Shocks, Structural Change, and the Patterns of Income Diversification in Burkina Faso

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This paper investigates changes in income diversification patterns for the case of Burkina Faso between 1994 and 2003. Contrary to common beliefs, our empirical analysis shows that rural households are not increasingly diversifying their income portfolios. Beyond insuring against and coping with weather shocks, diversification behaviour reflects structural change. Higher returns to agricultural activities, in particular in the cotton and livestock sectors, appear to be the root cause for less non-agricultural diversification and some of our findings hint at better opportunities in the non-farm sector. Yet, average returns in the non-farm sector appear to remain relatively low and migration increasingly turns into a desperation-led strategy. Overall, structural change seems to be biased in favour of richer households. Regarding responses to droughts, we confirm earlier findings, especially that the poorest households are hit particularly hard being forced to sell livestock, often their only asset.

Introduction

A number of studies have illustrated the diversity of rural livelihoods in sub-Saharan Africa and shown that income diversification serves as a coping strategy in risky agricultural environments. Still, relatively little is known about changes in patterns of income diversification in the medium to long run. Farming typically constitutes the main source of livelihood for rural households and leaves them vulnerable to crop failures in drought-prone environments, in particular in the Sahel zone. Still, it has been demonstrated that households insure themselves against harvest shortfalls through engagement in activities outside crop farming (e.g. Reardon et al. 1992). A common insurance mechanism is the selling of livestock, but households also diversify into local non-agricultural activities or by sending household members elsewhere (Reardon and Taylor 1996).

Such an "insurance" view on off-farm income diversification is clearly too narrow. When diversification is pursued to ensure survival, for example because of land constraints, it is also referred to as distress-push or desperation-led diversification (Islam 1997, Reardon et al. 2000, Barrett et al. 2001). In contrast, rural households may face opportunities outside agriculture, e.g. due to higher demand for non-food products (Reardon 1997). In this case, non-agricultural income diversification is also regarded as demand-pull or opportunity-led diversification. For Asia, country case studies show a dramatic increase of the share of non-farm income in high-growth countries like Thailand. This opportunity-led diversification is accompanied by a shift towards more diversified farming systems with a more important role for high-value cash-crops and livestock (Otsuka and Yamano 2006). While it seems to be common ground that sub-Saharan rural households also increasingly diversify their livelihoods – yet mainly driven by desperation (Bryceson, 2002a) – systematic evidence on the patterns of change over longer time periods is rather scarce. Accordingly, most existing studies on income diversification in the sub-Saharan context rely on cross-sectional or short-term panel data.[1]

This paper intends to fill this gap. More specifically, we examine income diversification patterns of farm households in rural Burkina Faso between 1994 and 2003. After structural adjustment in the early 1990s, the country experienced fairly

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[1] Exceptions include Block and Webb (2001) and Lemi (2006) on Ethiopia.

high per capita income growth that went along with substantial poverty reduction in rural areas (Grimm and Günther 2007a), although the economy was recurrently hit by droughts and other external shocks. In particular, Burkinabè households were affected by the political crisis in Côte d'Ivoire, its major destination for temporary work migration.

Our empirical analysis indicates that rural households are not increasingly diversifying their income portfolios in Burkina Faso. In addition, the motivations for diversification are subject to change and our findings do not support the view that desperation-led diversification is (or becomes) the rule in poor African countries. Rather, a nuanced picture emerges: Better opportunities in agriculture, in particular in the cotton and livestock sectors, allow households to specialise in these activities although richer households are more likely to do so. Non-farm activities become somewhat more opportunity-led. Yet, our findings also give reasons to worry. Average returns in the non-farm sector appear to remain relatively low and migration increasingly turns into a strategy pursued by more desperate households. In addition, farmers' responses to the 1997/98 drought are very similar to the pattern that could be observed in earlier work by Reardon and Taylor (1996) for the early 1980s. The poorest households are forced to sell livestock, often their only asset, which may keep them in a poverty trap. In the remainder of the paper, we first shortly review the literature on the determinants and effects of diversification, with a focus on distinct motivations. We then present some more detailed country background and an empirical analysis of changes in income portfolios for the case of Burkina Faso. The paper closes with some concluding remarks.

Determinants and effects of income diversification

A large number of rural households in sub-Saharan Africa rely on earnings generated outside home agriculture (e.g. Otsuka and Yamano 2006, Reardon 1997). Besides soil cultivation and livestock breeding, non-agricultural activities in the local non-farm sector and non-local income generation via migration are important income sources, so that "diversification is the norm" (Barrett and Reardon 2000). Such behaviour is difficult to reconcile with economies of scale in any of the activities and comparative advantage, which would imply a specialisation in one activity. Yet, it may be explained by the following factors that can be categorised into insurance, desperation

and opportunity motives.

If credit and insurance markets are incomplete and formal safety nets are missing – which is the case for most parts of rural sub-Saharan Africa – households will choose to diversify their income sources in order to smooth consumption (Murdoch 1995). Under climatically unstable conditions rainfall shocks play a major role in activity decisions. In regions with high rainfall variability households may opt to diversify incomes ex-ante to manage the risk of possible shocks. Alternatively, household may be pushed into diversification ex-post as soon as harvest shortfalls occur (Reardon et al. 1992). For instance, they may be forced to sell their livestock (Dercon 1998, Reardon and Taylor 1996). Alternatively, households may send members to engage in markets at other places, where returns are not correlated to the returns at home (Lucas and Stark 1985).

It has been emphasised in the sub-Saharan context that households may be forced to diversify if land endowments become too small to sustain subsistence following subdivision at inheritance (e.g. Bryceson and Jamal 1997, Barrett et al. 2000). This may hold particularly for female-headed households, which often have limited access to land due to a poor enforcement of land property rights (Chapoto et al. 2006). Such desperation-led diversification may also be observed in areas with generally low agricultural potential (e.g. Matsumoto et al. 2006).

In contrast, agriculturally favoured regions may exhibit higher levels of opportunity-led non-farm diversification through intersectoral linkages (Haggblade et al. 1989, Liedholm and Kilby 1989). In these regions, demand for non-food products may be higher (consumption linkage) and food processing can become an important non-farm activity (production linkage). Certainly, the existence of such local non-farm opportunities is linked to access to markets (de Janvry et al. 1991).

The capacity for diversification is often shaped at the household level. Obviously, entry barriers are higher for opportunity-led diversification, but even desperation-led diversification may be constrained. Household decisions for migration are facilitated by home-village networks at the destination place (Hampshire 2002). Educational attainment determines earning possibilities off the home-farm (e.g. de Janvry and Sadoulet 2001, Yúnez-Naude and Taylor 2001). Lucrative non-farm activities often require some capital that asset-poor households are not able to provide (Woldenhanna and Oskam 2001, Abdulai and CroleRees 2001, Dercon and Krishan 1996). For

instance, launching a non-farm enterprise requires business expertise and some capital, even though most rural non-farm activities are labour-intensive (Norcliffe 1983). Barrett (1997) reveals that many households lack access to lumpy assets (e.g. machinery and other equipment) to enter profitable niches in the non-farm sector. Where credit markets exist, livestock assets can serve as collateral (Fafchamps et al. 1998). When credit is not available, households need liquid assets for such investments, so that cash-cropping can be an important means for overcoming entry constraints. Alternatively, the necessary cash capital can come from remittances (Lucas 1987, Francis and Hoddinott 1993).

All these conditions that constrain or foster both opportunity- and desperation-led income diversification – at the household, regional, or national level – are subject to change. Rapid population growth and the related pressure on the natural resource base are often identified as the major cause for the rise of non-agricultural activities and migration in sub-Saharan Africa (Bryceson and Jamal 1997, Barrett et al. 2000, Bryceson 2002b). While shortages of fertile land may hence push households increasingly into diversification, other factors at the household-level, in particular the expansion of education, may enable them to earn higher returns from local non-farm activities or migration. In addition, technological advances, better infrastructure, the intensification of links with markets outside the local economy, local engines of growth, such as commercial agriculture or proximity to an urban area, or simply per capita growth and increased demand for non-food goods and services can lead to a growing non-farm sector (Reardon 1999, Haggblade et al. 2002).

The structural reform programs that many African countries have undergone in the late 1980s and early 1990s have certainly shaped the patterns of growth and household portfolios in these countries since then. Possibly, reforms had their most pronounced impact on income portfolios through altering the returns in agricultural activities, in particular in cash crop sectors, which often had been subject to heavy regulation. Furthermore, macroeconomic stability that has been recorded by most reform countries since the mid-1990s may have strengthened farmers' trust into markets thereby contributing to increased market participation.

Changes in the patterns of income portfolio will also have important poverty and inequality implications. Again, the existing evidence typically builds on cross-sectional or short-term panel data. All in all, there seems to be a positive correlation

between wealth and diversification in rural Africa (Barrett et al. 2001). If diversifying incomes go mainly to the better-off, as for instance non-farm income often does, growth in these sectors is inequality-increasing (Elbers and Lanjouw 2001). However, others find that non-farm income is concentrated among the poor, so that an increase in these incomes is eventually pro-poor (van de Berg and Kumbi 2006, Adams 2002). These seemingly contradictory findings can possibly be reconciled by taking into account the distinct motivations for diversification. Accordingly, Lay et al. (forthcoming) find the expansion of opportunity-led diversification to have little impact on poverty, while growth of income from desperation-led activities significantly reduces poverty. In such a case, the overall impact of diversification on the income distribution remains mixed.

It is against the background of this variety of empirical findings that we analyse Burkina Faso's income diversification patterns and their determinants.

Income diversification and inequality in Burkina Faso: Patterns and changes

Country setting: Shocks and change

We use three country-wide representative household surveys for Burkina Faso, Enquete Prioritaires (EP) that were conducted in 1994 (EP I), 1998 (EP II), and 2003 (EP III). Between 1994 and 2003, annual per capita growth averaged 2% due to a wide range of economic reforms and rural poverty rates fell from 63.4% to 53.3% (Grimm and Günther 2007a).

In this West-African country rainfall levels are low and vary over regions. Drought periods occur regularly, like in 1997/98 and 2000/01. Harvest shortfalls often involve an explosion of staple prices, as for example after the 1997/98 drought. This price hike contributed to the high levels of poverty in 1998, when the headcount rose to 68.7%, as most of the rural poor are net buyers of food (Grimm and Günther 2007a). Agriculture has a strong seasonal character with a short rainy season from May to August, so that the agricultural labour force faces a long lean season (Delgado and Ranade 1987). Therefore, there is a tradition of seasonal migration to agriculturally more favourable regions in Côte d'Ivoire, where household members temporarily work on cocoa and coffee farms (Konseiga 2007). Furthermore, quite a few

Burkinabè households rely on remittances from relatives who have settled down permanently in Côte d'Ivoire. However, in 2002 the ongoing political crisis in Burkina Faso's neighbouring country gave rise to a civil war, which affected these labour movements. In both 1998 and 2003, Burkinabè households hence faced substantial adverse shocks that should have influenced their income portfolio choices. Another though rather positive shock, at least for rural households, was the CFA Franc devaluation in 1994. The devaluation favoured Burkina's main export sector, cotton, which became the main driver of agricultural growth in the period under consideration. The share of cotton farmers increased significantly from 8 per cent in 1994 to 24 per cent in 2003.[2] Yet, change in agriculture was not limited to the cotton sector: Despite little or no improvement in overall agricultural productivity, market integration of staple-food farmers also improved considerably. Furthermore, the livestock sector grew rapidly. Own calculations based on the survey data reveal that cattle ownership increased from 40 per cent of rural households in 1994 to 67 per cent in 2003, with the average number of cattle conditional on ownership remaining constant at approximately 8.5.

These developments in the agricultural sector as well as the external shocks shaped the patterns of income diversification that we analyse below. In the Burkinabè context, diversification and its welfare impact have been investigated earlier by Reardon et al. (1992) and Reardon and Taylor (1996). These studies were based on a panel dataset for the cropping seasons 1983/84 and 1984/85 and focused on household responses to drought.[3] They show that poor households depend mainly on crop income and lack access to non-farm income that could cushion the effect of harvest failures (Reardon et al. 1988, Reardon et al. 1992, Reardon and Taylor 1996). As a result, poor households turn to selling their livestock during periods of drought, thereby increasing inequality and possibly trapping these households in poverty (Reardon and Taylor 1996). As the 1998 survey data should also capture the impact of the 1997/1998 drought, the subsequent analysis also sheds light on the question of whether Reardon and Taylor's findings still hold 13 years later.

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[2] See Grimm and Günther (2007b). All cotton in Burkina is bought by the parastatal Sofitex, which guarantees a fixed price at the beginning of the season. While the gains from the devaluation therefore mainly benefited Sofitex, cotton producers were protected from the subsequent decline in world market prices between 1998 and 2003.

[3] The survey covers only 150 households, 50 in each agro-climatic region, which somewhat impairs the significance of the results.

We first provide a simple descriptive analysis of the patterns of income diversification for 1994, 1998, and 2003. These observations allow us to identify some broad patterns of change that will then be put to scrutiny and refined in a multivariate framework.

Pattern of income diversification in Burkina Faso

Table 1 presents a matrix of participation in different income portfolios. We consider participation in crop-farming, livestock selling, non-farm activities, such as wage and self-employment, and migration within the country and to Côte D'Ivoire. The columns show the different types of farm households and the rows further classify them according to their engagement in non-agricultural activities. Accordingly, the first row illustrates that in 1994 most of the sample households were engaged in cropping (62 per cent), whereas only a few were engaged in livestock selling as their only farm activity. About 40 per cent of the farmers derived their income from both agricultural activities. In 1998, the drought year, farmers heavily moved into livestock selling and the share of those who only sold livestock increased significantly, most likely reflecting complete harvest failure. In 2003, agricultural portfolios were similar to 1994.

Table 1: Income diversification matrix, 1994-2003

		agricultural activities								
		1994			1998			2003		
		cropping	livestock	cropping & livestock	cropping	livestock	cropping & livestock	cropping	livestock	cropping & livestock
	total	0.62	0.01	0.37	0.35	0.09	0.56	0.64	0.03	0.33
non-agricultural activities	no non-agricultural diversification	0.21	0.01	0.11	0.15	0.04	0.18	0.32	0.01	0.15
	non-farm	0.25	0.00	0.14	0.11	0.02	0.17	0.23	0.01	0.13
	migration	0.08	0.00	0.05	0.04	0.02	0.10	0.05	0.00	0.03
	non-farm and migration	0.08	0.00	0.07	0.04	0.01	0.12	0.04	0.00	0.02

Source: Authors' calculations.

In each year, the (4x3) diversification matrix shows pure crop households at the top left, e.g. 21 per cent in 1994, while households at the bottom right fully diversify, deriving income from cropping, livestock selling, the non-farm sector and migration, e.g. 7 per cent in 1994. The degree of diversification is highest in the shock year, 1998, but households seem to become more specialised, when 2003 is compared to 1994. In 1994 non-agricultural diversification was dominated by non-farm activities although quite a large share of households (15 per cent) receives income from both

remittances and local non-farm activities. For 1998, rising numbers at the bottom right of the matrix indicate increased diversification through livestock selling and migration. After 1998, migration decreases significantly, as does non-farm participation. Even compared to 1994, income portfolios of farm households in Burkina Faso have become less diversified.

Table 2 provides information on participation in and income shares (average for all households as well as conditional on participation) from different activities by per capita expenditure quintiles. The crop income shares went down considerably in 1998 due to harvest shortfalls. While rates of participation in crop farming recovered by 2003, the income share remained at the low levels of 1998. It might be that this reflects biases resulting from differences in data collection. Whereas the EP I and EP II collected annual income data, the EP III only recorded income in the last month. As the EP III survey was undertaken in a pre-harvest month, income from cropping is most likely to be underreported. This seasonal bias in the data prevents us from putting too much trust into the income shares for 2003 and we focus on participation rates instead. More specifically, underreporting of crop income is very likely to lead to an upward bias in other shares. We are, however, confident that we can minimise these biases for participation rates (see Appendix 1).

Participation in livestock selling and income shares from this source rose significantly from 1994 to 1998. This increase was highest in the lowest expenditure quintiles implying that pressure on poor households to sell their livestock, often their only asset, was particularly strong. In 2003, overall participation rates were again at the same level as in 1994, but now richer households participated more in income generation from livestock selling – possibly indicating a tendency towards commercialisation of this sector.

Table 2: Participation in and income shares from different activities, 1994-2003

quintil	Cropping			Livestock selling			Non-farm activities			Migration		
	1994	1998	2003	1994	1998	2003	1994	1998	2003	1994	1998	2003
participation rates												
1	0.98	0.89	0.99	0.38	0.67	0.34	0.48	0.45	0.37	0.27	0.40	0.12
2	0.99	0.91	0.98	0.38	0.68	0.35	0.51	0.49	0.47	0.28	0.36	0.14
3	1.00	0.90	0.98	0.38	0.68	0.34	0.56	0.48	0.44	0.27	0.34	0.15
4	0.99	0.95	0.97	0.40	0.63	0.36	0.55	0.45	0.44	0.30	0.31	0.14
5	0.98	0.93	0.94	0.35	0.57	0.39	0.58	0.46	0.44	0.30	0.27	0.16
tot	0.99	0.91	0.97	0.38	0.65	0.36	0.54	0.47	0.43	0.28	0.33	0.14
share in total income												
1	0.75	0.48	0.61	0.07	0.23	0.14	0.11	0.13	0.11	0.04	0.09	0.05
2	0.77	0.53	0.58	0.06	0.20	0.14	0.10	0.12	0.16	0.03	0.08	0.05
3	0.77	0.55	0.58	0.06	0.19	0.15	0.11	0.12	0.14	0.03	0.06	0.05
4	0.74	0.58	0.59	0.06	0.16	0.16	0.12	0.11	0.12	0.04	0.06	0.04
5	0.70	0.60	0.53	0.06	0.15	0.20	0.15	0.13	0.12	0.04	0.04	0.05
tot	0.75	0.55	0.58	0.06	0.19	0.16	0.12	0.12	0.13	0.04	0.07	0.05
shares conditional on participation												
1	0.74	0.54	0.62	0.25	0.34	0.43	0.23	0.30	0.31	0.26	0.18	0.45
2	0.74	0.59	0.58	0.19	0.30	0.41	0.21	0.27	0.29	0.15	0.23	0.40
3	0.75	0.61	0.58	0.19	0.29	0.46	0.21	0.25	0.28	0.12	0.21	0.35
4	0.72	0.61	0.60	0.20	0.27	0.45	0.24	0.26	0.27	0.14	0.21	0.38
5	0.69	0.64	0.55	0.24	0.28	0.53	0.28	0.30	0.30	0.15	0.19	0.37
tot	0.72	0.60	0.58	0.21	0.29	0.47	0.24	0.28	0.29	0.15	0.22	0.38

Source: Authors' calculations.

Participation in non-farm activities was negatively affected by the drought and participation rates dropped significantly. This appears to contradict the perception of non-farm activities as an insurance strategy. Yet, it may just reflect that households use this strategy to insure *ex-ante* by maintaining some level of non-farm activity. It seems plausible that returns to non-farm activities fall during the drought since local demand for non-agricultural products and services is likely to decline when a region is hit by a drought. Non-farm activities still serve as an insurance mechanism, as the associated losses may still be lower than those in cropping activities. Interestingly, households from upper quintiles withdraw disproportionately from this activity. At the same time, income shares conditional on participation increased strongest in the lowest quintiles. It may be that the poorest households were forced to stick to this income source whereas wealthier households were in the position to withdraw from the non-farm sector as a response to falling returns. Participation rates further dropped in 2003 and this decline of the non-farm sector affected all household groups equally. Surprisingly, shares from this income source were not significantly higher than in

1994 or 1998, as should be expected as a result of underreported crop incomes. Thus, it seems that non-farm income shares shrank in reality.

Overall participation rates in migration went up in 1998, disproportionately in the lowest quintiles, while they decreased in the highest quintile. This suggests that the most desperate households turned to this strategy in order to mitigate the drought impact. By 2003, migratory activities had declined significantly mainly due to the Ivorian crisis, affecting all households to the same extent.

In sum, these observations suggest the following broad patterns of changes in income portfolios: First, in the drought year livestock selling and migration were coping mechanisms for dealing with harvest shortfalls. Mainly the most desperate households seemed to turn to these strategies. Non-farm activities did not serve as coping mechanism through increased participation in that sector, but income shares rose in shock years. Second, between 1994 and 2003 income portfolios became less diversified. Overall participation in livestock selling remained constant, but participation rates over expenditure quintiles reversed, with richer households becoming more likely to sell livestock. The decline of non-farm activities and of migration affected all quintiles equally.

Determinants of income portfolio diversification

We estimate a multivariate probit model to illustrate the importance of specific determinants of diversification behaviour. Furthermore, the multivariate framework allows us to more rigorously assess the determinants of change. In the model, households choose to engage in livestock ownership, livestock selling, non-farm activities, migration, and cotton farming. The reason for distinguishing livestock selling and ownership in the choice model is to disentangle the determinants of the former, which often represents an ex-post reaction, from the latter that can be seen as an ex-ante diversification strategy for insurance against shocks.[4] Both of course capture livestock breeding and selling as a commercial activity. The model is estimated on the pooled cross-sections, using year interaction terms for most variables to allow for changes in coefficients over years.

At the regional or community level, we incorporate market access, the availability of a

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[4] More than 40% of the sample households own livestock, but do not generate any income by selling it.

village-based migration network, and rain-variables at the provincial level.[5] We include mean rainfall to proxy for agricultural potential, rain variability to proxy for the risk of harvest shortfalls and the deviation from average rainfall levels in the respective year for capturing the effect of agricultural performance. At the household level, household composition variables and household head characteristics, like education and age are used.

Table 3 presents the estimation results. The hypothesis that the correlations between the error terms of each equation (rho) are all zero can be rejected at a very high significance level, so that that the multivariate model seems to be appropriate. The residuals of the models for livestock owning and selling are highly correlated. The positive and significant sign proves that these two strategies are complementary, which is not surprising by definition. All pair-wise correlations between the error terms of the migration and other activity choices considered turn out to be significantly negative. This suggests that migration is an important substitute for the other income-generating strategies. In principle, some of these strategies could also be complementary, e.g. if remittances could be used by the household to set up a non-farm activity. Although these effects may still be present, our results imply that they are not strong enough. Given the high average number of children in Burkinabè households, the departure of an adult member is likely to make it too difficult for the remaining members to pick up a non-crop activity, which are often quite labour-intensive. In contrast, the error terms indicate important complementarities between activities in the cotton and livestock sectors. Livestock holdings, especially in the form of cattle, play an important role in Burkina Faso, indicating social status (Nianogo and Somda 1999) and serving as a store of wealth (Fafchamps et al. 1998). It seems that households able to engage in the attractive cotton sector use these returns to invest in livestock. Doing so, they were also able to take part in livestock selling. Yet, the correlation coefficient between cotton and livestock ownership is considerably higher than between cotton and livestock selling, so that cotton farmers predominantly hold livestock for storing wealth and not for selling it. Although cotton could provide the necessary start-up capital for non-farm activities, the correlation of the respective error terms does not support this view. For cotton farmers it is not attractive to engage in the non-farm sector as returns relative to cotton are low.

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[5] Burkina Faso is divided into 13 regions, subdivided into 45 provinces. A detailed description of all the included variables is provided in Appendix 2.

Table 3: Diversification determinants, multivariate probit estimation on pooled cross-section 1994, 1998, and 2003

	(1) livestock ownership	(2) livestock selling	(3) migration	(4) non-farm	(5) cotton
children <10	.0163***	.0133***	-.0107***	.0060***	.0069***
male children 10-15	.0166***	.0163***	-.0173	-.0008**	.0046
female children 10-15	.0135***	-.0004***	-.0078***	.0123	-.0003*
male adults	.0309***	.0255***	.0862***	.0025	.0156***
female adults	.0243***	.0138***	-.0196***	.0249***	-.0002
old > 64	.0214***	-.0039	.0267***	-.0037	-.0102**
age of head	-.0004*	-.0003	.00162***	-.0021***	-.3633***
education of head	-.0346*	-.0164	.0465**	.0718***	.0486***
education of head * 1998	.0093	-.0818*	-.0460	.0758*	-.0212
education of head * 2003	-.0154	-.1023**	-.0601**	.0668*	-.0170*
inaccessibility of markets	.1053***	.1377***	-.0780**	-.1631***	.0893
inaccessibility of markets * 1998	-.1451***	-.1284**	.0948*	-.0443	-.0677*
inaccessibility of markets * 2003	-.0967*	-.0342	.0147	-.0924	-.0673*
mean rain	-.0129*	-.0492***	-.0237***	-.0254***	.0198***
rain variability	.0017*	.0016	.0027**	-.0007	-.0006
rain deviation	.0001	-.0006*	-.0004**	.0002	.0005**
Sahel zone	.0624***	.1630***	-.1507***	-.1502***	-.1110***
Sahel zone * 1998	.0383	.0262	-.1138***	.0213	.0088
Sahel zone * 2003	.0238	.3077***	.2568***	.1146*	
Sub-Sahel zone	.0744***	.2503***	.0035	-.0160	-.0813*
Sub-Sahel zone * 1998	.0200	.0367	.0664*	.0046	-.0182
Sub-Sahel zone * 2003	-.0632**	-.1472***	-.0195	-.0931**	.0166
South Sudanese zone	-.0408	-.0909*	-.0231	.1128***	.0893**
South Sudanese zone * 1998	-.0186	.0025	-.0172	-.0556	-.0090
South Sudanese * 2003	.0555**	.2905***	.0742**	.1145*	-.0148
village migration network			.1571***		
year dummy 1998	.1477***	.3168***	-.0060	.0338	.1544***
year dummy 2003	.1502***	.0191	-.0945***	.0029	.1911***

coefficients of correlation between error terms:					
rho 21	0.6544***		rho 42	-0.0011	
rho 31	-0.1515***		rho 52	0.0483**	
rho 41	-0.0071		rho 43	-0.0364**	
rho 51	0.1735***		rho 53	-0.1792***	
rho 32	-0.0668***		rho 54	-0.0300	

Likelihood ratio test of rho21 = rho31 = rho41 = rho51 = rho32 = rho42 = rho52 = rho43 = rho53 = rho54 = 0:
chi2(10) = 2218.84 Prob > chi2 = 0.0000

Source: Authors' calculations.

Notes: The table reports marginal effects of the explanatory variables on the dependent variables holding all other variables constant at their mean. Effects of dummy variables: discrete change from 0 to 1. Effects of rain variables consider 10% changes. The effect of market access is calculated for a change from 1 (perfect market access) to 6 (extremely poor market access). The Sahel zone dummy interacted with the 2003 dummy is a perfect predictor for non-participation in cotton and is hence dropped.
*** coefficient significant at 1% level, ** at 5% level, * at 10% level, based on robust standard errors corrected for clustering.

Most controls at the household level show the expected signs. Several household composition and size variables are significantly linked to diversification strategies. While the availability of male, female or child labour may favour engagement in a certain activity, more members, in particular prime age adults, may also put pressure on the household's resource base, forcing it into non-crop activities.[6] The positively significant coefficients of all age and gender groups on livestock ownership as well as livestock selling may indeed reflect both effects. Non-farm activities appear to be undertaken mainly by households with a relatively high number of female adults, while many male adults in a household increase the likelihood of engaging in migration or the cultivation of cotton. The decision to migrate is negatively affected by the number of children, since parents would not want to leave their children behind. Accordingly, the number of old members is positively linked to it, since they may step in and take care of children. The number of female adults is negatively linked to migration, as they would be left in a weak position in the Burkinabè society (Diallo 2002) after the departure of male household members.

Older household heads are more likely to send household members elsewhere, while younger household heads tend to diversify more into non-farm activities and especially cotton. At least in 1994, better educated households tend to participate more in non-farm activities and migration as well as cotton. However, the education coefficients vary significantly across the years, a finding that we interpret in more detail below.

At the community level, migrant networks play an important role in facilitating migration. As expected, easier access to markets increases the likelihood of participating in non-farm activities and migration. Yet, if markets are far and farm and non-farm products cannot be sold easily, livestock ownership seems to be an alternative strategy for income generation. Accordingly, livestock selling is also more likely to occur where markets are inaccessible. Another explanation might be that livestock selling is the only way of income generation when organised market places are absent, as livestock may just be traded among neighbouring households not requiring a market place. In fact, this would explain the switch in the sign of the coefficient in 1998: Trade between neighbours may collapse in case of a shock that

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[6] Note that household composition variables may be jointly determined with activity choices, as households' fertility choices may depend on future diversification plans (e.g. migration).

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affects all villagers simultaneously, which implies a more important role for markets for livestock trading. Accessibility of markets also plays a crucial role for the decision to diversify into cotton. The competitiveness of cotton increased considerably after the devaluation of the CFA franc in 1994. Still, as a result of high transportation costs, this noticeably favoured those farmers with relatively good access to markets in 1998 and 2003.

In such a diverse country in agro-climatic terms, diversification patterns of course differ over regions. In the Sahel and Sub-Sahel zone, where soil quality is poor, many farm households do not depend on cropping including cotton but are herders. Moreover, in the Sahel regions diversification into non-agricultural activities is rare. A small population scattered over vast areas would render most non-farm activities unprofitable. By contrast, rural households in the South-Sudanese belt, which comprises tree-covered and cotton regions, are more likely to engage in non-farm activities and the cultivation of cotton, but are less likely to sell livestock.

The negative effect of average rainfall in all activity choices except cotton indicates that households in provinces with low levels of rainfall are forced to diversify into non-cropping activities. As expected, livestock owning serves as an ex-ante diversification strategy that is most relevant in provinces with high rainfall variability. Accordingly, households turn to selling livestock when rain falls short of long-run averages. Similar to livestock ownership, migration tends to be more prevalent in provinces with high rainfall variability serving as an insurance mechanism. In addition, migration appears to occur in response to negative shocks, as the number of households receiving remittances increases with the short-run rain deviations.

So far, the multivariate analysis illustrates that diversification in Burkina Faso is mainly pursued as an insurance strategy. In particular, rainfall variables indicate that participation in non-cropping activities takes place in provinces with the poorest agro-climate. Both migration and livestock selling appear to serve as direct responses to negative shocks. In line with the above descriptive findings on participation, non-farm activities are an ex-ante diversification strategy that is pursued in better connected and more densely populated areas. Unfortunately, we lack data on landholdings to investigate more rigorously the hypothesis of diversification being driven by desperation.

From these more general patterns, we now turn to changes over time. The year

dummies include year-specific effects and time trends that are not captured by other controls. Both the 1998 and 2003 time dummies are large and significant for livestock ownership and cotton reflecting the abovementioned expansion of these sectors. The 2003 year dummy is negative for migration reflecting the negative effects of the unstable situation in Côte d'Ivoire.

Education becomes more important in non-farm participation, possibly reflecting better opportunities and higher returns, but also higher barriers to better remunerated non-farm activities. Thus, it seems that there is a shift to more sophisticated, skill-based activities for generating income from this sector. For migration, we observe the opposite: the positive effect of education is offset in 2003. This points to migration being less determined by opportunities at the destination place, but rather by desperation at home.

Conclusions

Most existing studies of income diversification in rural sub-Saharan Africa provide a snapshot view on household behaviour. Often, these snapshots yield pessimistic views on non-farm activities as being mainly driven by desperation. Furthermore, in countries with unfavourable and unstable climatic conditions, as for example Burkina Faso, the literature has stressed income diversification as a means to smooth income and cope with recurrent droughts. Our empirical analysis shows that diversification behaviour is indeed dominated by insurance motivations. Yet, there also signs of more profound structural changes. We observe a tendency for non-farm activities to become more opportunity-led, while poorer households seem to resort to migration although overall migration flows decline significantly because of the political crisis in Côte d'Ivoire.

This paper hence argues that a more comprehensive view on income diversification (beyond insuring or coping with risks) even in shock-prone environments is warranted. As in this paper, researchers may use available cross-sectional datasets to examine patterns of change. Clearly, the analysis of three cross-sections has important limitations. In particular, it is difficult to establish causal relationships and to isolate the effects of shocks. Nonetheless, we consider our rather descriptive approach based on imperfect data to yield interesting insights into the relationship between the growth process, income diversification, and inequality in a shock-prone agricultural

environment.

Had we examined only household reactions to the 1997/98 drought, we might have concluded that the livelihoods of Burkinabè farmers had not changed much between the mid-1980s and the mid-1990s. The non-farm sector, although it shields households against crop shortfalls, is also negatively affected by a drought, and households resume to selling livestock to smooth consumption or ensure survival. This may turn out to be particularly harmful to very poor households that are deprived of their asset base. While these patterns can still be observed in Burkina Faso, there are also signs of structural change that are reflected in income portfolio choices. Between 1994 and 2003 income portfolios become less diversified, mainly since agricultural activities, in particular cotton and livestock, appear to offer higher returns. In addition, some of our findings hint at better opportunities in the non-farm sector. Both findings reflect a more important role of a household's comparative advantage in income portfolio choices, which implies that diversification is increasingly opportunity-led. This seems to be a favourable development that can be attributed to economic reforms to some extent. Yet, as outlined by Barrett et al. (2001): "The key point is that the wealthy have greater freedom to choose among a wider range of options than do the poor". In fact, some of our findings illustrate that this holds (increasingly) for the Burkinabè context. Low returns in non-farm activities go hand in hand with higher entry barriers and migration seems to be more desperation-led. Furthermore, richer households appear to be in a better position to participate in livestock and cotton. Finally, one should not be overly optimistic with regards to the increased agricultural specialisation of rural Burkinabè households. Such a strategy entails important risks that may not be limited to climatic factors: Between 2004/05 and 2006/07 the parastatal Sofitex has recorded losses of USD 128 million. This puts a big question mark behind the sustainability of Burkina Faso's cotton sector success story.

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Appendices

Appendix 1: Data description

1. The surveys were undertaken by the Institut National de la Statistique et de la Demographie de Burkina Faso (INSD), the United Nations Development Programme (UNDP) and partly by the World Bank (WB). Each survey covers 8,500 households. The sample design is based on a tow-step procedure. The primary sampling units are the zone de dénombrement (ZD). In the second step in each ZD 20 households are drawn randomly. Thus, household weights and cluster sampling is allowed for in our empirical analysis.

2. From the approximately 5,800 rural households per year we excluded households able to specialise fully in some kind of non-agricultural activity in order to focus on diversification out of the agricultural sector. This leaves us with a sample of 5,608 households in 1994, 5,325 households in 1998 and 5,460 households in 2003.

3. Crop income includes cash income from selling crops and the value of self-consumed crops.

4. Livestock income contains sales of cattle, goats, sheep and pigs.

5. Non-farm income is composed of income from wage and self-employment. Only 2% of the sample households receive wage income. Hence, non-farm income is driven by running non-farm enterprises. If profits from the household's non-farm businesses, listed in the non-farm enterprise section, exceed self-employment income, we take the former value.

6. Migration only considers remittances from national migration and from migration to Côte d'Ivoire. We expect these migration flows to follow quite similar patterns due to geographical and cultural proximity. In contrast, migration to other countries, especially overseas migration, might be fundamentally different. In fact, this latter type of migration plays only a minor role in Burkina Faso affecting about 1% of the sample households.

7. Households are regarded as participating in a certain income portfolio as soon as they receive an income above a certain threshold of this activity generating activity. So we avoid the inclusion of households with very small incomes in the respective income groups.

8. The EP I was undertaken in the post-harvest months of 1994, but the EP II and EP III were conducted in the pre-harvest months of 1998 and 2003 respectively. Even though taking yearly incomes, this difference can lead to seasonal biases, as the latest incomes would be recalled more accurately.

9. The EP III only presents information about monthly income. Thus, the survey instrument creates a serious seasonal bias. Adjusting crop incomes with the value of self-consumed food items and non-farm incomes with profit of non-farm enterprises in the last 12 months, some of the resulting biases could be reduced.

Appendix 2: Variable description and mean values

Variable	*Description*	1994	1998	2003
per-capita expenditure	constructed by Grimm and Günther (2007c) based on household consumption data, deflated to the base year 1994 by using urban and rural decile specific price deflators	56,222	43,002	64,307
children < 10	number of household members under 10 years	4.74	4.32	3.36
male children 10-15	number of male household members between 10 and 15 years	0.88	0.87	1.37
female children 10-15	number of female household members between 10 and 15 years	0.80	0.78	0.64
male adults	number of male household members between 16 and 64 years; for all migrant households that do not list any potential migrant, this number is adjusted with a factor of 1 to reflect household size before the departure of the migrant, which are mainly male adults in Burkina Faso (Konseiga 2007, Hamphshire 2002)	2.71	2.64	1.96
female adults	number of female household members between 16 and 64 years	3.08	3.09	2.36
old > 64	number of household members older than 64 years	0.46	0.45	0.33
age of head	age in years of household head	50.66	50.39	47.76
education of head	dummy taking the value 1 if household head has ever attended any school	0.08	0.05	0.08
inaccessibility of markets	ordinal variable taking values between 1 and 6; it takes the value 1 if the next market can be reached in less than 30min and 6 if it takes more than one day	1.54	2.02	1.89
village migration network	dummy variable taking the value 1 if the share of migrant households within a ZD is higher than 10%, excluding the respective household itself in the share	0.86	0.81	0.63
mean rain	mean of provincial rainfall within the last four years prior to the harvest year reported in the survey	60.51	66.74	65.87
rain variability	standard deviation of provincial rainfall within the last four years prior to the harvest year reported in the survey	9.23	14.58	10.39
rain deviation	difference between rainfall in the year of the reported harvest and mean rain relative to mean rain (mean rain again based on the four years prior to the harvest year)	0.39	-0.12	-0.06
Sahelian zone	dummy for households living in the Sahel region	0.06	0.07	0.06
Sub-Sahelian zone	dummy for households living in one of these regions: Nord, Centre-Nord, Est, Plateau Central or Centre	0.35	0.39	0.38
North-Sudanese zone	dummy for households living in one of these regions: Mohon, Centre-Sud, Centre-Ouest or Centre-Est	0.38	0.37	0.38
South-Sudanese zone	dummy for households living in these regions: Haut-Bassins, Sud-Ouset or Cascades	0.21	0.17	0.18
livestock ownership	dummy for households owning cattle or small stock (sheep, pigs, goats), adjusted for households that declare sales of these animals but not any owning	0.79	0.92	0.90
livestock selling	dummy for households selling cattle, sheep, pigs, goats or donkeys	0.38	0.65	0.36
non-farm	dummy for households engaged in wage employment, non-farm enterprises or other non-farm self-employment	0.54	0.47	0.43
migration	dummy for households receiving remittances from urban or rural areas from Burkina Faso or from Côte d'Ivoire	0.28	0.33	0.14
cotton farmer	dummy for farmers selling cotton; in 2003 this dummy includes cotton producers to reduce seasonal bias in the 2003 income data	0.11	0.19	0.24

Source: Authors' calculations.