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## **Covariate Shocks and Rural Poverty in Burkina Faso**

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# Covariate Shocks and Rural Poverty in Burkina Faso

## Abstract:

The civil war in Côte d'Ivoire has caused an increase in household size due to returnees and a decrease in remittance received in rural Burkina Faso. This paper, taking advantage of a rare dataset covering the covariate shocks caused by the Ivorian Crisis, examines empirically the impact of such shocks on households' welfare in rural Burkina Faso.

It is found that the number of working-age returnees increases household cropped area: one working-age returnees increase 0.64 ha of cropped area and that the decrease of remittance from Côte d'Ivoire increases non-agricultural income: 1 FCFA reduction of remittance increases 0.78 FCFA of non-agricultural income. In spite of those coping behaviors, this paper demonstrates that the households do not fully smooth consumption against the reduction of remittance from Côte d'Ivoire. The impact is much larger for the asset-poor households than the asset-rich household, as expected. Female human capital, on the other hand, is found to enhance household expenditure per capita. Two-stage regression with non-agricultural income variable confirms the role of non-agricultural income in the reduction of poverty.

Key Words: covariate shocks, poverty, remittance

## Covariate Shocks and Rural Poverty in Burkina Faso

### 1. Introduction

Prevalent risk characterizes Sub-Saharan Africa, and is considered to be one of the major causes of its poverty (Dercon, 2005). Particularly, the risk of unexpected income loss due to drought and illness is very high. Households are prepared for risk by diversifying income sources and wealth, but because of the costly diversification they remain to be poor. Moreover, since such *ex-ante* risk management cannot be perfect, most households are affected by shocks of unexpected income loss. Even in such an event, households try to mitigate the shocks by liquidating assets and/or receiving transfer or loans from friends and relatives. Nevertheless, consumption cannot be unaffected (Dercon, 2002). In the case of covariate shock such as drought especially, informal risk coping mechanisms that depend on neighbors are not effective because many households within a certain region suffer simultaneously, and consequently the reduction of consumption level is not only severe but also more persistent (Hoddinott and Harrower, 2005 and Dercon, Hoddinott, and Woldehanna, 2005). Without relieving households from the vicious cycle of risk and poverty, poverty in Sub-Saharan Africa will not be alleviated.

Even in the case of covariate shocks, households could cope with them by receiving remittance from other regions that are not affected by the same shocks and/or out-migrating to such regions (e.g., forest zone in the case of drought). Since formal insurance is rarely available in Sub-Saharan Africa, income from such remittance and migration seem to be only one measure to cope with covariate shock. Most studies on covariate shocks deal with the case of drought (Dercon, Hoddinott, and Woldehanna, 2005), flood (Takasaki et al., 2005), earthquake (Sawada and Shimizutani, 2005), currency crisis (McKenzie, 2005), but it is not examined what will happen, particularly to household welfare, if the coping mechanisms against covariate shock themselves are

lost or weakened due to a covariate shock. Hence, this paper focuses on this issue using an original panel data set collected in Burkina Faso.

Burkina Faso, a landlocked country in West Africa, is located in the semi-arid zone on the southern edge of the Sahara desert, or in the Sahelian region (Figure 1). Most of the country's territory belongs to the Savanna zone whose annual precipitation varies from 400 mm in the north-east to 1200 mm in the south-west. Agriculture in this country is generally rain-fed, and frequent drought due to erratic rainfall keeps its productivity low and unstable. Since droughts are very frequent in Burkina Faso, rural households are known to be well prepared for them (e.g., Reardon, Matlon, and Delgado, 1988). But the country remains one of the poorest countries in the world: 53.1 percent of the country's rural population is below the poverty line in 2003 (Grimm and Günther, 2006). The poverty has made the rural population rely on external migration (mostly to neighboring Côte d'Ivoire) as well as remittance from the relatives living outside the country (also mostly in Côte d'Ivoire). It is estimated that such revenue constitutes 10 – 20 percent of their total income (Reardon, Matlon, and Delgado, 1988). In other words, rural households in Burkina Faso have diversified their income sources to zones (i.e., the forest zone) and sectors (i.e., non-agriculture) that are not subject to the erratic rainfall in the semi-arid zone. In addition, the regional migration has been contributing to the mitigation of population pressure on the land in Burkina Faso.

However, in September 2002, a military rebellion took place in Côte d'Ivoire. As a result, a considerable number of Burkinabés living in Côte d'Ivoire were obliged to return to their home and the total number is officially estimated to be some 350,000 as of July 2003. That is, the crisis in the neighboring country has imposed unexpected income reduction because the sources of remittance and migration income have been lost. In addition, the

returnees from Côte d'Ivoire have caused unexpected population pressure on rural Burkina Faso.<sup>1</sup> This kind of covariate shock has been rarely investigated in the literature. Hence, this paper investigates empirically the effect of the covariate shocks due to the Ivorian crisis on the welfare of rural households in Burkina Faso.

## **2. Study Site and Data**

The study site is eight villages shown in Figure 2, where Japan International Research Center for Agricultural Sciences (JIRCAS) and University of Ouagadougou (UO) have been conducting household survey since 1999<sup>2</sup>. They spread over the four major agro-ecological zones in Burkina Faso: the northern Sudanian zone, the southern Sudanian zone, the northern Guinean zone, and the southern Guinean zone. They differ significantly in the level of annual precipitation, and accordingly households' technological choice and risk management are different.

Thirty-two households were selected in each village in the following way. First, a village census was carried out in 1998, and village households were stratified based on the ownership/adoption of animal traction technology. Then, the number of sample households of each stratum is determined proportionally to the total number of households in each stratum so that the sample size of each village is fixed at thirty-two households. As a result, the number of sample households amount to 256 spread over the eight villages in the four agro-ecological zones.

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<sup>1</sup> Burkina Faso's total population is 13.2 million as of 2005 (World Bank), and total number of returnees is estimated to be 500,000 (Sakurai and Uchida, 2007).

<sup>2</sup> Among these eight villages, six villages (villages 1 and 2 in the northern Sudanian zone, villages 3 and 4 in the southern Sudanian zone, and villages 5 and 6 in the northern Guinean zone) are those where ICRISAT (International Crop Research Institute for the Semi-Arid Tropics) conducted household survey from 1980 to 1985. JIRCAS/UO chose them as the study site to see how they have changed in twenty years.

Then, from 1999 they were surveyed repeatedly for five years so as to construct a panel dataset. The interview was conducted three times a year; after harvest in February, at the end of the dry season in May, and after planting in September. In the middle of the survey period, the civil war in Côte d'Ivoire took place unexpectedly in September 2002. Therefore, this paper uses the panel dataset to explore the impact of the crisis. In order to focus on the direct impact of the Ivorian crisis, this paper uses the data collected in two villages in the southern Sudanian zone (village 3 and village 4 on Figure 2) because they are known to have been relying on remittance from Côte d'Ivoire significantly. Since these villages belong to the same agro-ecological zone and share the main market, influence of such factors need not be taken into account in the analyses. Around the two villages there are several small market places, but those are open only one or two days in a week. The main market is open every day and is located in Yako shown in Figure 2. Yako and the study villages are connected by a dirt but well maintained road, and hence those villages are reachable throughout a year by vehicle. A weather station is located in Yako and long-term rainfall data is available from the station. This paper uses annual rainfall observed at Yako weather station as annual rainfall level common to the two villages.

### **3. Analytical Framework**

Rural households in Burkina Faso are considered to have two kinds of covariate shock as a result of the Ivorian crisis. One is an increase in household size because of accepting returnees from Côte d'Ivoire. The other is a decrease in household income due to the suspension of remittance from Côte d'Ivoire. This paper assumes that these shocks are exogenous to the households as they are caused by the Ivorian crisis. As a result of the two exogenous shocks, household's income per

capita should decline due to the increase of household size and the decrease of remittance as well as migration income. To cope with the shocks, rural households will increase non-agricultural income, sell livestock, increase remittance from other sources, and increase agricultural production in the short-run. If such efforts are successful, household consumption per capita will not be affected, i.e., consumption is smoothed. Therefore, the main objective of this paper is to examine if rural households in Burkina Faso are insured against this kind of covariate shocks.

The analytical framework presented above can be expressed in the following econometric model.

$$A_{it} = A(R_{it}, GI_{it}, \mathbf{X}_{it}, \mathbf{Y}_t) \quad (1)$$

$$N_{ist} = N(R_{ist}, GI_{ist}, \mathbf{X}_{ist}, \mathbf{S}_s, \mathbf{Y}_t) \quad (2)$$

$$GB_{ist} = G(R_{ist}, GI_{ist}, \mathbf{X}_{ist}, \mathbf{S}_s, \mathbf{Y}_t) \quad (3)$$

$$L_{ist} = L(R_{ist}, GI_{ist}, \mathbf{X}_{ist}, \mathbf{S}_s, \mathbf{Y}_t) \quad (4)$$

The subscript  $i$  stands for household  $i$ ,  $t$  stands for harvest-year  $t$ , and  $s$  stands for season  $s$ . Harvest year starts from harvest season, then goes through dry season, and ends in planting season. Household data were collected three times a year in these three seasons, and the season in the model corresponds those three seasons.

Dependent variables are:  $A$  is household's total cropped area,  $N$  is the value of net non-agricultural income per capita including both self-employment and non-agricultural employment,  $GB$  is the value of net remittance per capita received from those who living in Burkina Faso, and  $L$  is the value of net livestock sales per capita. All the values are deflated by local food price index constructed by the survey data, and are in 2004 price. Since cropping is once a year, yearly data is used for equation (1), but otherwise seasonal data is used. Among explanatory variables, household level exogenous shocks are captured by the following two variables.  $R$ : total number of working-age



returnees in a period (either a year or a season)<sup>3</sup>, and  $GI$ : the real value of remittance received from those who living in Côte d'Ivoire in the corresponding period. Explanatory variables include the vector of household's characteristics and assets ( $\mathbf{X}$ ) and the vector of harvest-year and season dummies ( $\mathbf{S}$  and  $\mathbf{Y}$ ).

Then, as for the consumption smoothing, two models are considered. One is a reduced form, whose explanatory variables are the same as above:

$$E_{ist} = E (R_{ist}, GI_{ist}, \mathbf{X}_{ist}, \mathbf{S}_s, \mathbf{Y}_t) \quad (5)$$

where  $E$  is the natural logarithm of real expenditure per capita divided by the poverty line. The expenditure excludes durables, investment, and production inputs.

The other model includes the natural logarithm of total non-agricultural income ( $Q$ ) as an explanatory variable (equation (6)). The non-agricultural income ( $Q$ ) consists of net income from non-agricultural employment and self-employment ( $N$ ), net livestock sales ( $L$ ), net remittance received from those who living in Burkina Faso ( $GB$ ), institutional aids received, and agricultural employment income, but excludes income from own agricultural production. Since the non-agricultural income is considered to be endogenous in equation (6), it is instrumented.<sup>4</sup>

$$E_{is} = F (R_{ist}, GI_{ist}, Q_{ist}, \mathbf{X}_{ist}, \mathbf{S}_s, \mathbf{Y}_t) \quad (6)$$

In order to estimate equations (1) - (6), taking advantage of panel data, fixed effects model and random effects model are applied to each equation separately. Then, the Hausman test is used to judge which model is preferable.

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<sup>3</sup> Working-age is from 16 to 60. But in reality there are no returnees above the age of 60.

<sup>4</sup> Since the level of household human capital affects household income but its influences on household consumption is considered to be only through income, 8 exogenous variables capturing household human capital are used as instruments. In addition, sex and the age of household head, and the value of livestock holdings are used instruments.

## **4. Results**

### **4.1 Household Level Shocks due to Returnees**

First, the shocks are to be confirmed among sample households. Table 1 presents the demographic changes before and after the Ivorian crisis. It is clear that after the crisis a household received more than one working-age (age between 16 and 60) adult on average every year, and it increased household size significantly. Note that the number of working-age returnees is used as an exogenous shock variable rather than the change of household size because the latter includes other cases: for example, returnees under the age of 16, new-born babies, marriages, deceased, etc.

Table 2 summarizes the changes of net transfer during the survey period. Net transfer from non-household members living in Côte d'Ivoire, which is another exogenous shock in this study, declined significantly after the crisis. On the other hand, net transfer from non-household members living in Burkina Faso includes the cases within village, from near-by villages, and from cities in Burkina Faso, does not show a clear trend. It may be because households try to increase transfer from those people to cope with the reduction of transfer from Côte d'Ivoire. Almost all the cases of transfer from household members are within Burkina Faso, and as shown in the last column of Table 2, sample households are net givers on average. But the amount of net giving declined after the crisis although it is much smaller than that received from non-household members. From Tables 1 and 2, it is clear that the Ivorian crisis has caused shocks to rural households in Burkina Faso.

Did the shock affect households' welfare? Figure 3 shows the trend of average real expenditure per capita per month in 2004 harvest season price. There are significant seasonal and annual fluctuations, but the expenditure seems to be declining after the crisis, namely since 2002 planting season. Poverty line estimated for the sample households is 2832 FCFA per month per

capita in 2004 price, and the sample households on average were always below the poverty line.<sup>5</sup> In fact, poverty headcount ratio is always quite high, ranging from 0.63 (in 2000 dry season) to 0.94 (2002 planting season), as shown in Figure 3.<sup>6</sup> The headcount ratio also shows significant seasonal and annual fluctuations, but there seems to be an increasing trend over time. Hence, Figure 3 suggests that the Ivorian crisis have increased poverty among rural households in Burkina Faso.

In the next sections, the relationship between the shocks and the poverty will be formally investigated.

#### **4.2 Household Coping with Shock**

As shocks due to the Ivorian crisis are really observed, the next question is how rural households cope with them. To answer it, equations (1) – (4) are to be estimated. Table 3 is for household total cropped area. As expected, the number of working-age returnees has a positive impact on the household cropped area; one-adult returnees increases 0.64 hectare of area under cultivation. But the number of returnees does not change cropped area per capita. The regression results imply that land for cropping sufficiently exists in the study site. In fact, in the southern Sudanian zone where the study site is located, shifting cultivation is generally practiced, and households expand area for cropping in the bush and/or shorten fallow period if they need to produce more food. However, the expansion of cropping area may cause soil degradation, and as a result will make households trapped in poverty. On the other hand, transfer from Côte d'Ivoire does not have any significant effect on either household total cropped area or cropped area per capita. It

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<sup>5</sup> The poverty line of 2832 FCFA per month per capita in 2004 price is neither the official poverty line provided by Institut National de la Statistique et de la Démographie (INSD) nor rural poverty line given by Deuxieme Programme National de Gestion des Terroirs (PNGT 2). Rather it is calculated following the method and data given in appendix of Savadogo et al (2006). This is based on the observed prices of a 2283 calorie food component and regional level estimate of the share of non-food expenditure. Savadogo et al (2006) estimates 3487 FCFA per month per capita in 2004 price for the national level rural poverty line.

<sup>6</sup> Grimm and Günther (2006) estimates the headcount ratio of the North Region where the two sample villages are located is 0.69 in 2003 dry season. Our data shows 0.86, which is much higher than regional level given by Grimm and Günther (2006).

means that agricultural production does not substitute for the reduction of remittance. Concerning the effect of household human capital, it is found that high education level of adult male tends to reduce household total cropped area significantly. This may suggest either male education increases the allocation of household resource to non-agricultural activities or male education increases the intensification of agricultural production.

Table 4 is the regression results of equations (2) – (4), showing the determinants of households' coping behaviors other than area expansion. First, the reduction of remittance from Côte d'Ivoire significantly increases non-agricultural income: a decrease of 1 FCFA remittance increases 0.78 FCFA of non-agricultural income.<sup>7</sup> But working-age returnees have no effect on non-agricultural income. Second, as for net remittance within Burkina Faso and net livestock sales, neither is significantly influenced by the reduction of remittance or the increase of returnees. That is, only non-agricultural income among the three household coping strategies is responding to the shocks due to the Ivorian crisis. Domestic remittance and livestock sales cannot be effective probably because the Ivorian crisis has induced covariate shocks in Burkina Faso.<sup>8</sup>

Moreover, household assets (livestock and agricultural products) increases non-agricultural income per capita, and female education also increases non-agricultural income per capita. Since about half of working-age adults are engaged in non-agricultural activities in the study site, the findings above imply that there may be some constraints in assets and education for the remaining working-age adults who are not engaged in non-agricultural activities. But note that insignificant

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<sup>7</sup> The estimated coefficient is -0.26 as shown in Table 4, but transfer is the sum of 3 months, while non-agricultural income is the sum of 1 month. Hence, the real impact should be three times.

<sup>8</sup> Note that the dependent variables of equations (2) – (4) are per capita. Therefore, the non-significant effect of the number of returnees indicates that households keep the level of domestic remittance and livestock sales per capita although they receive returnees, implying they cope with shocks to some extent. In fact, it is observed in the study village that the frequency of transfer receiving and the number of goats and sheep sold have increased after the crisis (Sakurai, 2006). But since livestock prices decline after the crisis, revenue from the sales may not be much different.

relationship is found between male education level and non-agricultural income. Also note that the levels of household assets and human capital have little effect on domestic remittance and livestock sales. Since male education has no influence on the three coping strategies analyzed here, the regression result shown in Table 3 can be interpreted that male education induces intensification of agricultural production, rather than allocation of more resource to non-agricultural activities.

### **4.3 Impact on Household Welfare**

The important question is if the rural households smooth consumption by using the coping strategies as analyzed above. In order to see the impact of the exogenous shocks on household welfare, equation (5) is estimated. The regression is done using full sample and sub-samples respectively. The sub-samples are asset-poor and asset-rich, which are obtained based on the initial livestock holdings (as of the harvest season in 2000) because livestock is known to be an important asset to cope with shocks in Burkina Faso (Sakurai and Reardon 1997 and Fafchamps, Udry, and Czukas, 1998).

Table 5 shows regression results. The estimated coefficient of remittance per capita is positive and significantly different from zero, indicating that the reduction of remittance received significantly decreases household expenditure per capita. As shown in the previous section, households increase non-agricultural income per capita when remittance received per capita decreases, but the results shown in Table 5 imply that such coping is not sufficient to perfectly smooth consumption. Then, comparison between asset-rich households and asset-poor households reveals that the impact of remittance shock is larger among asset-poor households than among asset-rich households (not significantly different from zero at 10 % significance level). Since households with large livestock holding are likely to earn more non-agricultural income as shown previously, asset-rich households can mitigate the shock from the decrease of remittance. On the other hand, the

number of working-age returnees has no effect on household expenditure per capita. That is, households can keep the level of expenditure per capita in spite of the growth of household size.

The significant influence of rainfall variable means that rainfall is an important determinant of household expenditure per capita regardless of the asset-holding level. That is, households are subject to covariate shock due to the fluctuation of agricultural production caused by variable rainfall.

Education has certain influences on the consumption level. First, adult female's human capital (particularly experience of alphabetization or Koran school) significantly increases household expenditure per capita. The effect of female human capital is observed among both asset-rich and asset-poor households, but the impact is larger among asset-rich households. On the other hand, male human capital has little impact on household expenditure per capita although alphabetization is found to have a positive effect among asset-poor households and a negative effect among asset-rich households.

Lastly, how much extent the rural households smooth consumption against the change in income is examined by estimating equation (6).<sup>9</sup> The results are in Table 6. The full sample regression shows that non-agricultural income increases household expenditure per capita. The same is observed with asset-poor households. Thus, non-agricultural income contributes to the improvement of welfare of poor households. However, non-agricultural income does not have such effect among asset-rich households. In other words, asset-rich households have high enough non-agricultural income, and its variation does not affect the level of household expenditure. Moreover, remittance from Côte d'Ivoire and rainfall in the previous year show similar results as obtained by the reduced form regressions.

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<sup>9</sup> The sources of non-agricultural income include self-employment (68.7%), non-agricultural employment (8.5%), livestock sales (21.7%), remittance within Burkina Faso (3.3%), agricultural employment (0.8%), and public aid (1.0%). Their average shares over the survey period are in the parentheses.

## 5. Conclusions

The civil war in Côte d'Ivoire has caused an increase in household size due to returnees and a decrease in remittance received in rural Burkina Faso. The impact of the two kinds of shock on household's coping behavior is investigated first. The number of working-age returnees increases household cropped area: one working-age returnees increase 0.64 ha of cropped area. And the decrease of remittance from Côte d'Ivoire increases non-agricultural income: 1 FCFA reduction of remittance increases 0.78 FCFA of non-agricultural income. However, livestock sales and remittance within Burkina Faso are found not to be a response to those shocks.

In spite of those coping behaviors, this study demonstrates that the households do not fully smooth consumption against the reduction of remittance from Côte d'Ivoire. The impact is much larger for the asset-poor households than the asset-rich households, as expected. Female human capital, on the other hand, is found to enhance household expenditure per capita. Female human capital and livestock holdings are considered to mitigate the shock by increasing non-agricultural income. Two-stage regression with non-agricultural income variable confirms the role of non-agricultural income in the reduction of poverty.

It is well-known that remittance is one of the most important income sources for rural households not only in Burkina Faso but also in most part of Sub-Saharan Africa. However, it has not been examined how significant the remittance is for the welfare of rural households. This paper, taking advantage of a rare occasion of region-wide suspension of remittance, shows that the loss of remittance has made rural households poorer because agricultural production cannot replace remittance and local non-agricultural income does not fully compensate for the loss of remittance. Diversification of remittance sources and/or enhancement of the capacity of local non-agricultural activities will be required to make rural households more robust to such shocks.

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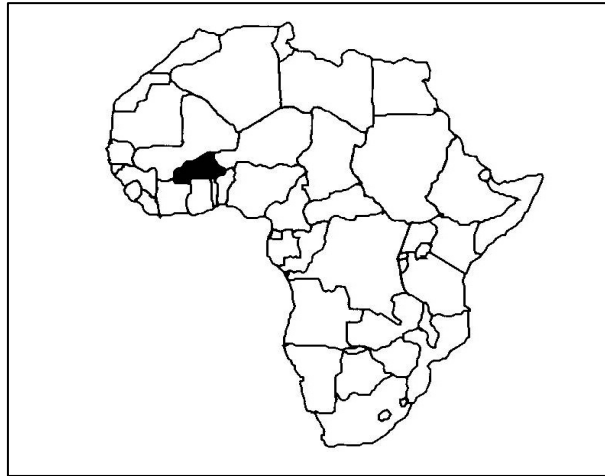
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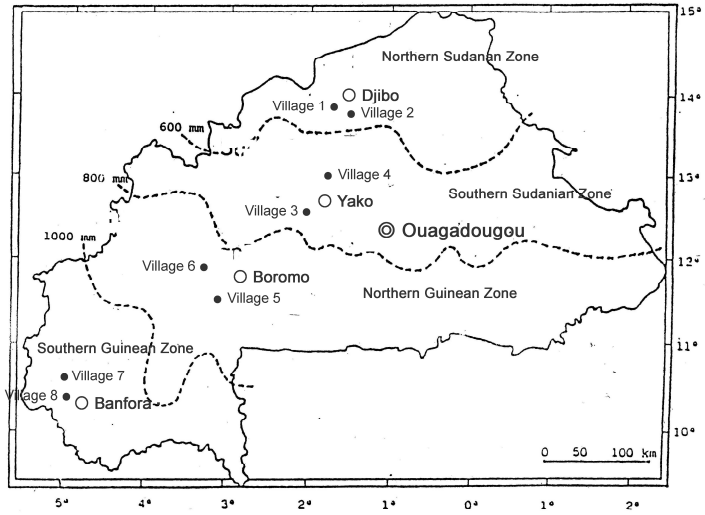
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**Figure 1** Location of Burkina Faso



**Figure 2 Study Site**

Table 1 Demographic Impact of the Ivorian Crisis

Harvest Year	Number of Working-Age Returnees in a Year	Number of Working-Age Adults	Number of Household Members
2000/2001	0.49 (0.78)	4.24 (4.20)	11.6 (9.91)
2001/2002	0.67 (1.00)	4.53 (3.93)	12.0 (9.69)
2002/2003 (after the crisis)	1.27 (1.96)	5.66 (4.42)	13.6 (10.6)
2003/2004 (after the crisis)	1.40 (2.65)	6.01 (4.61)	14.2 (11.6)

The numbers are mean number of persons per household, and the standard deviations are in the parentheses.

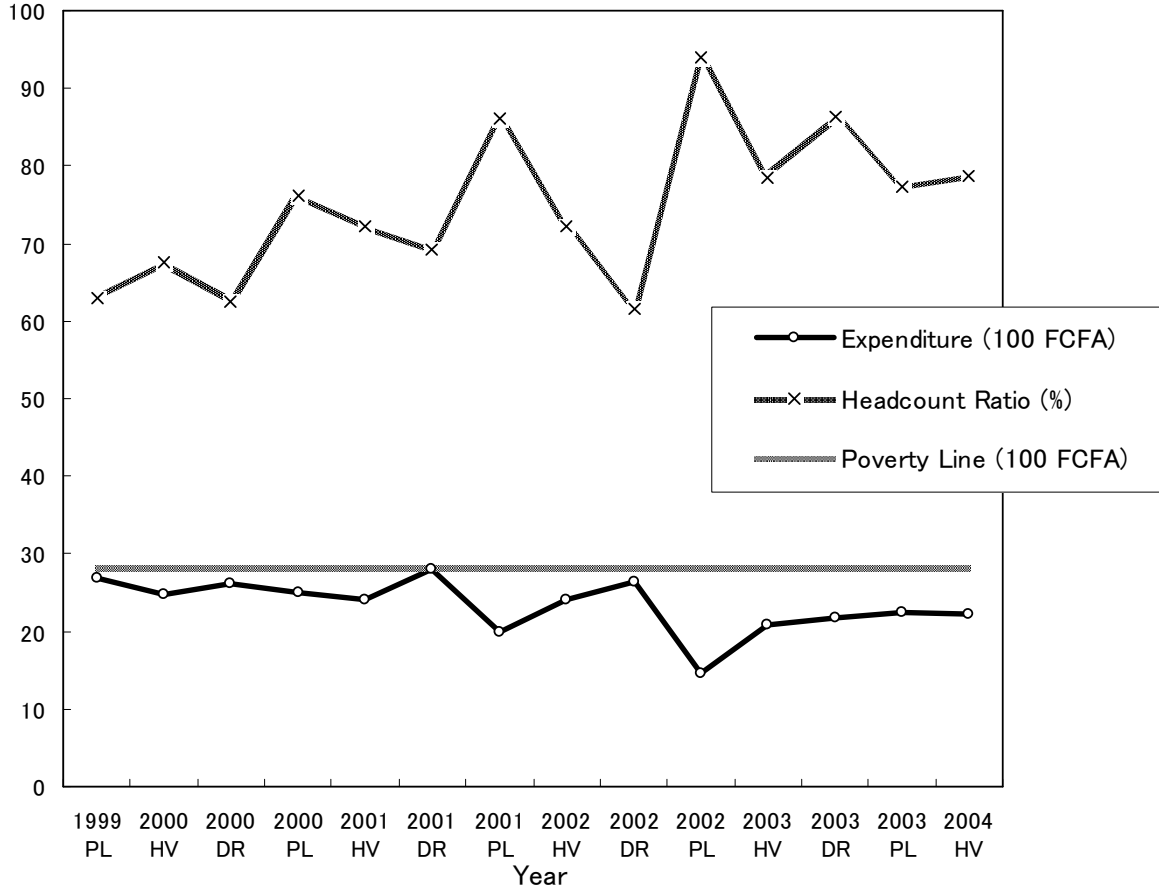
Table 2 Impact of the Ivorian Crisis on Transfer

Harvest Year	From Non-Household Members Living in Côte d'Ivoire	From Non-Household Members Living in Burkina	From Household Members Living Away from Home <sup>1</sup>
2000/2001	254 (471)	89.7 (339)	-34.1 (126)
2001/2002	239 (312)	36.9 (279)	-38.2 (83.0)
2002/2003 (after the crisis)	208 (326)	64.7 (273)	-24.7 (79.0)
2003/2004 (after the crisis)	172 (346)	76.2 (220)	-16.3 (36.2)

The numbers are real value of net transfer per capita per month in FCFA, and the standard deviations are in the parentheses.

<sup>1</sup> They are living in Burkina Faso.

Figure 3 Poverty Over Time



Note: PL=planting season, HV=harvesting season, and DR=dry season

Table 3 Determinants of Household's Total Cropped Area

Explanatory Variables	Dependent Variable	Total Cropped Area (ha)	Cropped Area per Capita (10 <sup>-1</sup> ha)
Exogenous Shocks			
Transfer from Côte d'Ivoire <sup>1</sup>		3.04 (1.00)	3.47 (1.42)
Number of Working-Age Returnees <sup>2</sup>		0.64 (1.82) *	0.10 (0.40)
Household Assets			
Real Value of Livestock Holdings per Capita		5.14 (2.34) **	3.44 (1.63)
Household Demographics			
Household Size		0.44 (14.7) ***	-0.06 (2.09) **
Working-Age Male Rate (Number/HH size)		-4.76 (2.41) **	-4.73 (2.22) **
Working-Age Female Rate (Number/HH size)		-0.09 (0.04)	1.80 (1.17)
Number of Working-Age Deceased <sup>2</sup>		-0.61 (1.45)	0.15 (0.38)
Household Head's Characteristics			
Male (dummy)		0.66 (0.66)	-0.62 (0.36)
Household Head's Age (10)		-1.78 (0.31)	-3.84 (0.48)
Household Head's Age Squared (10 <sup>2</sup> )		1.71 (0.38)	2.52 (0.43)
Household Human Capital			
Adult Male Highest Education			
Alphabetization of Local Language (dummy)		-1.71 (1.74) *	-1.45 (2.40) **
Koran school (dummy)		-2.46 (2.01) **	-0.98 (0.89)
Primary School (dummy)		-1.63 (1.38)	0.05 (0.06)
Secondary School or Higher (dummy)		-7.20 (3.18) ***	-2.64 (2.08) **
Adult Female Highest Education Level			
Alphabetization of Local Language (dummy)		2.53 (2.52) **	2.32 (2.38) **
Koran school (dummy)		-1.66 (1.17)	-0.67 (0.91)
Primary School (dummy)		1.05 (1.25)	0.40 (0.58)
Secondary School or Higher (dummy)		NA	NA
Harvest Year Dummies		included	included
Constant		1.42 (0.87)	6.37 (2.65) ***
Number of Observations		231	231
R <sup>2</sup>		0.81	0.18
Hausman Test		4.26	33.0 <sup>3</sup>
Estimation Method		random effect	random effect

Standard errors are in parentheses. \*, \*\*, and \*\*\* indicate that the coefficient is estimated at significance level 10%, 5%, and 1% respectively.

<sup>1</sup> Real value in 2004 price per capita per year (10<sup>4</sup> FCFA).

<sup>2</sup> Total number during the past 1 year

<sup>3</sup> Hausman test supports fixed effect model.

Table 4 Determinants of Household's Coping Behavior

Explanatory Variables	Dependent Variable	Non-agricultural Net Income <sup>1</sup>	Transfer within Burkina Faso <sup>2</sup>	Net Livestock Sales <sup>2</sup>
Exogenous Shocks				
Transfer from Côte d'Ivoire <sup>3</sup>		-0.26 (2.80) ***	0.02 (0.19)	0.09 (0.27)
Working-Age Returnees Rate (Number/HH size)		0.10 (0.58)	0.35 (1.21)	-0.11 (0.23)
Household Assets				
Real Value of Livestock Holdings per Capita		0.13 (2.10) **	-0.12 (1.05)	0.52 (1.52)
Crop Production in the Previous year <sup>4</sup>		0.17 (2.08) **	-0.08 (0.83)	-0.11 (0.74)
Household Demographics				
Household Size (10 <sup>2</sup> )		0.47 (3.09) ***	-0.44 (1.94) *	-1.47 (3.78) ***
Working-Age Male Rate (Number/HH size)		0.29 (1.76) *	-0.11 (0.71)	-0.22 (0.48)
Working-Age Female Rate (Number/HH size)		0.06 (0.55)	0.09 (0.53)	-0.33 (1.13)
Working-Age Deceased Rate (Number/HH size)		-0.15 (0.22)	0.64 (1.56)	0.40 (0.28)
Household Head's Characteristics				
Male (dummy)		-0.10 (1.42)	-0.05 (0.84)	0.24 (1.37)
Household Head's Age (10)		0.22 (0.97)	-1.87 (3.19) ***	1.29 (1.69) *
Household Head's Age Squared (10 <sup>2</sup> )		-0.20 (1.14)	1.91 (3.78) ***	-1.02 (1.87) *
Household Human Capital				
Adult Male Highest Education				
Alphabetization of Local Language (dummy)		-0.05 (1.63)	0.04 (1.19)	0.30 (2.36) **
Koran school (dummy)		-0.06 (1.36)	-0.03 (0.17)	-0.07 (0.67)
Primary School (dummy)		0.04 (0.72)	-0.07 (1.12)	0.14 (1.15)
Secondary School or Higher (dummy)		0.10 (0.86)	-0.03 (0.18)	-0.09 (0.18)
Adult Female Highest Education Level				
Alphabetization of Local Language (dummy)		0.11 (2.65) ***	-0.05 (0.67)	-0.29 (2.02) **
Koran school (dummy)		0.28 (2.32) **	-0.37 (3.63) ***	-0.14 (1.00)
Primary School (dummy)		-0.02 (0.76)	0.07 (0.98)	0.09 (0.93)
Secondary School or Higher (dummy)		0.04 (1.05)	-0.19 (1.57)	0.21 (1.43)
Harvest Year /Season Dummies		included	included	included
Constant		-0.15 (1.34)	0.33 (0.32)	1.17 (0.66) *
Number of Observations		703	703	703
R <sup>2</sup>		0.19	0.16	0.05
Hausman Test		16.2	10.9	0.00
Estimation Method		random effect	random effect	random effect

Standard errors are in parentheses. \*, \*\*, and \*\*\* indicate that the coefficient is estimated at significance level 10%, 5%, and 1% respectively.

<sup>1</sup> Real value in 2004 price per capita per month (10<sup>4</sup> FCFA).

<sup>2</sup> Real value in 2004 price per capita per month (10<sup>5</sup> FCFA).

<sup>3</sup> Real value in 2004 price per capita per year (10<sup>4</sup> FCFA).

<sup>4</sup> The product of household's cropped area per capita in the previous year and annual rainfall in the previous year (10<sup>3</sup> ha\*mm).

Table 5 Determinants of Household Welfare (Reduced-form Models)

Variable	Dependent	Expenditure <sup>1</sup> Full Sample	Expenditure <sup>1</sup> Asset-Poor <sup>2</sup>	Expenditure <sup>1</sup> Asset-Rich <sup>2</sup>
<b>Exogenous Shocks</b>				
Transfer from Côte d'Ivoire <sup>3</sup>		0.48 (2.10) **	0.91 (2.02) **	0.45 (1.55)
Working-Age Returnees Rate (Number/HH size)		0.13 (0.42)	0.28 (0.52)	0.19 (0.45)
<b>Household Assets</b>				
Real Value of Livestock Holdings per Capita		0.25 (2.31) **	1.36 (3.23) ***	0.15 (1.36)
Crop Production in the Previous Year <sup>4</sup>		0.28 (3.61) ***	0.20 (1.75) *	0.30 (3.03) ***
<b>Household Demographics</b>				
Household Size (10 <sup>2</sup> )		0.10 (0.31)	-1.53 (3.19) ***	0.48 (1.45)
Working-Age Male Rate (Number/HH size)		0.33 (1.23)	0.02 (0.07)	-0.12 (0.33)
Working-Age Female Rate (Number/HH size)		0.61 (2.71) ***	0.79 (2.94) ***	0.64 (2.01) **
Working-Age Deceased Rate (Number/HH size)		0.79 (1.11)	-0.03 (0.05)	1.47 (2.21) **
<b>Household Head's Characteristics</b>				
Male (dummy)		0.23 (1.70) *	0.36 (2.98) ***	NA
Age (10 <sup>2</sup> )		-1.21 (2.40) **	-2.00 (1.98) **	-1.16 (1.70) *
Age Squared (10 <sup>4</sup> )		0.97 (2.41) **	2.02 (2.19) **	0.78 (1.45)
<b>Household Human Capital</b>				
<b>Adult Male Highest Education</b>				
Alphabetization of Local Language (dummy)		0.05 (0.45)	0.42 (2.95) ***	-0.20 (1.91) *
Koran school (dummy)		0.00 (0.03)	NA	-0.02 (0.14)
Primary School (dummy)		-0.01 (0.14)	0.14 (0.89)	-0.02 (0.28)
Secondary School or Higher (dummy)		-0.04 (0.32)	NA	-0.01 (0.11)
<b>Adult Female Highest Education Level</b>				
Alphabetization of Local Language (dummy)		0.02 (0.14)	NA	0.24 (2.03) **
Koran school (dummy)		0.29 (2.45) **	0.31 (1.81) **	0.42 (2.42) **
Primary School (dummy)		-0.08 (1.10)	-0.04 (0.48)	0.03 (0.30)
Secondary School or Higher (dummy)		-0.33 (4.19) ***	-0.15 (1.42)	NA
Rainfall (10 <sup>-</sup> mm) in the Previous Year		0.13 (4.173) ***	0.14 (2.61) ***	0.13 (3.55) ***
Harvest Year /Season Dummies		included	included	included
Constant		-0.82 (2.67) ***	-0.68 (1.45)	-0.95 (2.94) ***
<hr/>				
Number of Observations		825	384	408
R <sup>2</sup>		0.19	0.26	0.24
Hausman Test		16.7	3.36	13.2
Estimation Method		random effect	random effect	random effect

Standard errors are in parentheses. \*, \*\*, and \*\*\* indicate that the coefficient is estimated at significance level 10%, 5%, and 1% respectively.

<sup>1</sup> The dependent variable is natural logarithm of real per capita expenditure per month divided by the poverty line.

<sup>2</sup> Asset poor households are those whose real livestock value per capita was less than 1,290 FCFA as of the harvest season of 2000, and asset rich households owned more livestock than 1,290 FCFA.

<sup>3</sup> Total amount of remittance received per capita in real value during the current period (10<sup>4</sup> FCFA)

<sup>4</sup> The product of household's cropped area per capita in the previous year and annual rainfall in the previous year (10<sup>3</sup> ha\*mm).



Table 6 Determinants of Household Welfare (2 stage Model)

Explanatory Variables	Dependent Variable	Expenditure <sup>1</sup> Full Sample	Expenditure <sup>1</sup> Asset-Poor <sup>2</sup>	Expenditure <sup>1</sup> Asset-Rich <sup>2</sup>
Total Income except from Agricultural Production <sup>3</sup>		0.15 (2.84) ***	0.35 (4.25) ***	0.05 (0.66)
Exogenous Shocks				
Transfer from Côte d'Ivoire <sup>4</sup>		0.85 (3.04) ***	1.32 (1.91) *	0.77 (2.70) ***
Working-Age Returnees Rate (Number/HH size)		-0.34 (1.04)	-0.09 (0.16)	-0.58 (1.30)
Household Assets				
Crop Production in the Previous Year <sup>5</sup>		0.22 (2.27) **	0.05 (0.28)	0.30 (2.20) **
Household Demographics				
Household Size (10 <sup>2</sup> )		0.30 (1.17)	0.53 (0.81)	0.55 (1.61)
Working-Age Male Rate (Number/HH size)		0.29 (1.35)	0.03 (0.07)	0.01 (0.02)
Working-Age Female Rate (Number/HH size)		0.39 (2.05) **	0.44 (1.47)	0.42 (1.42)
Working-Age Deceased Rate (Number/HH size)		1.25 (2.22) **	1.89 (1.30)	1.62 (2.79) ***
Rainfall (10 <sup>2</sup> mm) in the Previous Year		0.22 (2.27) ***	0.22 (3.53) ***	0.14 (3.44) ***
Harvest Year /Season Dummies		included	included	included
Constant		-1.17 (4.15) ***	-1.31 (2.80) ***	-1.24 (3.12) ***
Number of Observations		689	336	324
R <sup>2</sup>		0.24	0.17	0.27
Hausman Test		13.0	15.0	1.18
Estimation Method		random effect	random effect	random effect

Standard errors are in parentheses. \*, \*\*, and \*\*\* indicate that the coefficient is estimated at significance level 10%, 5%, and 1% respectively.

<sup>1</sup> The dependent variable is natural logarithm of real per capita expenditure per month divided by the poverty line.

<sup>2</sup> Asset poor households are those whose real livestock value per capita was less than 1,290 FCFA as of the harvest season of 2000, and asset rich households owned more livestock than 1,290 FCFA.

<sup>3</sup> Natural logarithm of household total real income per capita per month except for that from own agricultural production (10<sup>4</sup> FCFA).

<sup>4</sup> Total amount of remittance received per capita in real value during the current period (10<sup>4</sup> FCFA).

<sup>5</sup> The product of household's cropped area per capita in the previous year and annual rainfall in the previous year (10<sup>3</sup> ha\*mm).