Agricultural Risk and Remittances: The case of Uganda

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Abstract

The economic literature showed that remittances could replace missing credit and insurance markets. As a result, it is natural to expect that higher amounts of remittances will motivate agricultural farmers to engage in riskier activities. The present study aims to verify the latter hypothesis by answering two distinct questions: do households that receive higher remittances choose to cultivate a riskier crop portfolio; do households that receive higher remittances choose to engage either in crop specialization or in crop diversification? I use the Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) dataset on Uganda established by the World Bank to test these hypotheses. The results show that remittances have no significant impact on farmers risk decisions in terms of crop portfolio and crop diversification. There is some evidence that credit constrained households that receive remittances engage in crop specialisation, which can be interpreted as a wealth effect.

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1 Introduction

The stock of migrants in the world is 215.8 million people which represents about 3.2 percent of the total world population [World Bank, 2010]. The major part of these migrants comes from the developing world: 171.6 million international and local migrants [World Bank, 2013]. This trend is followed by an important increase in the amount of remittances sent to the developing countries which achieved a level of $401 billion in 2012 and provide a financial flow that is higher than the official development aid [World Bank, 2010]. It is expected that remittances in developing countries will grow even faster, today the growth rate of remittances in developing countries is 5.3 percent and is expected to reach 8.8 percent during 2013-15. This phenomenon confirms the "New economics of labor migration" (NELM) assumption that the decision of a household member to migrate is taken collectively by the household and migrants keep interacting economically with their remaining family [Stark, 1991]. Given the size of these financial transfers, it is essential to study their effect on remaining households' decision making. Taking into account that the agricultural sector represents 17 percent of the African GDP and that 75 percent of the African population live in rural areas, investigating the impact of remittances on different agricultural outcomes and agricultural behavior is crucial for understanding farm organization. The NELM assumes that migration and remittances have the role to replace missing credit and insurance markets by generating informal risk-sharing strategies. The mechanism behind this hypothesis is the following: consider a household which sends a migrant away from his home such that the covariance of facing a negative shock of the remaining household and the migrant simultaneously is zero and thus diversifies the sources of income for both parts [Stark and Levhari, 1982]. In this sense, migration is considered to be an insurance strategy as remittances will serve to absorb any negative shock of the remaining household and to smooth consumption. Yang and Choi [2007] and Gubert [2002] showed that households facing a negative crop income shock received higher amounts remittances, but the received amount did not allow them to fully buffer the shock. Notwithstanding, it is intuitive to expect that better insured households (households with higher remittances) are those that will undertake riskier agricultural activities and will have less need to diversify their production. By riskier agricultural activity, I include the crop choice of the farmer in terms of risk.

The first question that the present study seeks to answer is whether households that receive remittances increase the riskiness of their crop production by cultivating more crops with higher but uncertain revenue. Damon [2010] studies this question by estimating how basic grains acreage, coffee acreage and other cash crop acreage respond to remittances. She finds that this hypothesis is not supported by data from agricultural households in El Salvador as the land area dedicated to basic grains increases and the area dedicated to commercial cash crops decreases with remittances and migration. In an analysis on community-level data Gonzalez-Velosa [2011] find that remittances reduce the proportion of farmers cultivating low income crops (corn, coconut) and increases the proportion of farmers cultivating high income crops (mango). Thus these two studies do not show a consensus. Instead of focusing only on a selected types of crops, the novelty of the present study is to construct a measure of riskiness of each crop cultivated by a given household and to evaluate how different crops contribute to the riskiness of the total crop portfolio by taking into account the interdependence that might exist at a farm level and afterwards to study its relation to remittances. In that way the research question can be reformulated as: does the riskiness of the crop portfolio of a household increase with remittances? To this end, I will use the Single Index Model (SIM) developed by Turvey [1991] and applied by Bezabih and Di Falco [2012] in order to construct the measure of the individual crop and portfolio riskiness.

Following the intuition that migration and remittances represent an alternative for missing credit and insurance markets, a second question on crop diversification with two possible answers arises. On the one hand, farmers that receive higher remittances might choose more specialized crop production as specialization is seen as a risk increasing strategy. In addition, as their income is spatially diversified, then there is less need to use crop diversification as an ex ante insurance. On the other hand, several studies showed that farmers in developing countries under-diversify their portfolio due to knowledge and financial barriers [Di Falco et al., 2007, Di Falco and Chavas, 2009] . In particular, remittances can play a role of substitutes or complements to rural loans [Richter, 2008]. In other words, they can relax credit constraints directly by substituting them and indirectly by initiating a risk averse household to take a loan that previously was not taken because of fear of losing the collateral. Therefore, I expect that farmers can diversify more their crop production. This paper seeks to complement the existing literature by using other measures of diversification such as the Shannon index, the Simpson index and the Berger-Parker index which take into account the distribution of shares to each variety and not only the number of different crops [Baumgärtner, 2004].

The answers to these questions have important policy implications. On the one hand, the economic literature state that African farmers choose low yield/low risk portfolios because of their negative past experience (weather shocks). This is mostly due to missing insurance and credit markets, but also absence of irrigation systems. It was shown that low yield portfolios are suboptimal, and taking more risk in the decision making can increase the efficiency of the household agricultural portfolio as farmers forgo more profitable opportunities for the sake of certainty [Mendola, 2008]. Farmers in developing countries choose low-risk portfolios and low-risk production technologies that result in low yields in order to avoid the damages of weather shocks that occur often. Therefore, the existence of insured risk makes households stuck in poverty traps, especially when households are obliged to avoid risk as this risk is linked to their subsistence needs. The consequences are amplified in the case of African farms when considering climate change. The African continent is the most vulnerable to climate change. Adaptation to climate change by cropping drought/flood resistant crops will make a pressure on farmers to engage in risk avoidance thus pushing them into poverty.

2 Data and construction of variables

I use data from the Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) established by the Bill and Melinda Gates Foundation and implemented by the Living Standards Measurement Study (LSMS) within the Development Research Group at the World Bank. The Uganda National Panel Survey (UNPS) sample includes economic and social information on about 3 200 households (with about 2000 households that are engaged in agriculture).

These households were previously interviewed in the 2005/2006 Uganda National Household Survey (UNHS). The sample also includes households that were randomly selected after 2005/2006. This sample is representative at the national, urban/rural and main regional levels (North, East, West and Central regions). Afterwards, the initial sample was visited for two consecutive years (2009/10 and 2010/11).

Three different sets of dependent variables will be used in the analysis. The first dependent variable is the weighted portfolio beta which is an average of each beta from a Single Index Model estimation for the crops cultivated by a given household. The construction of this variable is explained in detail in Section 3. The second set of dependent variables is constituted of different diversity indices that are borrowed from the ecological literature [Baumgärtner, 2004] .

Table 1: Summary statistics: Dependent variable

Variable name	**Mean**	**Standard Deviation**	**Min.**	**Max.**
Risk variable				
weighted portfoliobeta	0.284	0.497	0	7.605
Interspecific diversity variables				
count index n	4.916	2.068	1	16
inverse Simpson	3.302	1.358	1	9.404
Shannon	1.258	0.446	0	2.304
Berger-Parker	2.372	0.875	1	6.792

Four types of inter-specific diversity indices are used: count index, Inverse Simpson index, Shannon index and Berger-Parker index. The count index represents simply the total number n of different crops cultivated by a given household. This index gives an equal contribution of each crop to the household's crop diversity. However, one might argue that different crops should account differently for the degree of diversity. In particular, different crops should be weighted by the part of land that is dedicated to each crop. For this reason, the three other indices will be used because they take into account the weights of each crop and not only the total number of crops. The inverse Simpson and the Shannon index give the average proportional abundance of the crops cultivated by the household. The Berger-Parker index represents the inverse abundance of the crop that is cultivated the most by the farming household.

Tables 1 describes the summary statistics of the dependent variables. The statistics on the count measure shows that on average, households planted 4.92 crops in the period from 2009 to 2011. What can be noted is that other diversity variables are lower than the count index which indicates that land is not equally distributed to different crops. All the three indices are left-censored for households that cultivate one crop.

Table 2 presents definitions and the summary statistics of the explanatory variables and the other control variables that will be used in the estimations. The main variable of interest is the level of remittances that a household receives from migrants. As discussed above, it is expected that remittances have a positive impact on the riskiness of crop portfolio give households incentives to undertake more risk, but the impact on crop diversification is less evident. About thirty five percent of the households in the dataset reported to receive remittances locally or from abroad. The mean value of remittances is 107 363 Shs per household. About thirty percent of the households have a migrant. The mean level of migration is 0.55 per household migrants. Among the households having migrants, on average there are 2.98 migrants per household.

Controlling for socio-economic factors such as sex, age and education of the household's head is important as several studies showed that household heads with different gender, age and education level have different risk choices. It has been showen that older and female household heads choose lower risk activities [Bezabih and Di Falco, 2012]. Household heads with higher education may choose low risk activities as they might have

Table 2: Summary statistics: Explanatory variables

Variable		**Mean**
Migration and Remittances		
migrants	migrants of the hh, locally or abroad	.549
remittances	received by the hh from migrants locally or abroad in *t-1* (Shs)	107 363
ditlevelmig	mean district level of migrants	.528
ditlevelremit	mean district level of remittances (Shs)	114 665
Household characteristics		
sex	the gender of the hh head: equals 1 if the hh head is male	0.711
age	the age of the hh head	46.95
education	the highest school level achieved by the hh head 1-primary, 2-secondary, 3-post secondary training, 4-higher studies	1.111
male adults	male adults in the hh	1.12
female adults	female adults in the hh	1.28
Wealth characteristics		
non agricultural income	income coming from non agricultural activities (Shs)	703 223
assets	total assets in monetary value (Shs)	5 855 451
lqdconstraint	credit/liquidity constraint dummy equals 1 if the household is constrained, 0 otherwise	0.496
Land characteristics		
land	agricultural land ownings in hectars	3.18
topography	Number of plots with different slope	1.241
soiltexture	Number of plots with different texture	1.1
soilquality	Number of plots with different quality	1.092
qualityindex	weighted index of soil quality with: level 3 being good quality and level 1 being poor quality	1.439

more information on the negative consequences of taking risk. Also, the number of female and male adults of the household and the land owning are included as they are the principle production factors and thus can impact the crop production decision making. Higher land owning might increase the possibility of diversification. Also, riskier crops can be labor intensive, thus labor will have a positive impact on the riskiness of the crop portfolio.

Another important factor that concerns the risk taking of the household is its wealth. It is well known in the economic literature that richer households can smooth more easily their consumption when facing a negative shock than poorer households. Land owning and other assets (jewelery, houses, radio etc) are used to control for the effect that different levels of wealth can have on the risk behavior of households.

A variable that defines a dummy whether a household is credit/ liquidity constrained is included too. Such a constraint can be overcome by remittances, but also by another form of income diversification such as off-farm activities that is represented by a nonagricultural income. However, the covariance between the agricultural and nonagricultural income in the same location should be higher than the covariance of agricultural income and remittances from different places, thus remittances should offer higher insurance than nonagricultural income earned in the same location.

The previously described control variables are included when examining the impact of remittances on risk and diversification decisions. In addition, the number of plots with different slope, quality and texture are included as a higher number of different plots might facilitate the diversification [Cavatassi et al., 2012]. A weighted index of land quality is included too in order to capture the fact that cultivating riskier crops might demand a higher quality of land.

3 The riskiness of a crop portfolio

The first estimation aims to study the effect of remittances on the riskiness of a crop portfolio and I will first concentrate on the construction of the crop production riskiness measure, the weighted portfolio beta. To do so, I will use the Single Index Model (SIM) applied by Turvey [1991] and also recently used by Bezabih and Di Falco [2012]. Unlike the Capital Asset Pricing Model (CAPM), SIM is not an equilibrium model and can be applied to any portfolio. This is an argument for the application of the SIM on African agriculture where markets are incomplete.

The Single Index Model assumes that the revenues associated with various farm enterprises are related through their covariance with some basic underlying factor or index. The risk correlated with this index is called non diversifiable or systematic index and the second risk component is the part of farm returns that is not correlated with the index, called specific risk that can be completely diversified.

The systematic risk can be determined by a reference portfolio defined as:

$$R_{pht} = \sum_{i=1}^{n} w_{iht} R_{iht} \tag{1}$$

where w_{iht} refers to the land weights of crop i for household h in the time t and R_{iht} are the stochastic crop revenues. The choice of the reference portfolio depends on what is the most important single influence on returns. In the present case, there are two major groups of shocks that can influence agricultural returns: quantity shocks and price shocks. Thus, we can consider a household's weighted income as a reference portfolio as it is subject to all these shocks. More precisely, as a household's income depends on the household's growing conditions (weather, crop diseases, land characteristics) and prices for input factors and products.

A parameter that measures the anticipated response of a particular crop to the changes in portfolio returns needs to be estimated. This coefficient, β_i, is given by a panel regression of R_{iht} on the reference portfolio R_{pt}:

$$R_{iht} = \alpha_{it} + \beta_i R_{pht} + e_{iht} \tag{2}$$

Beta coefficients are estimated with the equation (2) by using Panel fixed effect model in order to account for the unobservable household factors that can influence each crop revenue. Once the beta coefficients are estimated we can calculate the portfolio beta as the average of all betas of the crops that are cultivated by the household.

Table 3 gives the estimates of different crop beta coefficients. We can interpret these coefficients in the following way: if we take, for example, cotton and maize, we observe that an increase in the reference portfolio of 1 Shs will induce a more than proportional increase of the cotton revenue of 1.21 Shs and no increase in the maize revenue. These estimates indicate that cotton is riskier than maize as it is more sensible to the variation of the reference portfolio revenue than maize. Most of the coefficients are consistent with the agricultural and economic literature on riskiness of crops.

The portfolio beta represents the weighted average of the betas of each crop cultivated by a given household. The mean risk (Table 1) of crop portfolio in this dataset is relatively low 0.287, with a minimum of 0 which means that the given portfolio does not react to the movements of the reference portfolio and a maximum of 2.73 which means that an increase of 1 ShS in the reference portfolio provokes an increase of 2.73 Shs in the portfolio.

Table 3: Estimation results : Beta Coefficients

Crop	Coefficient	Crop	Coefficient
sweet potatoes	0	tobaco	5.25
rice	.03	irish potatoes	1.05
maize	0	cassava	0
millet	0	yam	.13
sorghum	.22	dodo	.001
beans	.25	oranges	.63
field peas	2.00	paw paw	.025
banana	.70	pineapples	.52
banana sweet	.14	sunflower	2.00
banana beer	.10	pigeon peas	.08
ground nuts	.12	cotton	1.22
soya beans	.11	mango	.43
vanilla	0	jackfruit	.2
simsim	.50	avocado	.36
cabbage	2.31	passion fruit	3.69
tomatos	.50	coffee	.15
eggplants	.04	cocoa	3.23
onions	-.13	tea	.78
pumpkins	0	sugarcane	7.96

4 The identification strategy

In this section, the econometric specification and the different estimation methods that are used to study the impact of remittances on the different outcome variables are discussed. First, I proceed by defining the general equation to estimate, which is the same for the three dependent variables. Second, according to the character of each dependent variable, different estimation methods are considered. I also propose possible solutions to the endogeneity problems generated from the econometric specification.

4.1 Econometric specification

In order to study the impact of remittances on the riskiness of the farmer's crop portfolio, crop diversity, I use the following equation:

$$A_{ht} = \alpha_0 + \alpha_1 X_{ht} + \alpha_2 R_{ht-1} + \alpha_3 C_{ht} + \alpha_4 C_{ht} * R_{ht-1} + \mu_h + \eta_t + \kappa_r + \varepsilon_{ht} \tag{3}$$

where A_{ht} stands for the agricultural outcome variables : the portfolio beta, the diversity indices. X_{ht} represents household characteristics such as the gender, the age and the level of education of the household head, the number of members net of migration, the size of the land of the household h in the time t. When using the different diversity indices as dependent variable, I add the number of parcels with different texture, slope and quality as this might increase the feasibility of diversification. X_{ht} also includes different indicators describing the wealth of a given household as wealth can be used as another tool of consumption smoothing. C_{ht} is a dummy that indicate whether a household is credit constraint or not.

Concerning the variable of interest, I use a lagged value of the level of remittances R_{ht-1} received by the household h following the assumption that households would make a decision on agricultural risk taking and crop diversification in the period t once it received the remittances in the previous period $t-1$. I incude an interaction term between C_{ht} and R_{ht-1} in order to account whether there are heterogenous effets of remittances depending on the credit position of a given household. Households, time and regional fixed effects are also taken into account in the equation (3). Controling for regional effects is important in this study as regions might differ considerably in the weather conditions, soil characteristics, the access to infrastructure etc. In the case of Uganda, the majority of the country is exposed to two cropping and rainy seasons except the North of the country where there is only one rainy seasson and the quality of the land is moderate to poor. In this mostly flat region, farmers engage more in pastoral activities and to some lower extent in production of drought resistant crops. The central-southern region is the most productive one in terms of crop production. It benefits from the access to the Lake Victoria and better infrastructure. I take this region as a reference region and test how individual agricultural decisions vary across the regions.

4.2 The estimation method(s)

Estimating equation (3) by Ordinary Least Squares (OLS) will yield biased results. There are problems of endogeneity which occur from the OLS estimation when studying the effect of remittances on different agricultural decisions. First, remittances are not random and depend on household characteristics. Thus, households that have migrants and receive remittances may differ from those households that neither have migrants nor remittances which might be linked to some unobservablecharacteristics of the household. Second, there might be some household unobservable characteristics that have a simultaneous impact on migration, remittances and agricultural decisions such as entrepreneurial spirit. Other studies have solved the second endogeneity problem by using an instrumental variable (IV) approach. A good instrument is a variable that is correlated with the explanatory variable and uncorrelated with the outcome variable. An instrumental variable influences the outcome variable only through the explanatory variable. The choice of the instrumental variable is constrained by the availability of the data and the outcome of interest. Several authors used the distance to the borders or the consulate to instrument the outcomes of migrants in the receiving country [McKenzie et al., 2010]. Some authors used also natural shocks such as rainfall intensity [Munshi, 2003, Yang and Choi, 2007] to instrument migration when studying outcomes abroad and others used economic shocks such as depreciations of different currencies to instrument migration [Yang et al., 2007, Yang, 2008], or unemployment rates and GDP shocks in the receiving countries [Damon, 2010, Gonzalez-Velosa, 2011]. Also cultural, historical, community and political factors can be used as instrumental variables such as the historical migration rate in a given village, or migration networks in the receiving countries [McKenzie, 2005, Acosta, 2006].

What we can conclude from the previous discussion is that when the outcome of interest is connected with the remaining household, the instrument used for remittances and migration is a variable ”coming from” the migrant receiving economy. In contrast, when the outcome of interest is for example the earnings of the migrant, then the instrumental variable is connected with the origin economy. Both cases satisfy the criteria that the instrumental variable should be exogenous to the outcome variable. Historical migration rates and migration networks satisfy this criteria too.

Unfortunately these kinds of instruments cannot be used in the present study because of the incompleteness of the data. For external migration, the destination of the migrant is not included in the data, thus instruments connected with the receiving economies cannot be used. Currencies in which remittances from abroad are received not included either. Also, as migration is mostly internal, we should use a local instrumental variable that is correlated with remittances and uncorrelated with agricultural risk. We are only left with community based variables, such as the average level of remittances and migrants on district level. The first stage estimation equation of remittances can be written as:

$$R_{ht-1} = \beta_0 + \beta_1 X_{ht} + \beta_2 Mdist_{ht-1} + \upsilon_{ht-1} \tag{4}$$

where R_{ht-1} stands for the level of remittances received by the household h in the period $t-1$. X_{ht} represents the household characteristics such as households head gender, age and level of education, as in the equation (3). Acosta [2006] uses as instrument for remittances some village level characteristics, such as the propensity of migration. It is expected that individual remittances increase with district level of migration. As migration is a prior condition for receving remittances, districts with higher level of remittances are those that have higher level of migrants. The district level of migrants is represented by the variable M_{dht-1} where d referes to the district where the households h lived in time $t-1$. Equation (4) will be estimated using a Tobit model, as remittances are observed only for a third of the sample. A linear prediction of R_{ht-1} is introduced in the second stage of the estimation, equation (4).

The third endogeneity problem is reverse causality which may also exist if households that are prone to risk taking send a migrant once they have made their agricultural decision and expect remittances in return. The latter case of endogeneity is avoided as the lagged value of remittances is used in the equation (3).

Another technical problem arises in this case as the diversity indices (Inverse Simpson, Shannon and Berger-Parker index), and to some extent the portfolio beta, are left-censored. This requires a Tobit which is a censoring model applied to the linear model with normal residuals. Once again, using OLS estimation for a censored outcome variable will lead to biased results. Also the count index n is categorical variable that takes limited number of values. The Poisson estimation model deals with this kind of dependent variables. The nonlinearity of the different models does not allow the use of fixed effects. The number of censored observations in the sample is around three percent. Using a panel model can also be appropriate as it allows to purge the unobservable time invariable household characteristics.

5 The Results

The First Stage regression (not shown here for sake of space) confirms that the district average level of migrants/remittances has a positive and significant impact on the level of remittances. In order to test the validity of the instrument and the necessity of an IV approach, a Durbin Wu Hausman test is runed. In the case of diversity indices estimation remittances are not exogenous thus an IV approach is needed, but I rely on the simple Panel FE estimation in the case of the portfolio beta estimation as the null hypothesis cannot be rejected.

The regression results for equation (3) are in Table 4. The Tobit-IV and Panel-IV results show that the level of remittances influences negatively the level of richness and evenness of different crops cultivated by the farmers, but this result is insignificant. However, we observe for the three categories od diversity indices that an interaction variable composed of the binary variable credit constraint and the level of predicted remittances has a negative impact on these diversity indices. Receiving 10000 Shs remittances for households that are credit constraint lowers the level of relative abundance by 0.004 points (Inverse Simpson index). In other words, remittances push credit-constrained farmers into crop specialisation, thus can be considered as risk-increasing strategy. This can be interpreted as a wealth effect of remittances that encourages constrained farmers to engage in crop specialisation.

Table 4: Second stage: Estimating the effect on relative abundance

	Inverse Simpson Index		Shannon Index	
VARIABLES	IV panel FE	IV Tobit	IV panel FE	IV Tobit
remittances	-0.00348	-0.00785	-5.57e-05	-0.00234
	(0.00974)	(0.00547)	(0.00281)	(0.00169))
credit constraint*remittances	-0.00401**	-3.11e-05	-0.00113**	5.27e-05
	(0.00176)	(0.00121)	(0.000565)	(0.000372)
land	-0.0127***	-0.00772***	-0.00394***	-0.00226***
	(0.00381)	(0.00218)	(0.00117)	(0.000671)
adults	0.00653	0.0754***	0.0171	0.0298***
	(0.0560)	(0.0255)	(0.0171)	(0.00788)
dep. Ratio	0.0193	0.0591***	0.00423	0.0196***
	(0.0421)	(0.0204)	(0.0124)	(0.00635)
male hh head	-0.310	-0.447	-0.0383	-0.132
	(0.615)	(0.313)	(0.185)	(0.0964)
age of hh head	0.00336	0.0155***	0.00132	0.00490***
	(0.0130)	(0.00561)	(0.00335)	(0.00173)
primary education	0.288	0.373***	0.0673	0.121***
	(0.247)	(0.120)	(0.0728)	(0.0371)
secondary education	0.337	0.503**	0.0738	0.171***
	(0.375)	(0.196)	(0.110)	(0.0604)
post secondary training	0.597	0.621***	0.125	0.185***
	(0.417)	(0.215)	(0.127)	(0.0663)
higher education	2.019	1.107*	0.387	0.257
	(1.328)	(0.668)	(0.400)	(0.206)
fisrst cropping season	-0.684***	-0.787***	-0.255***	-0.305***
	(0.0724)	(0.0579)	(0.0236)	(0.0178)
second cropping season	-0.530***	-0.752***	-0.238***	-0.305***
	(0.0954)	(0.0641)	(0.0292)	(0.0196)
Eastern region		-0.325***		-0.109***
		(0.0871)		(0.0271)
Northen region		-0.496***		-0.141***
		(0.0972)		(0.0302)
Western region		-0.400*		-0.124*
		(0.206)		(0.0636)
non agricultural income	8.62e-09	-1.13e-08	3.76e-09	-4.31e-09
	(9.96e-09)	(9.28e-09)	(4.65e-09)	(2.85e-09)
assets	3.37e-09	6.35e-10	1.02e-09*	2.92e-10
	(2.03e-09)	(1.33e-09)	(6.05e-10)	(4.10e-10)
credit constraint	-0.117	0.0139	-0.0383	0.00776
	(0.105)	(0.0690)	(0.0335)	(0.0212)
soil quality index	0.00755	-0.0238	-0.0188	-0.0127
	(0.0577)	(0.0429))	(0.0165)	(0.0132)
number of plots with different texture	-0.187**	-0.111	-0.0604**	-0.0263
	(0.0870)	(0.0687)	(0.0255)	(0.0211)
number of plots with different slope	0.0949	0.113**	0.0203	0.0515***
	(0.0750)	(0.0508)	(0.0220)	(0.0157)
Constant	3.174***	2.517***	1.264***	0.994***
	(0.943)	(0.439)	(0.135)	(0.00929)
DurbinWuHausman test (pvalue)	0.045	0.012	0.067	0.011
R-squared	0.096		0.138	
Number of hhid	1,849	1,849	1,849	1,849

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

There are few socio-economic factors that influence the household's decision in terms of crop diversification. First, I observe that an increase of the land size of 1 ha decreases the relative abundance of crops by 0.01 points at significance level of 1 percent. The interpretation of this result might be linked to an existence of economies of scale on farm crop cultivation of the sample. As expected, land size as production factor seems to have an important influence on crop management decisions regardless of the estimation strategy. Second, if we consider the Panel FE estimation, higher number of plots with different soil texture, that a farmer owns, reduces the relative and absolute abundance of by 0.18 and 0.09 points, which is opposite of what was expected initially. If we compare the different indices that include weights in their computation to the count index, we observe that both categories are influenced by different factors in the panel/poisson analysis. The number of adults of the household that is a proxy for labour endowment of the household influences positively the number of crops, but not the diversity measurements that include weights.

Table 5: Second Stage: Estimating the effect on Portfolio Beta

VARIABLES	Panel FE	Tobit
Remittances	0.000106	1.29e-05
	(0.000306)	(0.000238)
credit constraint*remittances	-0.000358	-0.000138
	(0.000407)	(0.000323)
land	0.000820	0.00120*
	(0.000883)	(0.000695)
adults	0.0182	0.00706
	(0.0156)	(0.00581)
dep. ratio	0.00615	0.000368
	(0.0120)	(0.00661)
male hh head	0.142***	0.0594***
	(0.0549)	(0.0217)
age	0.00127	-0.000932
	(0.00216)	(0.000655)
primary education	-0.0721*	-0.0690***
	(0.0399)	(0.0231)
secondary education	0.00367	-0.0372
	(0.0643)	(0.0331)
post secondary training education	-0.0134	-0.0209
	(0.0678)	(0.0347)
higher education	0.0273	-0.118
	(0.182)	(0.0932)
1st cropping season	-0.0289	-0.0201
	(0.0209)	(0.0173)
2nd cropping subwave	-0.0328	-0.0553***
	(0.0220)	(0.0192)
Eastern region		-0.103***
		(0.0282)
Northen region		-0.0805***
		(0.0293)
Western region		0.0875***
		(0.0293)
nonagricultural income	-6.11e-10	-1.38e-09
	(3.61e-09)	(1.32e-09)
assets	4.06e-10	1.66e-10
	(4.13e-10)	(1.98e-10)
credit constraint	0.00409	0.0142
	(0.0168)	(0.0142)
Constant	0.112	0.346***
	(0.129)	(0.0515)
R-squared	0.013	
Number of hhid	1,849	1,849

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The cropping season categorical variable(s) indicates that households for which we have observations only for the 1st or 2nd cropping period have a lower level of crop diversity (from every aspect) than households for which we have observations for both cropping seasons, although the dependent variable is based on an average of the two seasons. An intuitive result concerning regions is that, households coming from the Northern, Eastern and Western regions of Uganda have lower predicted degree of diversity compared to the Central (Southern) region where the capital city belongs, as the rainfall and land pattern are such that lower number of crops are cultivated in these regions especially in the North where pastoral activities are the most common and where the lands are of poor quality; also the rainfall level is lower and there is a lack of infrastructure compared to the Central region.

The results of the model studying the relationship between the riskiness of a crop portfolio and remittances are less significant than the previous results. Remittances have a positive but statistically insignificant effect on the level of the portfolio beta. According to the panel fixed effect estimation, having a household's head that is male inceases the risk index by 0.142 points than having a female household's head. Also, a household head that has primary education has a risk portfolio index that is 0.0721 lower than household with a head that does not have any education. This result seems coherent with the initial intuition, as we expect that more educated members of the households should be more aware of the consequences of undertaking more risky activities.

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Considering the tobit estimation that allow for regional effects, we observe similar significant regional results as in the case of the diversity indices. In the Northern and Eastern region, households cultivate less crops and lower-risk drought resistant crops then in the Central region. More precisely, a household that lives in the Northern region has a predicted value of the portfolio beta that is 0.1 points lower than a household in the Central region. Another intuitive result coming from the tobit estimation model is that the level of land ownings increases the predicted level of the portfolio beta which goes in line with the assumption that wealthier households are able to better smooth consumption or income shocks and thus they are better placed when undertaking higher risk/higher income activities. If we compare the results to the previous section, we observe that increase of land ownings increase riskiness in terms of crop choice and crop specialisation. Once again, we can more be confident about the panel estimation as the tobit estimation do not deal with unobserved heterogeneity and the number of censored observations is under three percent. In the Panel estimation, suprisingly we do not find other significant factors that influence the risk prortfolio. In the next section, we disscuss the possible explanation of this case.

6 Conclusion

In order to sum up the different results, I relay on the Panel (IV) estimation regarding the diversity indices as it purges the "unobservable" household characteristic and there very few censored observations, eventough by definition a Tobit estimation should be used. The main significant findings in the present study are that remittances alone do no have a significant impact neither on risk choices nor on crop diversification. This result is probably a matter of the low amount of remittances that households receive. However, when remittances are interacted with credit status of the household, crop specialisation is more observed for credit constrained households. This can be interpreted as a wealth effect for the constrained households, which was not found in the literature. The major question that arises is to discover whether households engages in low-risk crop specialisation or high-risk crop specialisation. By running a simple correlation between the riskiness of crop portfolio and the diversity indices, I find a positive but week correlation (0.05), thus no conclusions can be made and the questions stays open for further analysis. Also, migration and remittances can be seen as a risky strategy as the outcomes from these kinds of income diversification are not certain. Including the degree of certainty of remittances can give some new insights.

An additional result is that different production factors (labour and land) do affect separately the number and the weight of crops. Labour seems to be significant for the household's choice if the number of crops and land size seems to be a key factor for the distribution of weights among different crops. I find significant difference crop choices in terms of risk between male and female heads of households. There is also some evidence that head of households that have primary education have lower-risk decisions compared to non-educated household heads. However this is no longer true for higher levels of education.

Concerning the insignificance of different factors for the risk crop choices, limited variability of the portfolio beta variable may be an explanation for two reasons. The first reason is that the individual crop riskiness is not time varying so if a household that cultivates the same crops in the two periods and if the weights of these crops do not change significantly, then the portfolio beta will not differ between the periods. The second reason is that the two waves in this analysis are consecutive, thus we cannot expect that farmers easily make different decisions on what to crop. Since making different crop decisions may take time, the invariability of the dependent variable may be due to the consecutiveness of the waves and the invariability of the crop risk measure. A dataset that includes higher number of periods in the surveys or a longer gap between the periods will be more suitable to analyse the portfolio beta.

As the results of the impact of remittances on the riskiness of the crop choice are not significant, we cannot conclude that remittances help farmers to undertake riskier activities that yield higher incomes and help them to avoid or escape poverty traps. The only result(s) that we can discus is that remittances lead to crop specialization for credit constrained households. On the one hand, Ugandan agriculture is mostly rain-fed and relying only on one low-risk crop can lead farmers into a poverty trap. Instead, higher diversity in crops that have different resistance to weather shocks should be a better solution when adapting to irregular weather conditions. This strategy seems more appropriate when dealing with the consequences of climate change. On the other hand, crop specialization can yield economics of scale. A cost/benefit study on whether crop diversification or crop specialization in riskier crops is the most beneficial can be done by agro ecological zone in future research in order to evaluate if remittances contribute to undertake the right strategy. Also the analysis can be extended to interspecific diversity, by using different crop varieties that can have different impact on risk behaviour.

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