

Sample means	All (N=290)	Poor (N=213)	Non-poor (N=77)
Livestock Ownership (fraction yes)	0.42	0.42	0.43
Number of Heads	2.70	2.41	3.51
Value of Livestock (1998 BIF)	55017	46803	77740
Activity choice (fraction yes)			
Food crop production	0.60	0.56	0.73
Cash crop production	0.31	0.31	0.31
Beer production	0.19	0.20	0.16
Agricultural wage employment	0.27	0.28	0.25
(unskilled)	0.16	0.13	0.23
Off-farm self employment	0.07	0.06	0.08
Livestock rearing	2.67	1.85	2.03
Number of activities			
Income shares (fraction of total	0.33	0.33	0.33
income)	0.13	0.14	0.11
Food crops	0.09	0.09	0.07
Cash crops	0.15	0.16	0.16
Beer sales	0.07	0.05	0.13
Agricultural wage employment	0.02	0.02	0.03
(unskilled)			
Off-farm self employment			
Livestock and livestock products	0.58	0.59	0.54
	0.75	0.72	0.84
Crop choice (fraction yes)			
Cassava cultivation			
Maize cultivation	0.20	0.22	0.15
	0.13	0.12	0.13
Crop shares (fraction in total	1049	925	1390
production)			
Cassava	51783	41994	78861
Maize	6818	4404	13497
Total production (kg)			
Total income			
Total consumption expenditures			

Notes: Poor households defined as households with monthly expenditures per adult equivalent less than 8174 BIF or 18.25$ in constant 1998 prices. For full calculations, see Bundervoet (2006). Data source: The Republic of Burundi, 1998.

Table 4: Evolution of Live Animals, 1990-1998

Livestock	1990	1994	1998	% change
Cattle	431839	400000	346000	- 19.9
Goats	927472	910000	659000	- 28.9
Sheep	360633	360000	200000	- 44.5
Pigs	102799	85000	73000	- 29.0
Poultry	4400	4800	4600	+ 4.5
Rabbits	110	100	75	- 31.8
TLU	721617	686150	557030	-22.8

Notes: Poultry and rabbits per 1000 heads. For conversion to tropical livestock units (TLU): 1 cattle = 1 TLU; 1 goat = 1 sheep = 0.17 TLU; 1 pig = 0.25 TLU; 1 rabbit = 1 chicken = 0.01 TLU. Data source: FAOSTAT data, 2005.

Table 5: Evolution of Household Livestock Holdings Across Regions, 1993-1998

Region	Average TLU in 1993	Average TLU in 1998	Evolution
Civil War Provinces	3.93 (n=778)	0.68 (n=290)	-3.25
Other Provinces	2.14 (n=5316)	0.62 (n=3618)	-1.52
Mean Difference	1.79*** [0.305]	0.06 [0.092]	

Notes: Conversion of livestock holdings to tropical livestock units using the same factors as in Table 5. Data source for the 1993 data: United Nations Population Fund, 2002 (nationally representative household survey); Data source for 1998 data: The Republic of Burundi, 1998 (nationally representative household survey). N = number of surveyed households. Standard errors in brackets. ***: significant at 1%; **: significant at 5%; *: significant at 10%.

Table 6: Observables Across War and Non-War Provinces

	War Provinces	Other Provinces
Pre-War Poverty Headcount (% Poor in 1990)	22.4	40.5
1998 Poverty Headcount (% Poor in 1998)	52.5	53.2
Pre-War TLU per Household	3.93	2.14
1998 TLU per Household	0.68	0.62
Percentage of Household Heads with Any	41.0	31.0
Education	31.3	30.5
Percentage of Literate Mothers		

Notes: 1990 poverty headcount based on relative poverty line of 17.700 BIF per capita per year in 1990 prices (World Bank, 1995). Consumption expenditures in 1998 are deflated to make them comparable to the 1990 poverty line. Significant differences across war and other provinces for pre-war TLU and percentage of educated household heads. We cannot test for differences between pre-war poverty headcounts since we do not have the raw data. Data sources: World Bank, 1995; The Republic of Burundi, 1998; United Nations Population Fund, 2002.

Table 7: Savings and Safe Activity Choice: Empirical Results

	(1)	(2)	(3)
Dependent Variable:	Unskilled Off-Farm	Unskilled Off-Farm	Off-Farm + Food Crops
Estimation Procedure	Tobit	Tobit	Tobit
Assets per Capita	-0.742***	-0.608***	-0.114***
	[0.082]	[0.093]	[0.024]
Civil War*Assets per Capita	0.750***	0.648***	0.150**
	[0.097]	[0.151]	[0.067]
Female Head of Household		0.040	0.018
		[0.038]	[0.017]
Head of Household Education		-0.133***	-0.056***
		[0.033]	[0.015]
Head of Household's Age		-0.007	-0.005**
		[0.005]	[0.002]
(Head of Household's Age)^2		0.000	0.000
		[0.000]	[0.000]
Number of Male Adults		0.033	-0.006
		[0.021]	[0.009]
Number of Female Adults		0.023	-0.010
		[0.020]	[0.009]
Total Agricultural Production		-0.655***	0.118***
		[0.088]	[0.032]
Distance to Market		0.005	-0.009
		[0.013]	[0.006]
Constant	-0.747***	-0.404***	0.500***
	[0.082]	[0.142]	[0.060]
Province Fixed Effects	yes	yes	yes
Number of Observations	3801	3801	3801
Fraction of Positive Observations	23.5	23.5	79.7

Notes: Civil war equals one in the provinces of Bubanza, Bujumbura Rural and Cibitoke, zero otherwise. Head of household is educated if he/she completed at least primary education (dummy variable, 1 if educated). Total agricultural production equals total household production of all crops during the last agricultural season, expressed in 10.000 kg. Distance to market measured as number of minutes a person has to walk to reach the nearest market. Standard errors in brackets. ***: significant at 1%; **: significant at 5%; *: significant at 10%. Data source: The Republic of Burundi, 1998.

Table 8: Deflated Prices and Calorific and Protein Composition of Cassava and Maize

Crop	Deflated price in 1993	Deflated price in 1998	% change	Energy (kcal per 100g)	Protein (g per 100g)
Cassava	18.04	17.06	- 5.4	149	1.2
Maize	21.97	26.95	+ 22.7	364	10.0

Notes: ISTEEBU and WT Wu Leung et al. (1968); author's calculations.

Table 9: Savings and Crop Choice: Empirical Results

	(4)	(5)	(6)	(7)
Dependent Variable:	Cassava	Cassava	Maize	Maize
Estimation Procedure	Probit	Tobit	Probit	Tobit
Assets per Capita	-0.330***	-0.077***	0.324***	0.036***
	[0.086]	[0.017]	[0.113]	[0.007]
Civil War*Assets per Capita	0.575**	0.124***	-0.203	-0.035*
	[0.265]	[0.045]	[0.345]	[0.020]
Female Head of Household	-0.232***	-0.024**	-0.145**	0.003
	[0.059]	[0.010]	[0.061]	[0.006]
Head of Household Education	-0.092*	-0.020**	0.003	0.004
	[0.051]	[0.008]	[0.052]	[0.005]
Head of Household's Age	0.004	-0.001	-0.011	-0.000
	[0.007]	[0.001]	[0.007]	[0.000]
(Head of Household's Age)^2	-0.000	0.000	0.000	-.000
	[0.000]	[0.000]	[0.000]	[0.000]
Number of Male Adults	0.042	0.008	0.059*	0.004
	[0.032]	[0.005]	[0.033]	[0.003]
Number of Female Adults	0.011	0.001	0.007	0.002
	[0.030]	[0.005]	[0.032]	[0.003]
Total Agricultural Production	2.075***	0.145***	1.588***	-0.014
	[0.202]	[0.031]	[0.200]	[0.018]
(Total Agricultural Production)^2	-0.599***	-0.051***	-0.518***	0.013
	[0.093]	[0.016]	[0.096]	[0.009]
Distance to Market	0.016	-0.002	-0.030	-0.002
	[0.020]	[0.003	[0.021]	[0.002]
Constant	0.788***	0.260***	0.769***	0.011
	[0.205]	[0.034]	[0.206]	[0.020]
Province Fixed Effects	yes	yes	Yes	yes
Number of Observations	3774	3774	3774	3774
Fraction of Positive Observations	62.0	62.0	64.3	64.3
Pseudo R-squared	23.0		25.3	

Notes: Civil war equals one in the provinces of Bubanza, Bujumbura Rural and Cibitoke, zero otherwise. Head of household is educated if he/she completed at least primary education (dummy variable, 1 if educated). Total agricultural production equals total household production of all crops during the last agricultural season, expressed in 10.000 kg. Distance to market measured as number of minutes a person has to walk to reach the nearest market. In probit analyses (4) and (6): dependent variable equals one if household grows crop, zero otherwise. In tobit analyses (5) and (7): dependent variable is fraction of specific crop in total production Standard errors in brackets. ***: significant at 1%; **: significant at 5%; *: significant at 10%. Data source: The Republic of Burundi, 1998.