Consumption Growth and Agricultural Shocks in Rural Madagascar

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***Abstract*— The aim of this paper is to evaluate the effect of rainfall and agricultural shocks on consumption growth in Madagascar. We are also interested in the impact of local endowments in infrastructures and social services on consumption growth. To achieve this goal, a micro model of household consumption growth is estimated thanks to household panel data collected by the *Reseau des Observatoires Ruraux* (ROR) between 1999 and 2004. Additional data sources include the 2001 communes census organized by the *Ilo* program of Cornell University. Altogether these different data sources make an unusually rich data set, at least when considered with developing country standards. We use panel data fixed effect estimation technique to remove unobserved household and community level time invariant heterogeneity. We find that production shocks have a substantial impact on consumption growth and we find sign of persistence of rainfall shocks. Roads and education seems to improve household's consumption growth and remotness decreases it.**

Keywords: **risks, growth, poverty**

I. INTRODUCTION

Reducing poverty is a priority for many governments of developing countries and international institutions. Dollar and Kray's paradigm expresses that "growth is good for the poor" [1]. Despite sustained economic growth in Madagascar since 1997, living conditions in rural areas have not improved. Why do we observe poverty persistence especially in rural areas? Many factors have been mentioned including institutional, agro-climatic or ethnic endowments. In many cases, the "African dummy" appears to explain the gap in growth of poor countries. But studies have failed to investigate further and explain the African growth paradox. The mechanisms at play are not disentangled. This paper assumes that uninsured risk is one cause of poverty persistence and examines to what extent uninsured risk impacts consumption growth and poverty at the household level in rural Madagascar.

The relation between risk and poverty is a matter of direct and indirect effects. We call risk the quantifiable likelihood of a loss of revenue or less-than-expected returns. A shock is the realisation of the risk. It is straightforward that a direct impact of a negative shock is a drop in revenue. If in addition, a household lacks insurance mechanisms, a drop in its revenue directly translates into a drop in its consumption. Moreover, in a context of high exposure to risk and absence of insurance or credit markets, indirect effects of either shocks or uninsured risks are also at stake. These indirect effects arise from the household's risk coping mechanisms. We distinguish *ex-post* mechanisms such as saving or participation in informal insurance networks and *ex-ante* mechanisms such as revenue diversification, technology adoption and production choices. These mechanisms only results in partial insurance [2]. Risk mitigation trough *ex-ante* self insurance often corresponds to low risk but also low return activities that may keep households in poverty. Moreover, for households lacking insurance mechanisms, *ex-post* coping mechanisms may imply loss or selling of productive assets like animals or land to maintain their consumption above an acceptable level. The loss of productive assets hinders further the productive capacity of households. Uninsured risk is thus likely to contribute to poverty persistence. In this article, we aim to test for persistence in the impact of shocks suffered by the household on consumption growth.

Madagascar is an obvious setting for the study of impact of risks on poverty. Malagasy households are indeed confronted with many different types of risk, especially in rural areas. Farm households are subject to production risks, both covariate risks (typhoons, droughts, flooding) and idiosyncratic risks (farm-specific crop and livestock damages by predators and diseases) in a context where credit and insurance markets are missing. Half of rural Malagasy households have declared damages linked to environment and climate in 2004 and 2005 [3]. Types of risk also vary across the rural regions of Madagascar. For example, typhoons are more prominent in the Eastern regions whereas droughts in the Southern.

This paper has two main contributions. First, it studies consumption at the household level using an exceptionally rich panel database of 11,000 rural households observed from 1999 to 2004. The study of growth in living standards using household-level data is not that common. Growth models have been tested against data mainly through cross-countries regressions. These cross-countries regressions are not fully satisfying because their results are often subjected to econometric and data problems [4, 5]. Studying distributional issues at aggregate country level is not satisfying. The relevance of cross-countries evidence for policy formulation is also limited. Investigating the determinants of growth at the household level is more promising.

Second, the paper quantifies the impact of shocks on consumption growth at the household level. The relation between risk and poverty is well established in the literature but the quantification of that relation is seldom available. In particular, few papers study persistence of shocks at the household level. Deiniger et al. [6] stress the crucial role of price level and variability, access to key public goods such as health care, electricity and infrastructure, and the importance of initial endowment in assets for income growth. Gunning [7] shows that income growth of a panel of Zimbabwean households mostly results from an increase in the return on the asset and an accumulation of assets. Jalan and Ravallion [8, 9, and 10] study the dynamics of living standards of a panel of Chinese households. De Vreyer et *al*. [11] investigate the existence of poverty traps linked to geographic endowment in Peru. This paper largely draws from Dercon's [12] recent work on consumption growth and shocks in rural Ethiopia.

This paper is structured as follows. The next section presents the empirical framework. Section three presents the data and the empirical specification. Section four presents and interprets the results. Section six concludes.

II. EMPIRICAL FRAMEWORK

The Solow income growth model [13] and its development with human capital accumulation by Mankiw *et al* [14] motivates our empirical growth model. Income growth rate is related to initial level of income and a number of variables determining the steady state including investment in physical and human capital and factor productivity. In the context of panel data of per capita income *c* of H households *h* in R regions r from period *t-1* to *t*, the empirical growth model can be rewritten as follows:

$$\ln c_{hrt} - \ln c_{hrt-1} = \alpha + \boldsymbol{\beta} \ln c_{hrt-1} + \delta\, x_{hrt} + \gamma\, z_{ir} \quad [1]$$

where c_{hrt} is income per capita (or any other indicator of living standards), α is a common source of growth across households, x_{hrt} is a vector of time varying household characteristics and z_{ir} a vector of time invariant characteristics from either the household or the region, determining investment in human and physical capital and factor productivity. Per capita income growth will be proxied by per capita consumption later on.

This empirical framework implies very strong assumptions (see for example [15]). But it can be used as a starting point to investigate a set of questions.

A standard question in growth empirical analyses is whether convergence in per capita living standard exists between countries. At the household level, the question translates into the following: do incomes of the poor households grow as fast than those of the rich households after controlling for variables that determines the steady state? In other words, we examine if the growth rate is roughly what is predicted by the model once differences in investment rate and productivity are controlled for. A negative estimate for the parameter β would suggest conditional convergence.

Shocks have *a priori* no explicit role to play in this specification. Often, shocks are accounted for by introducing a stationary error term in the regression. The introduction of shocks in an empirical growth model is justified on the ground that period-specific conditions can affect initial efficiency, i.e., the technological parameter in the underlying production function. Dercon [12] argues that this approach is short of accounting for neither the persistence nor the accumulation of shocks. As mentioned above, it is most likely that uninsured risk has a structural effect on the behaviour of poor households. If we assume that a multiplicative risk affects the technological parameter of the implicit Cobb Douglass technology of the Solow model, it is then possible to introduce the shock directly in the specification after linearization. To evaluate persistency in the impact of shocks on consumption growth, we introduce contemporaneous and lagged shocks in the empirical growth model as follows:

$$\ln c_{hrt} - \ln c_{hrt-1} = \alpha + \boldsymbol{\beta} \ln c_{hrt-1} + \delta x_{hrt} + \gamma z_{ir} + \Sigma\, \boldsymbol{\theta}_{\mathbf{k}} (\ln s_{hrt-k+1} - \ln s_{hrt-k}) \quad [2]$$

With $s_{hrt-k+1}$ the intensity of the shock in year t-k+1, k=1 to T and T the number of time period and s_{hrt-k} 1 the intensity of the shock in year t-k, k=1to T.

III. DATA AND EMPIRICAL SPECIFICATION

The database is computed from annual surveys administered by the *Réseau des Observatoires Ruraux* (ROR) in several rural communities from Madagascar and the 2001 exhaustive population census organized by the *Ilo* program.

The ROR is a joint project of the Malagasy National Statistical Institute (INSTAT) and the Institut de Recherche pour le Développement (IRD). Thanks to field operators, the ROR runs annual surveys of a panel of rural households in twenty one rural areas of Madagascar since 1999.[1] These areas are not randomly selected but are rather judiciously chosen to illustrate different facets of the Malagasy rural economy. The household sample is therefore not statistically representative of the country. The areas strongly differ from each other in terms of soil quality, rainfall pattern and population density. Within each area, households are randomly chosen from an exhaustive list. Approximately 500 households are surveyed every year in each area. Households that had moved or are unwilling to be interviewed are replaced by new households with similar characteristics from the same area. The survey provides many data on housing, household demography, education, revenue sources, agricultural production (landholding, crops and husbandry, farm technology, input use, stocks), agro-climatic shocks and expenditures in food and non-food items. As a result, we lay out a panel of rural Malagasy households surveyed each year since 1999. Additional data are drawn from the 2001 *Ilo* population census. This census is the first exhaustive census organised in Madagascar. It has been run from September to December 2001 by interviewing focus groups in each commune of the country. Data from the 2001 *Ilo* population census includes demography, health and education services, schooling, farm characteristic, market access, entrepreneurial environment, agro-climatic shocks, insecurity, record of organizations and associations.

In this study, we use household data for the period 1999-2004. Consumption exhibits a large variability within time, areas and households. During the 1999-2004 periods, we observe a slight annual per capita consumption growth of 0.2% in average for the rural household balanced panel. This average annual growth is, however, largely due to the per capita consumption increase of 6.4% in 2004[2] .In parallel, per capita Gross Domestic Product (GDP) decreases at an average annual rate of 0.05% during the same period. On average, per capita rural consumption growth is the highest in 2000 and 2004. In contrast, per capita GDP growth is the highest in 2003 as a result of the

[1] Actually four areas have already been surveyed since 1995. From 14 to 17 distinct regions are surveyed each year.

[2] This large increase in per capita consumption in 2004 could be an artifact caused by a high inflation that is not well captured by the deflator or a late recovery in rural areas from the 2002 turmoil.

recovery from the political turmoil in 2002. The evolution of the per capita consumption of rural households does not exactly match the evolution of the per capita GDP. The growth in per capita rural consumption is smoothened and seem to follow the per capita GDP growth with some delay (see table 1). Some observed areas have experienced different agro-climatic conditions over the period (see figure 1 to locate the areas surveyed). In Fenerive Est and Farafangana situated on the Eastern coast that is subjected to many cataclysms, the per capita consumption level is lower in 2004 than in 1999. Per capita consumption in Fenerive Est dropped in 2002 whereas per capita consumption in Farafangana was particularly low in 2000. Both areas have not fully recovered in 2004. Per capita consumption growth in Antsirabe and Maravoay performed particularly well in the recent years of 2003 and 2004. Per capita consumption in Ambovombe grew during the period but stayed the lowest among the areas. Per capita consumption in Ambatodrazaka stabilised after its drop in 2000. Per capita consumption in Toliara stagnated during the period except in 2004 when it dramatically increases. Areas that perform better in terms of overall per capita consumption growth rate during the period seem to have lower per capita consumption average during the same period. This observation suggests that some convergence in per capita consumption occurs. This suggestion is confirmed by the econometric analysis.

Year	Per capita consumption growth	Per capita GDP growth
2000	2.2	1.67
2001	1.2	2.95
2002	0.8	-15.21
2003	1.7	6.66
2004	6.4	2.06
Average	0.2	-0.05

Sources: ROR and IMF

Table 1: Per capita consumption and GDP growth in percentage from 2000 to 2004

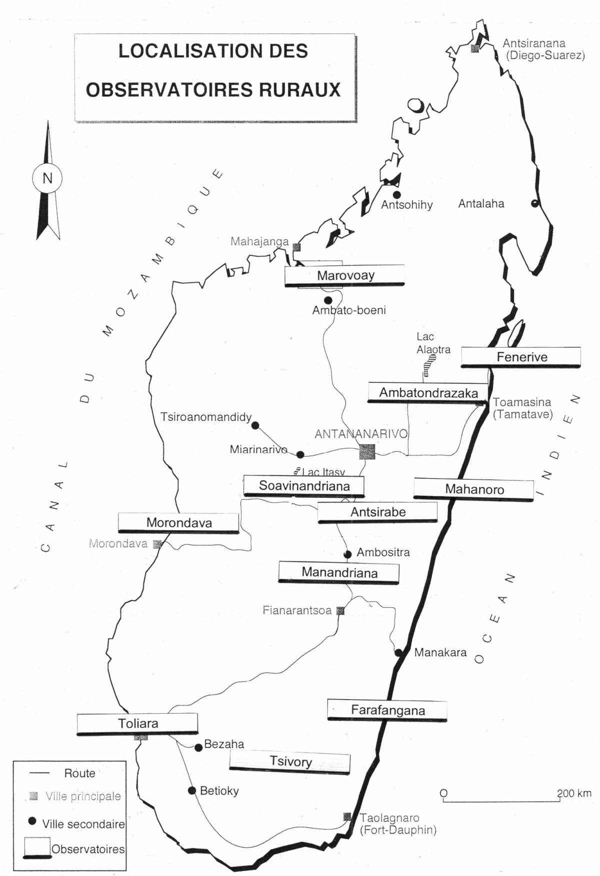

Figure 1: localization of the areas surveyed by the ROR in 2003-2004 (Source: ROR)

The basic econometric specification is drawn from the empirical growth model (2) presented in section II. Like in Dercon [12], the basic specification is written as follows:

$$\ln c_{hrt} - \ln c_{hrt-1} = \alpha + \boldsymbol{\beta} \ln c_{hrt-1} + \delta x_{hrt} + \gamma z_{ir} + \boldsymbol{\theta_0} (\ln s_{hrt} - \ln s_{hrt-1}) + u_{hrt} \quad [3]$$

where the error term u_{hrt} is a transitory error term with zero mean.

The dependent variable $g_{hrt} = \ln c_{hrt} - \ln c_{hrt-1}$ is the annual growth rate in total consumption per capita of household *h* in year *t*. Our measure of consumption expenditure includes cash expenditure and the imputed value of in-kind spending on food, clothing, medicines, housing, education, recreation, transportation, and rituals.[3] Because the Malagasy economy is subject to a high inflation, the consumption aggregate is deflated using the national price index calculated by the Malagasy national institute of statistics. Since this is not the most satisfying, a local price index is under construction to account for price dynamics at the local level. The shock vector S_{hrt} includes contemporaneous rainfall shocks as well as idiosyncratic agricultural shocks. Rainfall shocks stand for covariate shock undergone by the whole community whereas agricultural shocks declared by the households are considered as idiosynchratic shocks.

Rainfall shocks are defined as changes in the logarithm of annual rainfall at year *t* relative to year (*t-1*). Rainfall levels are scaled to long term mean to allow for comparison across areas. From Chérel – Robson and Minten [16], we know that risks depend on the type of plot cultivated. Rice cultivation on tanety areas (terrace cultivation) is riskier than on low ground areas. In 2001, cultivation on about 80% of tanety plots underwent production problems whereas only one third of low ground plots has production problems. Low ground plots are however more subject to flooding problems than tanety. To introduce heterogeneity in the intensity of rainfall shocks across households, we introduce an interaction term between the area in each plot type and rainfall shock in the specification.

Idiosyncratic crop shocks are represented by annual indices of crop damage lying between 0 (no damage) and 3 (harvest reduced to nothing) identified by individual crop (rice, maize, tuber and other crops). Crop damages result from degradation by men or predators, diseases or cataclysms. We introduce the heterogeneity in rice shocks by interacting the intensity of the damage on rice fields with the area planted in rice for each household. Livestock shocks are represented by annual numbers of dead animals.

Changes in the household demography are also included to control for life cycle and other demographic effects over the period.

We use different specifications. First, we introduce contemporaneous agricultural and rainfall shocks. Second, we introduce lagged rainfall shocks in the specification. The high correlation between shocks from one year to the next one leads us to introduce successively past shocks (t-2), (t-3) and (t-4). Significance of past shocks is an indication of persistence over the years.

$$\ln c_{hrt} - \ln c_{hrt-1} = \alpha + \beta \ln c_{hrt-1} + \delta x_{hrt} + \gamma z_{hr} + \boldsymbol{\theta_0} (\ln s_{hrt} - \ln s_{hrt-1}) + \boldsymbol{\theta_1} (\ln s_{hrt-1} - \ln s_{hrt-2}) + u_{hrt} \quad [4]$$

We then investigate the impact of the accumulation of rainfall shocks. We use an interaction term between current and lagged rainfall shocks with the same three specifications as above as follows:

$$\ln c_{hrt} - \ln c_{hrt-1} = \alpha + \beta \ln c_{hrt-1} + \delta x_{hrt} + \gamma z_{hr} + \boldsymbol{\theta_0} (\ln s_{hrt} - \ln s_{hrt-1}) + \boldsymbol{\theta_1} (\ln s_{hrt} - \ln s_{hrt-1}) (\ln s_{hrt-1} - \ln s_{hrt-2}) + u_{hrt} \quad [5]$$

We also introduce the sum of past shocks as follows:

$$\ln c_{hrt} - \ln c_{hrt-1} = \alpha + \beta \ln c_{hrt-1} + \delta x_{hrt} + \gamma z_{hr} + \boldsymbol{\theta_0} (\ln s_{hrt} - \ln s_{hrt-1}) + + \boldsymbol{\theta_1} \Sigma_{i=1..4} (\ln s_{hrt-i+1} - \ln s_{hrt-i}) + u_{hrt} \quad [6]$$

We must recognize that the lagged consumption is likely to be endogenous. Time varying unobserved characteristics of the households are integrated in the error term whereas time invariant heterogeneity is removed by the fixed effect regression. Potential candidates to instrument lagged consumption must be sufficiently correlated with consumption at (t-1) and be uncorrelated with the error term of the structural specifications. One potential instrument is consumption lagged twice but using it drops the observation for which this data is not available, i.e., the consumption growth between 1999 and 2000. We choose to use capital stock at (t-1), i.e., the number of persons at working age and the number of livestock as instruments. This choice is allows to have a limited number but well correlated instruments. We run a Hausman test that compares OLS versus 2SLS estimates that indicate that instrumentation is necessary.

It is likely that unobserved heterogeneity persists after controlling for individual and geographic effects. In particular, we can think that latent variables determining government investment in infrastructure program could not be measured. Moreover parameters

[3] durables are excluded from this aggregate

determining utility and production functions of the households could surely not be fully taken into account by the available data. A more proper way to write the error term u_{it} would be to disaggregate it as follows:

$$u_{it} = \omega_i + v_{it}$$

The panel structure of the data makes it possible to control for unobserved individual effect ω_i. The technique to be used depends on the nature of the unobserved effect, namely if it is correlated or not with the explanatory variable. In our case it is more likely correlated. The correlation is quite evident if we think as ω_i as the ability of the producer. The ability is surely correlated with characteristics of the households as education for example. As a result random effect estimations lead to inconsistent estimates. The cure is to use the fixed effect model. In our case this result in dropping the time invariant variables of interest like presence of bank, road infrastructure or technology level. To still have an idea of the impact of this variable, the model is first estimated using the standard fixed effect method identifying the coefficient of the time varying variables while controlling for individual heterogeneity. The fixed effect ω_i is then regressed on the time invariant variables of interest like the existence of a road, access to health and education services, access to market.

IV. RESULTS AND INTERPRETATION

We first discuss the results of a fixed effect regression of consumption growth on the initial level and a set of covariate and idiosyncratic shocks while controlling for change in demographic variable as in specification [3]. Table 2 below presents the results. The results point to a process of convergence indicating that poorer households grow faster than richer one after controlling for variables determining the steady state.

Contemporaneous rainfall shocks clearly matter and appear with a significant negative sign suggesting that rainfall negatively affects consumption growth on

	1	2
ln ($conso_{t-1}$)	-0.445*** (0.067)	-0.444*** (0.067)
ln (rice $shock_t$ - rice $shock_{t-1}$)	0.010** (0.004)	0.009** (0.004)
ln (rice $shock_{t-1}$ - rice $shock_{t-2}$)	-0.018*** (0.004)	-0.018*** (0.004)
ln (mais $shock_t$- mais $shock_{t-1}$)	-0.024* (0.014)	-0.024* (0.014)
ln (mais $shock_{t-1}$ - mais shock t-2)	-0.002 (0.013)	-0.002 (0.013)
ln (bovin $shock_t$)	0.128*** (0.017)	0.129*** (0.017)
ln (caprin $shock_t$)	0.101*** (0.027)	0.100*** (0.027)
ln (poultry $shock_t$)	0.032*** (0.003)	0.032*** (0.003)
ln (porcin $shock_t$)	0.030* (0.017)	0.033** (0.016)
ln (bovin $shock_{t-1}$)	-0.057*** (0.018)	-0.058*** (0.018)
ln ($caprinshock_{t-1}$)	-0.072*** (0.025)	-0.072*** (0.025)
ln (poultry $shock_{t-1}$)	-0.025*** (0.004)	-0.025*** (0.004)
Rainfall $shock_t$ (ln s_{it}-s_{it-1})	-0.162*** (0.043)	-0.205*** (0.046)
Rainfall $shock_{t-1}$ (ln s_{it-1}-s_{it-2})		0.144*** (0.040)
skP_basf: $skrain_t$ * area in low ground		0.580** (0.285)
skP_tanet: $skrain_t$ * area in tanety		0.560 (0.546)
skP_tavy: $skrain_t$ * area in tavy		1.571 (1.385)
skP_plain: $skrain_t$ * area in plain		0.357** (0.166)
Observations	29137	29137
Number of id	11571	11571

Table 2: FE estimates.
Dependant variable: per capita consumption growth. Variables included but not reported: time* obs dummies, changes in demographics

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average. But the relation between annual rainfall and rice production is, however, not monotonous neither within year nor within space. From the second column in table2, we see that plot type matter.

Contemporaneous shocks on rice appear with a significant positive sign that is unexpected whereas one-year lagged shocks on rice appear with the expected significant negative sign as the shock is coded from 0 to 3 in ascending order of the shock intensity. Contemporaneous production shocks on maize appear with a significant negative sign as expected whereas one-year lagged shocks on maize are insignificant. Estimates related to crop shocks could be due to the design of the questionnaire. Given the agricultural calendar, shocks undergone and recorded in year (*t-1*) could have consequences on the harvest recorded in the following year *t*.

Contemporaneous livestock shocks appear to be significantly positive but one-year lagged livestock shocks appear to be significantly negative. Because livestock shocks are measured in terms of the number of dead animals, one possible interpretation of the positive cotemporaneous relationship between livestock shocks and contemporaneous consumption growth is that households tend to consume and sell more their livestock under these shocks leading to a momentary increase in consumption. However, these shocks echo on the household's behaviour on the following year diminishing then its consumption. Households may adjust their consumption in response to herd depletion because they own fewer assets and thus have lower self-insurance capacity and lower quasi-liquid resources. This hypothetical behaviour cannot be derived from the results of the two regressions and has to be investigated further.

Table3 shows the persistence of rainfall shocks on consumption growth. Past shocks are directly introduced as in specification 4. The one-year lagged rainfall shock has a significant impact on current consumption growth in contrast to rainfall shocks that are lagged more than one period. The interaction term between the rainfall shocks at year *t* and year (*t-1*) as in specification 5 appears clearly significant whereas the sum of past rainfall shocks as in specification 6 appears to be non significant (Columns 5 and 6 in table 3).

	1	2	5	6
ln(conso$_{t-1}$)	-0.445***	-0.443***	-0.442***	
	(0.067)	(0.068)	(0.068)	
skrain$_t$	-0.162***		-0.110**	
ln(s$_{it}$-s$_{it-1}$)	(0.043)		(0.054)	
skrain t-1		0.144***		
(ln s$_{it-1}$-s$_{it-2}$)		(0.040)		
intersksk_1			0.567**	
(skrain$_t$*skrain$_{t-1}$)			(0.238)	
intersksk_2			-0.120	
(skrain$_t$*skrain$_{t-2}$)			(0.216)	
intersksk_3			0.052	
(skrain$_t$*skrain$_{t-3}$)			(0.204)	
intersksk_2			-0.120	
(skrain$_t$*skrain$_{t-2}$)			(0.216)	
intersksk_3			0.052	
(skrain$_t$*skrain$_{t-3}$)			(0.204)	
lnSskrain2				0.033
sum(skrain$_t$)				(0.047)

Table 3: FE Estimates.
Dependant variable: per capita consumption growth. Variables included but not reported: time* obs dummies, change in demographics, agricultural shocks

This suggests that past rainfall shocks matter in the management of the current rainfall shock.

We turn now our attention to the evaluation of the impact of infrastructure and social services on consumption growth. In particular we focus on access on the presence of a paved road, on fertiliser use, presence of a bank, remoteness and presence of a market. This attributes have been measured in the ILO 2001 census of the Malagasy communes. Because these variables are only observed for one period in 2001 in our dataset, they are considered as time invariant variables in the regression. As a consequence, they are removed when using fixed effect estimation. To still have an idea of the impact of these variables, we regress the estimated fixed effect from specification 3 on these variables. Results are presented in table 4. It indicates that fertiliser use, roads, markets and education of the household's head has a significantly positive effect on consumption

	1	2	3	4
	FE from regression col 1 from figure 3			
hhd size	-0.085***	-0.084***	-0.086***	-0.085***
	(0.002)	(0.002)	(0.002)	(0.002)
Nb of bovins	0.024***	0.025***	0.024***	0.024***
	(0.001)	(0.001)	(0.001)	(0.001)
Education of hhd's head	0.089***	0.090***	0.090***	0.091***
	(0.001)	(0.001)	(0.001)	(0.001)
Paved road	0.086***			
	(0.012)			
Fertiliser use	0.052***		0.051***	
	(0.003)		(0.003)	
Bank	-0.056***		-0.024*	
	(0.015)		(0.014)	
Remotness Index		-0.040***		
		(0.003)		
Market			0.037***	0.054***
			(0.009)	(0.009)
Constant	0.077***	0.257***	0.079***	0.120***
	(0.012)	(0.014)	(0.013)	(0.012)
Observations	25649	27589	25649	27589
R-squared	0.21	0.20	0.21	0.20

Table 4: OLS Estimation results
Dependant variables: estimated fixed effect from regression in the first column from figure 3.growth.

Unexpectedly, access to banks is associated with lower consumption growth. Remoteness[4] implies lower consumption growth.

V. CONCLUSIONS

This paper analyses consumption growth performance in several rural areas in Madagascar in the light of production shocks and access to infrastructure and social services. This analysis uses an unusually rich rural household database for a developing country covering the period between 1999 and 2004. Despite the large coverage of the database in terms of number of households, the database is quite short in time coverage to analyse consumption growth. The dependent variable may be contaminated by too much variability due to contemporaneous good or bad fortunes.

Estimation results confirm some consumption convergence among households while controlling for variables determining the steady state. Concerning production shocks, results show evidence of persistence of past rainfall shocks. In addition, fertilizer use, roads, markets and schools but not banks positively impacts consumption growth. Future work consists in describing and explaining better disparities of these results across regions, especially the role of infrastructure, social services and social capital endowment.

1. We use the remoteness index constructed by the ILO program. It takes into account the distance to different infrastructures and social services. We obtain an index ranked from 1 to 5. For more information see Stifel D., Moser M. , Randrianarison L. et Minten B., Situation actuelle du système de transport à Madagascar et implications sur le bien-être et les activités économiques : Résultats des enquêtes communales 2001 . Programme Ilo, Novembre 2002.

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