Walk the Talk: Private Sustainability Standards in the Ugandan Coffee Sector

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Abstract

We investigate the welfare and productivity implications of private sustainability standards in the coffee sector in Uganda. We use cross-sectional household survey data and an instrumental variable method with instruments that pass weak identification and over-identification restrictions. We find that triple Utz-RainforestAlliance-4C certification increases income, and land and labour productivity, and reduces poverty. Double Fairtrade-Organic certification is found to be associated with higher producer prices but results in lower land and labour productivity, and thereby fails to increase producer income and contribute to poverty reduction. We conclude that private sustainability standards do not always live up the expectations they create towards consumers.

Keywords: coffee certification, private sustainability standards, global value chains, poverty reduction, smallholder farmers, Uganda

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1. Introduction

Over the past two decades, Private Sustainability Standards (PSS) in global food value chains have spread rapidly (Beghin et al., 2015). PSS guarantee specific quality and/or safety attributes of food, and specific ethical and/or environmental aspects of food production and trade (Henson and Humphrey, 2010). They are especially important in international trade relations with developing countries because of information asymmetries between producers in those countries and overseas buyers and consumers (Schuster and Maertens, 2015). Understanding the welfare and poverty effects of PSS is particularly important because PSS raise expectations among consumers about the impact they have for smallholder producers in developing countries. For example, Fairtrade claims to *provide farmers with a better deal that allows them to improve their lives* and to *offer consumers a powerful way to reduce poverty through their everyday shopping* (Fairtrade International, 2016). Likewise, Rainforest Alliance claims to *ensure the long-term economic health of forest communities through protecting ecosystems, safeguarding the well-being of local communities and improving productivity* (Rainforest Alliance, 2016). There is a growing body of literature investigating the welfare implications of PSS but evidence is quite mixed (see Beghin et al., 2015 for a review). Some studies indicate that PSS enhance farmers' welfare (e.g. Asfaw et al., 2010; Handschuch et al., 2013) while others find no or even adverse effects (e.g. Holzapfel and Wollni, 2014; Hansen and Trifkovic, 2014).

In this paper, we assess the economic implications of coffee certification for smallholder coffee farmers in the Mount Elgon region in Eastern Uganda. We use cross-sectional household survey data and instrumental variable methods – with instruments that pass weak identification tests and over-identification restrictions – to reveal how participation in two different coffee certification schemes – a double Fairtrade - Organic scheme and a triple Utz - Rainforest Alliance - Common Code of Conduct for Coffee (4C) scheme – affects poverty, income, coffee production, yields and labour productivity. The focus on coffee in Uganda is particularly relevant because coffee is a major export crop produced by a large number of smallholder farmers. The government of Uganda promotes adoption of PSS and production of 'sustainable coffees' as a means to reposition the country in the international coffee market – as mentioned in the National Export Strategy (MAAIF, 2010; ITC, 2012).

The focus on PSS in the coffee sector is relevant because there is no consensus on whether PSS are good for smallholder coffee farmers or not. Studies from different institutional and agro-ecological settings provide diverse conclusions on the income and poverty effects of coffee standards. Most studies focus on Latin-America (e.g. Bacon, 2005; Wollni and Zeller, 2007; Bacon et al., 2008; Mendez et al., 2010; Valkila and Nygren, 2010; Beuchelt and Zeller, 2011; Ruben and Zuniga, 2011; Barham and Weber, 2012; Ruben and Fort, 2012) while evidence from Africa is limited to a handful of recent papers (Bolwig et al., 2009; Chiputwa et al., 2015; Van Rijsbergen et al., 2016). With our paper we contribute to the evidence on the impact of PSS in Africa. In addition, earlier studies mostly analyse the impact of one single certification scheme (e.g. Bacon et al., 2008; Bolwig et al., 2009; Valkila and Nygren, 2010; Ruben and Fort, 2012; Jena and Grote, 2016) – mostly Fairtrade certification as one of the oldest PSS in the coffee sector – while more recent studies investigate the impact of double or triple certification (e.g. Valkila, 2009; Weber, 2011; Jena, et al., 2012; Bolwig, et al., 2013) or compare different certification schemes in the same area (e.g. Mendez et al, 2010; Beuchelt and Zeller, 2011; Ruben and Zuniga, 2011; Barham and Weber, 2012; Chiputwa et al, 2015 and Van Rijsbergen et al, 2016). As PSS differ widely in focus and requirements, their effectiveness and their complementarity in improving farmers' welfare and reducing poverty in specific settings may vary as well. Comparative evidence and evidence on increasingly common multiple certification remains relevant and our paper contributes to this. Moreover, we focus on multiple outcome indicators in order to better understand the channels through which certification contributes to farmer welfare and poverty reduction. Furthermore, aforementioned economic studies on the impact of coffee certification usually do not control for differences in agro-ecological conditions – or only to a small extent, e.g. by controlling for altitude of coffee plots (Wollni and Zeller, 2007; Bolwig et al., 2009; Chiputwa et al., 2015). Based on a comprehensive GIS database for our research area, we are able to better control for agro-ecological heterogeneity using various plot-weighted indicators.

2. Background and Data

2.1 The coffee sector in Uganda

During the past two decades coffee production in Uganda increased from 3.2 million 60 Kg bags of green coffee in 1995 to about 4.8 million in 2015 (figure 1). Production decreased in the early 2000s, mainly due to

the Coffee Wilt Disease (*Tracheomycosis*), but recovered from 2005 onwards. About 80% of the production is Robusta coffee, mainly grown in central and south-western Uganda, and 20% is Arabica coffee, grown at higher altitude in western, north-western and eastern Uganda. Domestic consumption is very small (5% of production) ; coffee is mainly for export. Coffee constitutes about 20% of Uganda's foreign exchange earnings and Uganda is the second largest African coffee exporter (UCDA, 2013; ICO, 2015).

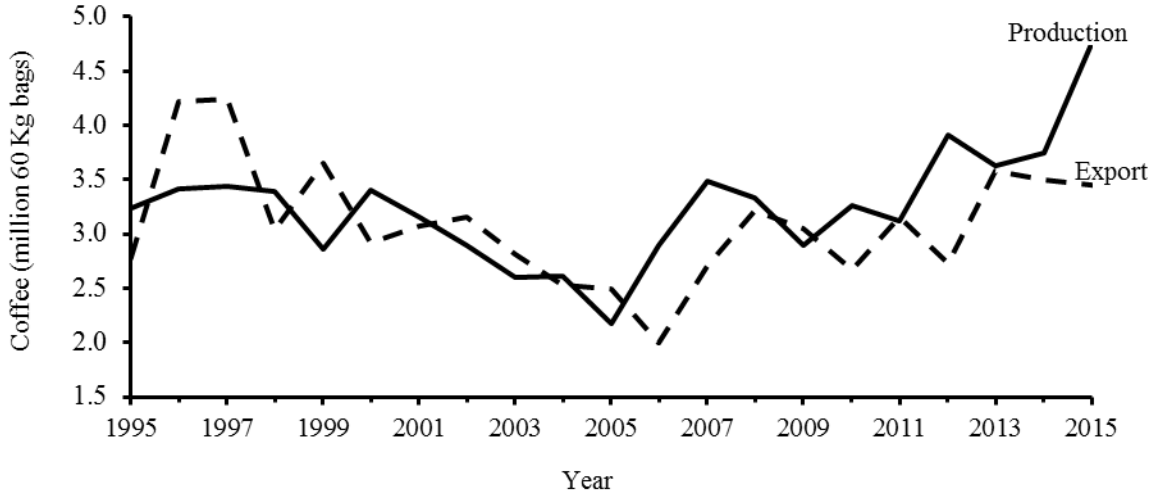

Figure 1: Coffee Production and Export Trends in Uganda (1995-2015); Source: Derived from FAOstat (www.faostat.org)

Until 1991, coffee trade in Uganda was controlled by the Coffee Marketing Board (CMB) and production organized through a centrally-planned cooperative system. Processes of liberalisation and privatisation in the 1990s led to abolition of CMB and the collapse of many coffee cooperatives. Private companies emerged and currently about 52 private roasting and exporting companies are registered, of which about 35 are active (UCDA, 2013). More than 90% of Ugandan coffee is produced by approximately 1.7 million smallholder producers (UBOS, 2014). Direct employment in various activities in the coffee chain is estimated at about five million people, including farmers, farm-workers, traders, and employees in roasting and exporting companies. Coffee yields in Uganda are low, on average 609 kg of green coffee per hectare or about 2,550 kg/ha of fresh cherries (FAO, 2016). Although higher than the African average of 502 kg/ha for green coffee, actual yield is a fifth of the 3,100 kg/ha green coffee (or 13,000 kg/ha fresh cherries) yield obtained in on-station research trials in Uganda (MAAIF, 2010; FAO, 2016).

Private sustainability standards started spreading in the Ugandan coffee sector in mid-1990s, starting with Fairtrade (FT) in 1994, followed by organic (Org), Utz, Rainforest Alliance (RA) and 4C. These standards

all focus to some extent on improving the livelihoods of smallholder coffee producers but this is most apparent for FT that focuses on reducing poverty and empowering farmers. RA and Org have the strongest focus on biodiversity and natural resource conservation while Utz and 4C primarily focus on good agricultural and farm management practices (see Table A1, appendix for more details on the characteristics and requirements of the standards). Currently about 35,000 Ugandan coffee producers are FT certified; 30,000 are Org certified; 65,450 are Utz certified; and 21,200 are RA certified (Table A1, appendix). 4C certification, now called the Baseline Common Code (BCC), was introduced in Uganda in 2008 but being a sector-wide standard, it is difficult to estimate the number of producers involved. Certified coffee production is currently estimated to be 3% of total coffee exports and continues to expand. In its National Export Strategy (NES), Uganda aims to further increase production of *sustainable coffees* to boost export earnings (ITC, 2012).

2.2 Study area

We study the implications of coffee certification for smallholder producers in the Mount Elgon region in Eastern Uganda, a main Arabica coffee producing area in the country. The region includes eight districts; ranges in altitude between 1,200 and 2,200 metres above sea level; and has a bi-modal rainfall pattern (1,600 – 2,200 mm) and reasonably fertile soils. The region faces increasing population pressure and land degradation, including problems of soil erosion and increased occurrence of landslides (Claessens et al., 2007; Knapen et al., 2006). The region is dominated by two ethnic groups, the Bagisu in the western Bugisu sub-region, and the Sabiny in the eastern Sebei sub-region. Coffee is grown in a garden system, usually intercropped with bananas and other food crops. There are four main coffee exporting companies operating in the region: Great Lakes, Kawacom, Kyagalanyi Coffee Limited (KCL) and Gumutindo Coffee Co-operative Enterprises (GCCE). The latter three implement coffee certification schemes in the region.

Before liberalisation of the coffee sector, production and marketing of coffee in Mount Elgon region was organised by Bugisu Cooperative Union (BCU), a state-controlled cooperative. BCU was one of the largest coffee cooperatives in the country with over 200 Growers' Cooperative Societies (GCSs) and about 467,000 members. It was one of the first cooperatives in Uganda to become FT certified in 1995. When the liberalisation process increased competition in the sector, BCU faced problems. Limited entrepreneurship, failure to deliver high quality FT coffee, and mismanagement of the FT social premium ultimately resulted in

the collapse of BCU in 1997. Gumutindo Coffee Cooperative Enterprise (GCCE) was then founded on BCU remains, by grouping its four best performing GCSs. Since its founding in 2000, GCCE started implementing FT and later, a double FT and Org (FT_Org) certification scheme. GCCE runs a cooperative business model, through a network of GCSs across the region. GCCE provides coffee specific extension services to its members and does not allow the use of chemical inputs. Registered cooperative societies transport and supply fully washed coffee to GCCE union in Mbale town. Farmers usually process their coffee at home and deliver it fully washed to the cooperative society.

Kyagalanyi Coffee Limited (KCL) is one of the oldest private coffee export company in Uganda, founded in 1992. In Mount Elgon region, KCL implements a triple Utz, RA and 4C coffee certification program (Utz_RA_4C) since 2006. KCL's business model is centred around the company's coffee washing stations and contract-farming with producer organisations. Currently, KCL has six washing stations in the Mount Elgon region; all established close to rivers in order to guarantee access to water for coffee washing. The company selects interested farmers within a 12.5 km radius from the washing stations and organises farmers into producer organisations (POs) per village. The company provides coffee specific extension services, agro-chemicals, protective gear, and facilities for cleaning protective gear and disposal of used chemical containers. KCL pays attention to timely delivery of good quality inputs and offers farmers the opportunity to obtain fertilizer on credit, deducting the cost from the end-season bonus farmers receive, and to buy other inputs in its agrochemical store. KCL collects fresh coffee cherries from the POs and processes them at the washing stations.

Independent coffee farmers and cooperatives also operate in the Mount Elgon region. They sell coffee to traders and agents of the four companies through spot market transactions, either individually or through independent coffee cooperatives or producer organisations. They sell fresh coffee cherries or home-processed dried (*kiboko*) or fully washed coffee. Most independent farmers do not receive coffee specific extension services, except for ad hoc trainings from NGOs, the National Agricultural Advisory Services (NAADS), or regional UCDA officers.

2.3 Data collection

We use original cross-sectional household survey data from the Mount Elgon region, collected between February and May 2014 and covering the 2013/2014 coffee season. A multi-stage stratified random sampling design was developed using information from company databases of certified producers and village Local Council (LC) lists of coffee producers. In the first stage, the five most intensive coffee growing districts were purposively selected out of the seven rural districts in the Mount Elgon region (table 1). In the second stage, four (or five for Kapchorwa district with smaller sub-counties) sub-counties per district were selected in a stratified random way with the certification schemes as strata. In each district two (or three in Kapchorwa) sub-counties were selected where GCCE or KCL source certified produce from – the two companies source from different sub-counties – and two sub-counties where they do not source from. In the third stage, we randomly selected three (or two in Kapchorwa) villages per sub-county and 10 coffee farmers in each village. The final sample includes 600 coffee producing farm-households from 60 villages in 21 sub-counties and five districts, of which 170 are FT_Org certified, 130 are Utz_RA_4C certified and 300 are not certified (table 1). The analysis in this paper is done excluding five farmers in the sample whose coffee shrubs are still too young to be productive. In order to limit confounding the impact of certification with the impact of cooperative or association membership, all farmers in the sample belong to a cooperative or a producer association. Due to continuous administrative subdivision in Uganda, sub-counties (the lowest administrative unit) are very small and include only one coffee cooperative or association, impeding the selection of certified and control farmers in the same sub-county (and controlling for sub-county fixed effects in the analysis). Nevertheless, sub-counties within a district are relatively similar in terms of agro-ecological, infrastructure and institutional characteristics – although differences exists between sub-counties (Table A2, appendix).

Table 1: Sampling design

District	Sub-county	Certification	Total households	Sampled households
Bududa	Bududa	Utz_RA_4C	2,597	30
	Bumayoka	FT_Org	701	30
	Bukigai	None	2,000	30
	Bushiika	None	2,600	30
Bulambuli	Masiira	Utz_RA_4C	1,215	30
	Namisuni	FT_Org	359	30
	Sisiyi	None	2,480	30
	Bukibologoto /Simu	None	1,380	30
Kapchorwa	Gamogo	Utz_RA_4C	520	20
	Kabeywa	Utz_RA_4C	485	20
	Munaria	FT_Org	268	20
	Kaptanya	None	2,400	30
	Tegeres	None	2,950	30
Manafwa	Bumbo	FT_Org	320	30
	Magale	FT_Org	262	30
	Bupoto	None	2,320	30
	Buwabwala	None	1,440	30
Sironko	Busulani	Utz_RA_4C	1,251	30
	Buwalasi	FT_Org	1,289	30
	Buyobo	None	2,100	30
	Buwasa	None	1,710	30
Total	**21**		**30,647**	**600**

Source: Authors' derivation from administrative data, company databases and village Local Council lists.

The survey was implemented using a quantitative structured questionnaire with different modules and through face-to-face interviews by a team of trained enumerators. Survey data include detailed information on coffee production, marketing and income, and on general household characteristics and overall income. GPS coordinates of the homestead and all coffee plots were recorded during the survey and available GIS data on Mount Elgon region was used to derive location-specific indicators. In addition, a village survey was implemented in all 60 sampled villages, using a structured questionnaire and face-to-face interviews with a small group of village leaders; and semi-structured interviews were carried out with 45 stakeholders in the coffee sector, including exporters, processors, traders, co-operative marketing managers and service providers.

3. Methods

To analyse the impact of the two coffee certification schemes in the Mount Elgon region, we estimate regression models of the following type:

$$Y_i = \alpha_0 + \beta X_i + \gamma C_i + \varepsilon_i \quad (1)$$

The dependent variable Y_i, measures the welfare outcome of household *i*. To create insights into the channels through which certification affects coffee farmers, we estimate multiple models for the following outcome indicators: 1/ *poverty*, measured as having a per capita household income below the international poverty line[1]; 2/ *total household income*, measured as total income in Ush from livestock, coffee and other crop production, off-farm activities and transfers in the last 12 months; 3/ *per capita income*, measured as total household income in Ush divided by the household size; 4/ *coffee income*, measured as net coffee income in Ush for the last 12 months; 5/ *coffee income per hectare*, measured as coffee income divided by area under coffee; 6/ *coffee production*, measured as the quantity of coffee harvested in kg during the last 12 months; 7/ *coffee yield*, measured as quantity of coffee harvested in kg per hectare; and 8/ *labour productivity*, measured as the net coffee income per person-day of family labour in coffee production, processing and marketing in Ush/person-day. The main explanatory variables of interest are included in C_i, a vector of dummy variables for participation in the Utz_RA_4C and FT_Org coffee certification schemes. These binary variables are mutually exclusive as no producer is contracting with GCCE and KCL at the same time.

In a first set of regressions we use a probit model estimation for the binary poverty outcome indicator, and OLS estimations for the other continuous outcome indicators. To control for possible selection bias from observed heterogeneity, we include a large set of observable household, agro-ecological and location characteristics in the vector X_i. Household characteristics include indicators of human and physical capital: the education level, gender and age of the household head, the number of adults and the number of children in the household, livestock ownership measured in tropical livestock units, and the coffee area and its square – the latter are replaced with the total farm size and its square for the regressions with poverty and total household income as outcome indicators. Agro-ecological indicators include slope measured in percentage, altitude measured in metres above sea level, topographic wetness measured as a dimension-less index, and heat load measured in trigonometric units. These variables are derived by overlaying GPS data of coffee plots

from the household survey, with GIS data, including a Digital Elevation Model (DEM)[2], and plot-size weighted averages are calculated at the household level. The topographic wetness index indicates rainfall and run-off flows and is a good proxy for soil nutrient flows (Sorensen et al., 2006). Heat load is a good proxy for how much sunshine a plot receives (McCune and Keon, 2002). Together these four variables capture variation in the suitability of land for coffee cultivation. Location variables include district dummies and a vector of village indicators including dummy variables for villages having a primary school, a health centre, a weekly market and an all-weather road, and the distance from the village centre to the nearest trading centre and to Mbale town. These variables capture observed and unobserved differences across districts, regarding access to infrastructure and transaction costs for accessing input and output markets. Infrastructure variables are derived from village interviews and distance variables from GPS information.

In a second set of regressions we use instrumental variable models (IV) and a 2SLS estimation technique:

$$Y_i = \alpha_0 + \beta X_i + \gamma \hat{C}_i + u_i \quad (2)$$

$$\hat{C}_i = \pi_0 + \pi_1 Z_i + \pi_2 X_i + v_i \quad (3)$$

With IV models we can reduce bias from heterogeneity in unobserved factors such as farmer motivation and experience being correlated with the certification variables of interest (C_i). As instruments Z_i in the first stage equation, we use the following variables: 1/ years of experience of the farm-household in BCU; 2/ distance between the homestead and the nearest KCL washing station; and 3/ the square of the distance between the homestead and the nearest KCL washing station. These are relevant instruments. Many farmers had bad experience with BCU before its collapse in 1997 and these farmers are less likely to engage in coffee cooperatives and contracting again. The correlation between the first instrument, years of experience with BCU, is negative and significant at the 1% level for both certification variables, with correlation coefficients of -0.16 for FT_Org and -0.22 for Utz_RA_4C certification. Given the business model of KCL and their practices of sourcing coffee from within a certain radius from their washing stations, farmers located closer to the washing stations are more likely to engage in supplying KCL under the Utz_RA_4C certification scheme while farmers located farther from the washing station are more likely to engage in supplying GCCE under the FT_Org certification scheme. Certification to the FT_Org scheme is significantly (at the 1% level)

positively correlated with the instruments distance to the washing station and the squared distance – with correlation coefficients of 0.26 and 0.33 – while for Utz_RA_4C certification the correlation is significantly (at the 1% level) negative with correlation coefficients of -0.54 and -0.41. The instruments are plausibly exogenous or only weakly correlated with the error term. The distance to the KCL washing station (and the squared distance) is exogenous to farm-household decision-making. KCL locates its washing stations close to rivers for easy access to water and given that we control for agro-ecological differences in our regression analysis, distance to the washing station can be considered exogenous. The years of experience with BCU before its collapse in 1997, is likely not or only weakly correlated with unobserved factors that determine the outcome indicators because of the time period of more than 15 years. Given the high correlation between the instruments and the instrumented certification variables, potential endogeneity bias is likely reduced in the IV models, even if the instruments are not completely exogenous. We further test the validity of our instrumental variable approach with an F-test for joint significance of the excluded instruments; a Sanderson-Windmeijer Chi2 test and Kleibergen-Paap LM test for under-identification; a Kleibergen-Paap F-test for weak identification; and a Sargan-Hansen test for over-identification restrictions. In spite of the instruments passing all these tests, we cannot rule out bias completely. We also perform an Anderson-Rubin test for endogeneity of the certification variables.

4. Results

4.1 Comparison of certified and non-certified households

In table 2, we present summary statistics for household, agro-ecological and village characteristics. We compare respectively Utz_RA_4C and FT_Org certified with non-certified households. The average age of household heads in the region is 50 years; the average years of education is 8.14; 11% of households are female-headed; and the average household size is 4.3 adults and 4.1 children. The statistics indicate that FT_Org and Utz_RA_4C certified households have a slightly lower level of education of the household head, and that FT_Org certified households are slightly older with a higher probability to be female-headed.

Table 2: Characteristics of certified and non-certified households

	Total sample		Non-certified households		Utz_RA_4C certified households			FT_Org certified households		
Sample size	600		300		130			170		
Human capital										
Education of head (years)	8.14	*(6.23)*	8.97	*(7.05)*	6.95	*(0.40)*	**	7.59	*(0.43)*	**
Female head (%)	0.11		0.06		0.08			0.22		***
Age of head (years)	50.3	*(0.65)*	49.6	*(0.89)*	48.1	*(1.36)*		53.3	*(1.22)*	***
Number of adults	4.32	*(0.10)*	4.33	*(0.14)*	4.12	*(0.23)*		4.46	*(0.18)*	
Number of children	4.16	*(0.12)*	4.29	*(0.16)*	4.05	*(0.24)*		4.03	*(0.23)*	
Physical assets										
Total area cultivated (ha)	1.05	*(0.05)*	1.00	*(0.07)*	1.18	*(0.10)*		1.06	*(0.08)*	
Coffee area (ha)	0.60	*(0.02)*	0.56	*(0.03)*	0.67	*(0.04)*	**	0.62	*(0.05)*	
Livestock units (TLU)	2.10	*(0.09)*	2.15	*(0.14)*	1.94	*(0.17)*		2.17	*(0.17)*	
Agro-ecological characteristics [a]										
Slope (percentage)	12.3	*(0.43)*	12.3	(0 .59)	15.0	*(1.04)*	**	10.4	*(0 .70)*	*
Altitude (masl)	1016	*(21.1)*	1045	(29.1)	1020	*(47.3)*		960	*(40.0)*	
Topographic wetness [b]	6.19	*(0 .13)*	6.46	(0.18)	5.91	*(0.30)*		5.90	*(0 .27)*	
Heat load [c]	0.068	*(0.004)*	0.068	(0.006)	0.046	*(0.01)*	*	0.085	*(0.006)*	**
Village infrastructure										
Primary school (%)	0.45		0.46		0.46			0 .41		
Weekly market (%)	0.41		0.40		0.37			0.46		
Health centre (%)	0.11		0.13		0.06		**	0.12		
All weather road (%)	0.47		0.43		0.53		*	0.48		
Distance trading centre (km)	3.78	*(0.26)*	5.65	(0 .49)	2.05	*(0.22)*	***	1.80	*(0.06)*	***
Distance Mbale town (km)	27.0	*(0.38)*	26.6	(0 .62)	27.8	*(0.56)*		27.0	*(0.63)*	

Source: Authors' calculation from survey data.

Notes: Standard errors for continuous variables in parentheses. Significant differences in means between certified and non-certified households are indicated with * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

[a] Agro-ecological characteristics are weighted average across household coffee plots with the plot area share in total household coffee area as weighting factor.

[b] The Saga topographic wetness index is calculated as ln(SCA/tanβ) with SCA the Specific Catchment Area, defined as the corresponding drainage area per unit contour width – calculated according to (Freeman, 1991; Bohner and Selige, 2006) – and tanβ the tangent of the local slope (β) in radians. High values of the index correspond to places where soil organic matter accumulate while low values correspond to drier and less fertile places (Beven and Kirkby, 1979; Sorensen et al., 2006).

[c] The heat load index is calculated as in McCune and Keon (2002) based on altitude (G), slope (K), and folded plot aspect (L): 1.467+1.582*cos(G)*cos(K)-1.5*cos(L)* sin(K)*sin(G) - 0.262*sin(G)*sin(K)+0.607* sin(L)*sin(K). Folded aspect (i.e. folding over around the north-south line) is used to correct for the time of the day the plot receives sunshine. Higher values of the heat load index correspond to more sunshine and radiation, a lower value to less sunshine and radiation.

Farm sizes in the region are small; on average 1.05 ha per household of which 0.6 ha is used for coffee cultivation. While there is no difference in total farm size or livestock ownership between certified and non-certified households, Utz_RA_4C certified households do have a significantly larger coffee area (0.67 ha) than non-certified households (0.56 ha). Compared to non-certified households, Utz_RA_4C certified households

cultivate on steeper slopes (15%) and on plots with a lower heat load index while FT_Org certified households cultivate on more gentle slopes (10.7%) and on plots with a higher heat load index. There is no significant difference in altitude and topographic wetness across certified and non-certified households. This is an indication that on average FT_Org household operate on plots that are slightly better suited for coffee production while Utz_RA_4C households manage plots slightly less suited for coffee production. Apart from Utz_RA_4C households having a lower probability of access to a health centre in the village and a higher probability of having access to an all-weather road, there are no differences in village infrastructure characteristics. Compared to non-certified households, both Utz_RA_4C and FT_Org households are closer to a trading centre.

Table 3 presents summary statistics on poverty, income and variables related to coffee production and a comparison of certified with non-certified households. In general, we observe a very high incidence of poverty in the research area, with 65% of households under the international poverty line, compared to the national average of 19.7% in 2012/13 (MFPED, 2014). Average household income is low, at around 3.9 million Ush or about 649 thousand Ush per capita; and a main part of the income, around 1.8 million Ush, comes from coffee cultivation. Utz_RA_4C certified households have a significantly lower incidence of poverty and significantly higher income, total household income, income per capita, coffee income as well as coffee income per hectare, than non-certified households while for FT_Org households there is no difference.

On average FT_Org certified households use significantly less inputs (75 thousand Ush/ha) than non-certified households (315 thousand Ush/ha) while there is no difference in labour input. Utz_RA_4C certified household use significantly less labour in coffee production (566 person-days) than non-certified households (882 person-days) while there is no difference in input costs. In general, coffee farmers in the research area have an average coffee output of 2,336 kg fresh cherries, an average coffee yield of 4,009 kg fresh coffee cherries per ha (equalling about 954 kg of green coffee per ha) and a labour productivity in coffee production of 8,249 Ush per person-day. There are large differences in output and productivity across farmers. Utz_RA_4C certified farmers have the highest coffee output, yield and labour productivity; their coffee output is 57% higher than for non-certified farmers, coffee yield 31% higher and return to labour 122% higher. On the contrary, FT_Org certified farmers have lower yields and labour productivity; their coffee yield is 20%

lower than for non-certified farmers and return to labour 238% lower. The coffee yield of FT_Org farmers of 3,179 kg/ha is slightly above the national average of about 2,550 kg/ha; the yield of Utz_RA_4C farmers of 5,200 kg/ha is more than double the national average yield but is still only half the potential coffee yield of 13,000 kg/ha measured in Ugandan on-station trials.

Table 3: Comparison of poverty incidence, income and coffee production performance indicators across certified and non-certified producers

	Total sample	Non-certified households	Utz_RA_4C certified households		FT_Org certified households	
Sample size	595	300	129		166	
Poverty incidence (%)	0.648	0.682	0.485	***	0.712	
	(0.02)	*(0.027)*	*(0.044)*		*(0.035)*	
Total household income (1,000 Ush)	3,855	3,603	4,783	***	3,604	
	(128)	*(170)*	*(314)*		*(230)*	
Income per capita (1,000 Ush)	649	608	810	***	599	
	(25.3)	*(36.2)*	*(58.8)*		*(42.0)*	
Coffee income (1,000 Ush)	1,788	1,584	2,601	***	1,532	
	(82)	*(111)*	*(214)*		*(126)*	
Coffee income per hectare (1,000 Ush/ha)	2,904	2,720	3,678	***	2,625	
	(64.1)	*(82.7)*	*(173)*		*(95.5)*	
Coffee production (kg)	2,336	2,146	3,367	***	1,891	
	(87.6)	*(118.6)*	*(227.3)*		*(125.4)*	
Coffee yield (kg/ha)	4,009	3,964	5,200	***	3,179	***
	(43.5)	*(43.2)*	*(78.3)*		*(61.9)*	
Input costs for coffee (Ush/ha)	259,892	315,541	372,038		75,227	***
	(20193)	*(28382)*	*(60620)*		*(12870)*	
Family labour in coffee (days/ha)	790	882	566	***	800	
	(33.6)	*(50.2)*	*(72.1)*		*(54.1)*	
Coffee labour productivity (Ush/day)	8,249	6,888	15,318	***	5,252	*
	(468)	*(604)*	*(1381)*		*(445)*	
Price fresh cherries (Ush/kg)	842.7	857.8	821.1	*	n.a.	
	(10.3)	*(18.3)*	*(9.88)*			
Price dried cherries (Ush/kg)	3,105	3,093	n.a.		n.a.	
	(14.1)	*(14.7)*				
Price fully washed (Ush/kg)	4,244	3,947	n.a.		4,364.06	***
	(37.6)	*(42.2)*			*(49.01)*	

Source: Authors' calculation from survey data.

Notes: Standard errors in parentheses. Significant differences in means for each certification category and the control are indicated with * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. n.a. = price data is not available because farmers do not or hardly sell coffee in this form.

Coffee prices are difficult to compare as farmers sell coffee as fresh cherries, home-dried cherries or home-processed fully washed coffee. Utz_RA_4C certified farmers mainly sell fresh cherries to the washing stations of KCL; FT_Org certified farmers mainly sell fully washed coffee to the GCCE unit in Mbale; and

non-certified farmers sell fresh, dried and/or washed coffee. The price for fresh cherries that Utz_RA_4C certified farmers receive is somewhat (4.3%) lower than the price non-certified farmers receive for fresh cherries; while the price for washed coffee that FT_Org farmers receive is substantially (11%) higher than the price non-certified farmers receive for washed coffee.

4.2 Econometric results

In table 4, we present a summary of the main estimated effects of Utz_RA_4C and FT_Org certification on the different outcome indicators from probit, OLS and IV estimations. The full regression results are given in tables A3 (first stage results), A4 (probit and OLS results) and A5 (IV results) in appendix. Before examining the main results, we first shortly discuss the relevance and validity of the instruments. For both certification variables, the instruments are jointly significant in the first stage regressions and the Sanderson-Windmeijer tests reject the null-hypotheses of under-identification (Table A1). In addition, based on the Kleibergen-Paap LM test we can reject overall under-identification of the model, and the Kleibergen-Paap test for weak identification reveals a Wald F statistic of 34.7, which is above the 10% Stock-Yogo critical value of 13.43 (Table A1). Moreover, all IV regressions, pass the Sargan-Hansen test for over-identification restrictions (Table A3). The tests show that the instruments are relevant and plausibly exogenous. The Anderson-Rubin test rejects the null hypotheses of certification being exogenous (Table A3), which justifies the use of IV estimations. Given that our instruments are strong and that exogeneity of the certification variables is rejected, the IV estimates likely result in the smallest bias and hence we base our discussion on these estimates.

Our results indicate that participation in the Utz_RA_4C coffee certification scheme reduces the likelihood to be poor with 16 percentage points, increases household income with 922 thousand Ush and increases per capita income with 132 thousand Ush, which are large effects relative to the average poverty incidence of 65% and average household income of 3.9 million in the region. Participation in the FT_Org certification scheme has no significant impact on poverty and reduces household income with about 1 million Ush. While the point estimate for poverty is positive and large, pointing to a poverty-increasing effect of FT_Org certification, we cannot reject the null hypothesis of a zero effect of FT_Org certification on poverty due to a large standard error. We find positive effects of Utz_RA_4C certification on coffee income, coffee income per ha, coffee production, coffee yield and labour productivity but negative effects for FT_Org

certification on the latter two indicators. Our estimates indicate that participation in the Utz_RA_4C scheme increases, coffee income with 421 thousand Ush, coffee income per hectare with 387 thousand Ush, coffee output with 0.7 ton, coffee yield with 1.1 ton per ha, and labour productivity in coffee production with 7.4 thousand Ush per person-day. Participation in the FT_Org scheme decreases coffee income with 336 thousand Ush, coffee output with 0.7 ton, coffee yield with 0.9 ton per ha, and labour productivity with about 3.3 thousand Ush per person-day.

Table 4: Summary of estimated effects of certification

	Utz_RA_4C		**FT-Org**	
	OLS / probit	**2SLS**	**OLS / probit**	**2SLS**
Poverty	-0.234 ***	-0.160 **	-0.034	0.120
	(0.059)	*(0.064)*	*(0.055)*	*(0.111)*
Total household income (1,000 Ush)	1,190 ***	922 ***	202	-1,090 *
	(316)	*(347)*	*(257)*	*(650)*
Income per capita (1,000 Ush)	200 ***	132 *	9.32	-278
	(61.5)	*(68.8)*	*(51.7)*	*(176)*
Coffee income (1,000 Ush)	740 ***	421 ***	-89.9	-336 *
	(121)	*(120)*	*(99.3)*	*(192)*
Coffee income per hectare (1,000 Ush/ha)	756 ***	387 *	-5.2	-606
	(182)	*(203)*	*(144)*	*(370)*
Coffee production (kg)	826.1 ***	694.6 ***	-319 ***	-740.4 ***
	(93.9)	*(97.52)*	*(70.5)*	*(138.7)*
Coffee yield (kg/ha)	1,130 ***	1,109 ***	-589.9 ***	-935.5 ***
	(74.2)	*(105.9)*	*(61.9)*	*(151.9)*
Coffee labour productivity (Ush/day)	7,113 ***	7,430 ***	-1,390 ***	-3,260 **
	(1064)	*(1290)*	*(617)*	*(1490)*

Source: Authors' estimation from survey data

Notes: Standard errors in parentheses; Headcount poverty based on WB poverty line = $3.10/day (ppp 2011), in 2014 = Ush 3473.80/day; For poverty, marginal effects from the probit estimation are reported.

For most outcome indicators the IV point estimates of the effect of Utz_RA_4C certification are smaller than the OLS estimates. For FT_Org certification, the magnitude of estimated effects is stronger or more negative in the IV estimations than in the OLS estimations, and for income and poverty effects reverse signs. This is consistent with an upward bias in the OLS estimates due to more productive and less poor coffee farmers self-selecting in the certification scheme.

5. Discussion

Our results show that participation in the Utz_RA_4C coffee certification scheme increases the income from coffee production and the overall household income of smallholder coffee farmers. This income effect mainly comes from an increase in land and labour productivity and not from a price effect. The increased income associated with Utz_RA_4C certification also results in substantial poverty reduction. The estimated increase in total household income (922 thousand Ush) is about double the estimated increase in coffee income (421 thousand Ush). Given that on average more than 90% of household income comes from farming, this may be an indication that the Utz_RA_4C coffee scheme results in managerial and technical spill-over effects on the farm or that increased revenue from coffee production relaxes farmers' cash constraints to invest in other farm activities. Such indirect effects have been reported in the literature for certification of other crops (e.g. Balineau, 2013; Graeme, 2010; Hidayat et al, 2015; Rueda and Lambin, 2013) and for contract-farming in general (e.g. Maertens and Vande Velde, 2016; Minten et al., 2007). Our results show that smallholder participation in the FT_Org coffee certification scheme reduces smallholders' income from coffee production and total household income, and does not contribute to poverty reduction. While FT_Org certified producers do receive higher prices for the supplied coffee, the certificate results in lower land and labour productivity and higher prices do not compensate for this. We find that the income-reducing effect of FT_Org is much stronger for total household income (-1.1 million Ush) than for coffee income (-336 thousand Ush). The negative impact on total household income is substantial; it is 28% of the average income in the region. Possible explanations for this include a negative spill-over effect of organic production to other crops, that are often intercropped with coffee; and a reduced availability of family labour for other income-generating activities, related to the need for labour-intensive coffee-processing to deliver fully washed coffee to GCCE. The results imply that 14 years after the introduction of FT_Org certification, the scheme fails to reduce poverty in the Mount Elgon region. The incidence of poverty among FT_Org certified producers is as high as the incidence of poverty among non-certified producers.

The results show that the two certification schemes differ substantially regarding the impact on smallholder producers. While the Utz_RA_4C scheme contributes to higher yields, labour productivity and coffee incomes – and ultimately results in higher total and per capita household income and reduced poverty – the FT_Org scheme results in lower yields, labour productivity and coffee income – and does not contribute

to reducing poverty. Utz_RA_4C certification is found to have a superior impact despite Utz_RA_4C certified households operating on plots that are on average less suited for coffee production; which holds up our strategy to control for agro-ecological differences[3]. The differences in findings between the two certification schemes are likely related to the different coffee production systems the two schemes promote. KCL promotes an intensive coffee production system with a balanced use of organic-inorganic fertilizer combination and different species of shade trees. The company has set up an extension system with company extension agents on motorcycles travelling regularly to all villages in the scheme to give advice over production and management practices to Utz_RA_4C certified farmers. The company provides quality inputs at its store for easy and timely access by farmers, and pays farmers cash at time of delivery of the coffee to the washing station and a bonus at the end of the season. For the 2013/2014 season farmers received a bonus of 35 Ush/kg. It is likely the combination of a well-organized contract-farming scheme with extension services, input delivery and timely payments to farmers on the one hand, and the requirements on good agricultural practices (including chemical input use) and environmental sustainability in the three certificates on the other, that explains the superior impact of the Utz_RA_4C certification scheme on land and labour productivity. GCCE promotes an organic production system that prohibits the use of inorganic fertilizers and pesticides. The scheme includes extension services to members and supports a farmer-to-farmer input sharing system. However, farmers in the GCCE scheme indicate that shortage of organic fertilizer is one of the main constraints for productivity growth; and that access to manure from their own livestock is insufficient while a market for manure hardly exists and sharing with other farmers is rarely practiced. Farmers are paid a fixed price per kg of supplied coffee, which varies according to the quality of their coffee. Payment is done after the GCS has delivered the coffee to GCCE and not at time of delivery to the GCS. Farmers receive a bonus per kg of supplied coffee at the end of the season when coffee prices are good, but for the 2013/2014 season FT_Org farmers reported not to have received a bonus. Our results suggest that in the Mount Elgon region, where coffee yields are far below their potential, where soils are increasingly depleted and where access to manure and organic fertilizer is insufficient, an organic production system further reduces yields and results in low labour productivity – and that a price premium of 11% cannot compensate for these productivity losses and improve farmers' income.

Our results are to some extent in line with other studies on the implications of coffee certification for smallholder producers. We find that participation in a double FT_Org certification scheme is associated with higher prices, lower yields and reduced labour productivity, and thereby fails to contribute to income growth and poverty reduction. Other studies have also indicated a lack of impact of FT, Org and double FT_Org certification for smallholder producers. For smallholder coffee producers in Nicaragua, Bacon et al. (2008), Valkila (2009, Valkila and Nygren (2010) and Ruben and Zuniga (2011), conclude that FT certification results in higher prices but does not improve yields, poverty and living conditions; and Beuchelt and Zeller (2011) indicate that both Org and double FT_Org certification have no impact on farm profits and poverty. For other countries in Latin-America, Ruben and Fort (2012) indicate that FT certification has no substantial impact on income and productivity for Peruvian coffee farmers; and Mendez et al. (2010) conclude, based on a cross-country analysis, that FT, Org and double FT_Org certification increase coffee prices but have no effect on poverty and living conditions. For smallholder coffee farmers in Ethiopia, Jena et al. (2012) find no substantial impact of FT certification on farm income and poverty, and a negative effect of Org certification on yields and coffee incomes. For India, Jena and Grote (2016) find that FT certification increases the income of coffee farmers somewhat but not enough to reduce poverty substantially. For Mexico, Perfecto, et al (2005), find that farmers receive higher prices for certified shade coffee but that price premiums are not enough to compensate for substantial yield reductions.

We find that participation in the triple Utz_RA_4C certification scheme results in higher yields, higher labour productivity and higher coffee incomes, and thereby creates income growth and poverty reduction. Very few other studies have estimated the economic impact of these types of coffee standards. Ruben and Zuniga (2011) come to very similar findings for RA certification among coffee farmers in Nicaragua and conclude that RA outperforms FT certification because of strong positive yield effects. Mitiku et al. (2017) show that RA certification in Ethiopia increases farm incomes and reduces poverty. However, in their study the superior impact of RA certification mainly comes from a large price effect, while we find that RA improves farmers' income especially through a positive yield effect.

Our results differ substantially from the findings of Chiputwa et al. (2015) who compare similar certification schemes (Utz, double Utz_FT, and double Utz_Org) in Central Uganda, a main Robusta coffee

producing area in Uganda. They find that Utz_FT certification increases household per capita expenditures and reduces poverty while single Utz and double Utz_Org certification have no impact. This is in contrast with our findings from Eastern Uganda that Utz_RA_4C certification contributes to poverty reduction while FT_Org does not, and that Utz_RA_4C certification has a positive impact on yields, labour productivity and incomes while FT_Org has a negative impact. We put forward possible interpretations of these differences in findings. First, differences in the organisation and structure of the supply chains could contribute to explaining the observed heterogeneity in effects. Coffee can be sold in different forms at different stages of processing and value-adding. In our sample, FT_Org farmers sell washed green coffee and Utz_RA_4C farmers sell fresh cherries while in the sample of Chiputwa et al. (2015) Utz_FT farmers sell milled coffee and Utz and Utz_Org farmers sell fresh cherries. In addition, contract conditions vary. In our sample both certification schemes entail exclusive contracts that do not allow side-selling while Chiputwa et al. (2015) indicate Utz_FT farmers in their sample to have non-exclusive agreements with the coffee company that allow selling to other buyers. In our sample no bonus was paid at the end of the season to FT_Org farmers while Chiputwa et al. (2015) indicate Utz_FT farmers to have received a FT bonus. Adding value through milling, being allowed to look for the highest bidder, and effectively receiving a FT bonus at the end of the coffee season may increase the return to farmers. Second, the combined results of our study and the study by Chiputwa et al. (2015) may imply that in Uganda, where coffee yields are rather low, FT certification is better for smallholder coffee farmers when combined with Utz certification than when combined with Org certification. Both studies indicate that FT certification results in higher prices, but the combination with Org in our analysis results in lower yields while the combination with Utz in the analysis by Chiputwa et al. (2015) results in better incomes and reduced poverty.

More generally, heterogeneity in the performance of cooperatives and contract-farming schemes are important factors driving the results in our analysis – and in other available studies on the impact of coffee certification. In most studies, including ours, the number of sampled certification schemes is very limited, which makes it impossible to completely disentangle the impact of certification and the impact of membership in a specific cooperative or participation in a specific contract-farming scheme. To better take into account cooperative and contract heterogeneity, and better distinguish the impact of certification, one would need a

larger and more varied sample of farmers, including farmers certified to the same standard in different contract and cooperative schemes.

6. Conclusion

In this paper we analyse the implications of two coffee certification schemes, a double Fairtrade - Organic certification scheme and a triple Utz - Rainforest Alliance - 4C certification scheme, for smallholder farmers in Eastern Uganda. Our results show that smallholder participation in the former scheme reduces producer incomes and has no impact on poverty. While certified producers do receive higher coffee prices, the certificate results in lower land and labour productivity and the price premium does not compensate for this. For the latter scheme, we find that smallholder participation increases income by increasing land and labour productivity in coffee production, and eventually contributes to poverty reduction. The results imply that 14 years after the introduction of Fairtrade - Organic certification, the scheme fails to reduce poverty in the Mount Elgon region.

Our results, along with previous findings in the literature, indicate that a price premium to producers is neither necessary, nor sufficient, for private sustainability standards to contribute to increasing rural incomes and reducing poverty. We find that a price premium of 11% in the FT_Org certification scheme cannot offset a detrimental impact on yield while a yield increase of about 45% in the Utz_RA_4C certification scheme results in higher coffee incomes, even without a price premium. Our findings corroborate the conclusions of Barham and Weber (2012), based on evidence from Mexico and Peru, that yields are more important than prices in increasing net returns to coffee farmers; and of Valkila (2009) that low yields and low intensity agriculture, promoted by standards, can trap people in poverty. From the interpretation of our results and the comparison with results from Chiputwa et al. (2015), we put forward that in areas with degraded soils and low average yields, Fairtrade certification focusing on fair producer prices, might be better for smallholder coffee farmers when combined with standards that focus on good agricultural practices and productivity growth, such as Utz, than when combined with Organic standards. It is an increasingly popular practice to combine Fairtrade and organic certification but this practice is driven by consumer demand and is less evident from a producer perspective because yield effects are more important than price effects in creating gains for smallholder producers (Barham and Weber, 2012; Van den Broeck et al., 2016).

Our results imply that private sustainability standards may not always live up to the expectations they create concerning poverty reduction and improving the welfare of smallholder farmers. In our study, this is most obvious for the double Fairtrade-Organic certification that does not create income benefits for farmers and does not contribute to poverty reduction while the Fairtrade standard claims to *offer consumers a powerful way to reduce poverty through their everyday shopping* (Fairtrade International, 2015). Other studies have come to similar conclusions on the lack of a substantial impact of private sustainability standards in the coffee sector in various countries. This puts doubt on the sincerity of private sustainability standards and the justification of the price premium consumers pay for certified products, as standard seem to not always walk their talk.

[1] The World Bank International poverty line of $3.10/day (in 2011 PPP prices) is used; this is equivalent to Ush 3,473.80 /day in 2014 price levels (World Bank, 2015).
[2] DEM was based on void filled Shuttle Radar Topography Mission (SRTM) data at a resolution of 1 arc-second (USGS, 2015).
[3] Failure to control for agro-ecological differences likely would have resulted in and underestimation of the impact of Utz_RA_4C certification and an overestimation of the impact of FT_Org certification.

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Appendix

Table A1: Characteristics of five coffee standards

Certificate, head office	Year certificate was launched			Certified coffee producers (2014, #)		Certified coffee area (2014, ha)		Main characteristics and focus
	in general	coffee sector	coffee sector Uganda	globally	Uganda	globally	Uganda	
Rainforest Alliance, New York, USA	1987	1995	2009	190,384	21,201	391,418	32,595	Covers forests wildlife, climate, communities, agriculture and human rights Focus on farm management practices to ensure - Biodiversity conservation - Improved livelihoods and human wellbeing - Natural resource conservation - Effective planning and farm management systems Protection of endangered species and forest areas of high conservation value Setting aside a portion of land as forest reserve Decent wages for worker and protection of their ability to organize Follow Forest Stewardship Council (FSC) guidelines on harvesting timber and non-timber forest products Respect for rights of local communities and indigenous people The seal is used on products containing a minimum of 30% certified commodity
Fair trade, Bonn, Germany	1988	1988	1994	812,500	35,000	1,105,600	28,000	Focus on poverty reduction and farmer empowerment in developing countries Co-operatives and companies are certified Coffee is purchased directly from cooperatives of small farmers Minimum contract price is guaranteed Buyers expected to provide at least partial short-term trade financing when necessary Producers expected to invest the social premium in democratically agreed local community development initiatives Producer co-operatives must be democratic Implicit strive to develop mutually beneficial long-term trade relationships, based on dialogue and transparency No child labour Farm and company workers must be treated fairly
Organic, Bonn, Germany	1990	1999	1999		95,276	762,916	17,721	Focus on the four principles of organic agriculture, health, equity and sustainability Farms are certified for groups of smallholder farmers to ensure - Healthy planet - the health of soils, plants, animals and humans - Ecology - using, sustaining and improving natural systems - Equity - respect and justice for all living things - Care for future generations Minimum price for quality and environment protection During external audits, farmer responsible for organic production must be present

Table A1: Characteristics of coffee standards (continued)

Certificate	Year certificate was launched			Certified coffee producers (2014, #)		Certified coffee area (2014, ha)		Main characteristics and focus
	in general	coffee sector	coffee sector Uganda	globally	Uganda	globally	Uganda	
Utz, Amsterdam, The Netherlands	2001	2000	2000	161,700	65,448	476,000	52,549	Focus on good agricultural and farm management practices according sustainable agriculture principles Producers and companies are certified Compliance with the Utz code of conduct during production and harvesting Compliance with a chain of custody which assures product flow along the value chain in a sustainable manner Compliance with Safe and healthy working conditions Abolition of child labour Protection of the environment Utz incorporates GlobalGAP and features a set of social and environmental criteria
4C, Bonn, Germany	2006	2006	2008	360,000	n.a.	1,400,000		Baseline coffee industry standard Focus on economic, social and environmental sustainability Lists 10 unacceptable practices which are not tolerated: child labour, forced labour, human trafficking, prohibition of trade unions, absence of drinking water, deforestation, use of certain pesticides and immoral dealings Lists 28 economic, social and environmental principles for continuous improvement Uses a system of red, amber and green lights to monitor each of the 28 principles The use of 4C Logo on coffee packs is not allowed, since the 4C does not imply product guarantee 4C association uses the terminology “verified” instead of “certified”

Source: (SAN (2014); Lernoud et al.(2015); Uganda responsible persons for Fairtrade, Utz and organic, to obtain national estimates (personal communication, November, 2015); Fairtrade International (2016); Utz-certified (2016); FiBL (2016); IFOAM (2016); Rainforest Alliance (2016); Global Coffee Platform (2016)

Table A2: Agro-ecological, infrastructure and institutional characteristics of selected sub-countries

District	Sub-county	Average slope of coffee plots (%)	Average altitude of coffee plots (masl)	Average distance (km) from village centre to the nearest						Percentage of village with access to				
				Forest	River	All-weather road	Market	Tarmac road	Trading centre	Weekly market	Primary school	Secondary school	Health centre	Coffee washing facility
Bududa	Bududa	11.8	653	2.95	1.33	1.06	1.62	26	1.2	60	67	0.0	27	0
	Bumayoga	14.0	709	3.59	0.54	1.81	2.60	30	1.3	63	63	30	33	33
	Bushika	14.2	896	1.88	1.67	0.89	1.00	29	1.3	33	33	33	0.0	0.0
	Bukigai	24.4	1119	4.89	1.13	0.60	1.18	32	1.5	67	33	0.0	0.0	0.0
Bulambuli	Masiira	11.4	1098	1.69	1.09	5.70	7.14	23	1.3	33	67	0.0	0.0	0.0
	Namisuni	14.0	950	3.32	0.59	3.94	4.87	7	1.9	31	31	34	0.0	0.0
	Sisyi	8.8	669	5.70	0.88	4.87	4.66	11	3.7	67	33	0.0	33	0.0
	Bukibologoto	9.0	664	6.08	1.28	4.61	4.68	7	4.7	33	33	33	0.0	0.0
Kapchorwa	Kabeywa	20.3	1540	0.65	0.64	3.94	7.44	24	2.5	50	0.0	0.0	0.0	50
	Gamogo	20.2	967	2.03	0.21	4.14	6.08	3	5.5	0.0	50	50	0.0	0
	Munaria	11.1	1384	2.35	0.57	0.54	7.97	8	1	50	0.0	50	0.0	50
	Kaptanya	10.7	1346	4.31	0.95	1.39	14.77	24	15.7	33	33	33	33	67
	Tegeres	12.9	1490	2.29	1.62	1.46	8.95	5	12.3	33	100	33	67	0.0
Manafwa	Bumbo	8.0	850	2.33	3.96	2.24	2.37	33	2.0	67	37	0.0	33	0.0
	Magale	7.1	953	5.98	1.85	2.06	2.07	23	2.3	36	64	0.0	0.0	0.0
	Bupoto	11.0	942	3.91	2.52	1.25	3.49	25	2.0	33	33	0.0	0.0	0.0
	Buwabwala	14.5	1255	3.46	1.12	4.61	3.53	19	3.7	33	67	0.0	0.0	0.0
Sironko	Busulani	15.3	1030	4.69	0.97	3.43	4.89	15	1.0	34	34	0.0	0.0	34
	Buwalasi	9.5	1165	9.25	2.87	0.99	1.96	4	2.0	33	33	33	0.0	0.0
	Buyobo	9.7	1062	6.30	2.72	2.03	3.20	30	9.2	33	67	33	0.0	0.0
	Buwasa	7.5	1012	9.29	3.003	0.601	2.69	18	2.7	33	33	0.0	0.0	0.0

Source: derived from survey and DEM data from USGS (2015).

Table A3: First stage regression results on the likelihood of certification

	Utz_RA_4C certification		FT_Org certification	
Included variables				
Education of head	-0.0021		-0.0008	
	(0.0017)		*(0.0031)*	
Female head	-0.0477	*	0.1453	**
	(0.0285)		*(0.0612)*	
Age of head	0.0007		0.0004	
	(0.0035)		*(0.0077)*	
Age of head^2	-0.0000003		0.00002	
	(0.00003)		*(0.0001)*	
Number of adults	-0.0057		0.0054	
	(0.0067)		*(0.0111)*	
Number of children	0.0061		-0.0042	
	(0.0057)		*(0.0087)*	
Coffee area	0.1083	*	0.1001	
	(0.0631)		*(0.0926)*	
Coffee area^2	-0.0260		-0.0510	
	(0.0267)		*(0.0350)*	
Livestock units	0.0062		-0.0025	
	(0.0045)		*(0.0063)*	
Weighted plot slope	-0.0047	**	0.0026	
	(0.0019)		*(0.0028)*	
Weighted plot altitude	0.0002	***	0.00003	
	(0.00005)		*(0.0001)*	
Weighted topographic wetness	-0.0242	***	-0.0168	
	(0.0065)		*(0.0108)*	
Weighted heat load	-0.5754	***	0.8521	***
	(0.1726)		*(0.2298)*	
Primary school dummy	0.0851	***	-0.0605	*
	(0.0220)		*(0.0326)*	
Weekly market dummy	-0.0296		-0.0158	
	(0.0236)		*(0.0358)*	
Health Centre dummy	0.0237		0.1638	***
	(0.0478)		*(0.0551)*	
All season road dummy	-0.0557	**	0.0171	
	(0.0272)		*(0.0475)*	
Distance to trading centre	-0.0026		-0.0111	***
	(0.0022)		*(0.0027)*	
Distance to Mbale	-0.0082	***	-0.0078	
	(0.0027)		*(0.0057)*	
Bulambuli district dummy	0.1535	***	-0.0122	
	(0.0531)		*(0.0972)*	
Kapchorwa district dummy	0.4495	***	-0.1158	
	(0.0762)		*(0.1471)*	
Manafa district dummy	0.3551	***	-0.3595	***
	(0.0467)		*(0.0855)*	
Sironko district dummy	0.3885	***	-0.1678	***
	(0.0455)		*(0.0556)*	
Excluded instruments				
Distance to washing station	-0.1941	***	-0.0532	***
	(0.0094)		*(0.0122)*	
Distance to washing station^2	0.0077	***	0.0051	***
	(0.0005)		*(0.0007)*	
BCU experience	-0.0004		-0.0077	***
	(0.0013)		*(0.0021)*	
Constant	0.8834	***	0.5366**	**
	(0.1430)		*(0.2374)*	
N-observations	595		595	
F-test for excluded instruments	258.9		41.71	
F-test p-value	0.00		0.00	
SW Chi^2 statistics	740.1		127.6	
Chi^2 p-value	0.00		0.00	
SW F-test	353.2		60.9	

Notes: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; SW Chi^2 = Sanderson-Windmeijer under identification Chi-square statistics; SW F-test = Sanderson-Windmeijer weak identification; Overall under-identification test, the Kleibergen-Paap LM statistic = 59.34 & p-value = 0.00; Overall weak identification test, the Kleibergen-Paap Wald F statistic = 34.67, the test statistic is above the Stock-Yogo critical value at 10% = 13.43.

Table A4: Results of probit and OLS estimations on different outcome indicators

	Poverty		Total household income		Income per capita		Coffee income	
Utz_RA_4C	-0.234	***	1,190	***	200	***	740	***
	(0.059)		*(316)*		*(61.5)*		*(121)*	
FT_Org	0.034		202		9.32		-89.9	
	(0.055)		*(257)*		*(51.7)*		*(99.3)*	
Education of head	-0.0062	*	29.1		3.81		8.34	
	(0.0038)		*(19)*		*(4.25)*		*(7.0)*	
Female head	0.051		-477		-10.2		-45.6	
	(0.072)		*(310)*		*(90.4)*		*(146)*	
Age of head	-0.004		62.5	**	1.97		-3.57	
	(0.0080)		*(29.8)*		*(8.29)*		*(9.51)*	
Age of head^2	0.00012		-0.637	**	-0.0098		0.068	
	(0.0001)		*(0.275)*		*(0.080)*		*(0.084)*	
Number of adults	0.044	***	79.7		-25.7		6.12	
	(0.015)		*(76.6)*		*(16.0)*		*(22.5)*	
Number of children	0.031	**	15.8		-63.2	***	14.1	
	(0.013)		*(61.5)*		*(13.9)*		*(20.6)*	
Total area	-0.222	***	1,220	***	183	**		
	(0.056)		*(425)*		*(82.4)*			
Total area^2	0.023	**	-18.1		-5.54			
	(0.011)		*(98.5)*		*(18.0)*			
Coffee area							2,550	***
							(423)	
Coffee area^2							358	
							(258)	
Livestock units	-0.046	***	216	***	34.5	***	-15.7	
	(0.011)		*(73.3)*		*(12.1)*		*(14.4)*	
Weighted plot slope	0.0004		-14		-4.99		-575	
	(0.0038)		*(17.6)*		*(4.0)*		*(7.21)*	
Weighted plot altitude	0.0001		-0.372		-0.022		0.251	
	(0.0001)		*(0.493)*		*(0.13)*		*(0.198)*	
Weighted topographic wetness index	0.015		-32		-2.78		-21.3	
	(0.015)		*(64.8)*		*(16.9)*		*(25.4)*	
Weighted heat load	-0.283		-719		-524	*	-375	
	(0.43)		*(1620)*		*(316)*		*(636)*	
Primary school dummy	-0.092	**	718	***	158	***	127	
	(0.045)		*(226)*		*(47)*		*(79.9)*	
Weekly market dummy	0.058		-25.5		39.2		-74.7	
	(0.046)		*(240)*		*(50.4)*		*(93.5)*	
Health Centre dummy	0.0099		-352		-69.6		-9.55	
	(0.084)		*(409)*		*(70.9)*		*(137)*	
All season road dummy	-0.041		-304		-26.1		-97.2	
	(0.055)		*(301)*		*(60.6)*		*(96.4)*	
Distance to trading centre	-0.004		12.9		4.36		-1.35	
	(0.0047)		*(19.9)*		*(4.05)*		*(7.19)*	
Distance to Mbale	0.016	**	-91.2	***	-19.7	***	6.66	
	(0.0064)		*(28.9)*		*(6.18)*		*(12.6)*	
Bulambuli district dummy			-284		121		-193	
			(631)		*(118)*		*(265)*	
Kapchorwa district dummy			1,430		398	**	-334	
			(910)		*(170)*		*(373)*	
Manafa district dummy			210		215	**	-340	*
			(538)		*(107)*		*(203)*	
Sironko district dummy			-683		-14.1		39.6	
			(439)		*(84.4)*		*(166)*	
Constant			2,830	***	1,070	***	-218	
			(1010)		*(266)*		*(395)*	
N-observations	595		595		595		595	
Chi2-stat / F-stat	131.6		12.26		6.77		50.6	
p-value	0.00		0.00		0.00		0.00	
Pseudo-R2 / R2	0.232		0.368		0.270		0.769	

Notes: Standard errors in parentheses; Significant effects indicated with * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; For poverty a probit estimation is used and marginal effects, a Chi^2 test for joint exclusion of variables and the Mc Fadden Pseudo R^2 are reported; For Total household income, Income per capita, Coffee income, Coffee income per hectare, Coffee production, Coffee yield and Labour productivity an OLS estimation is used and coefficient, an F-test for joint exclusion of variables and the R^2 are reported.

Table A4: Results of probit and OLS estimations on different outcome indicators (continued)

	Coffee income/ha		Coffee production		Coffee Yield		Labour productivity	
Utz_RA_4C	756	***	826.1	***	1,130	***	7,113	***
	(182)		*(93.9)*		*(74.2)*		*(1064)*	
FT_Org	-5.20		-319	***	-589.9	***	-1,390	**
	(144)		*(70.5)*		*(61.9)*		*(617)*	
Education of head	10.4		5.14		0.163		72.56	
	(8.24)		*(4.84)*		*(3.97)*		*(51.5)*	
Female head	-162		-173.7		-196.7	*	944	
	(183)		*(129.2)*		*(100.4)*		*(1187)*	
Age of head	-1.58		7.40		7.64		-72.41	
	(15.7)		*(10.03)*		*(8.72)*		*(100)*	
Age of head^2	0.080		-0.038		-0.074		0.756	
	(0.143)		*(0.085)*		*(0.077)*		*(0.922)*	
Number of adults	37.3		-23.03		-0.521		-549.5	***
	(38.2)		*(16.3)*		*(15.18)*		*(205)*	
Number of children	36.4		24.3		10.57		175	
	(35.2)		*(15.8)*		*(12.68)*		*(194)*	
Total area								
Total area^2								
Coffee area	-99.4		3,595	***	-891.2	***	7,087	*
	(396)		*(430)*		*(190.8)*		*(3960)*	
Coffee area^2	142		47.9		245.9	***	3,944	*
	(157)		*(262.4)*		*(87.41)*		*(2335)*	
Livestock units	-33.8		-6.77		-18.96	*	-166.9	
	(21.2)		*(9.82)*		*(10.6)*		*(125)*	
Weighted plot slope	4.67		-10.05	**	-8.57	*	-37.99	
	(16.1)		*(4.43)*		*(4.75)*		*(39)*	
Weighted plot altitude	0.291		0.1002		0.121		-1.56	
	(0.382)		*(0.150)*		*(0.139)*		*(1.73)*	
Weighted topographic wetness index	-46.2		-15.81		-48.31	**	481.7	*
	(44.3)		*(18.63)*		*(18.81)*		*(251)*	
Weighted heat load	-482		-412.7		-62.96		-9,000	**
	(1180)		*(503)*		*(504)*		*(4290)*	
Primary school dummy	79.8		187.5	***	104.6	*	378	
	(128)		*(58.9)*		*(53.52)*		*(662)*	
Weekly market dummy	-312	**	2.54		-54.07		-255	
	(128)		*(69)*		*(55.06)*		*(700)*	
Health Centre dummy	-0.247		-9.50		0.245		-1,570	
	(190)		*(113.8)*		*(87.26)*		*(1015)*	
All season road dummy	-256	*	-100.76		-78.92		765	
	(146)		*(69.4)*		*(62.995)*		*(797)*	
Distance to trading centre	-16.2		-4.70		-12.77	*	-11.47	
	(14.7)		*(5.73)*		*(7.067)*		*(54.19)*	
Distance to Mbale	31.2		7.46		14.86	**	294.8	***
	(19.3)		*(10.48)*		*(7.53)*		*(105)*	
Bulambuli district dummy	-222		-289.8		-370.2	***	-1,990	
	(275)		*(228.3)*		*(128.7)*		*(1996)*	
Kapchorwa district dummy	-358		-160.3		22.21		-4,540	
	(542)		*(303.9)*		*(189.4)*		*(2778)*	
Manafa district dummy	-771	***	-416.1	**	-856	***	-1,740	
	(260)		*(177.7)*		*(103.2)*		*(1343)*	
Sironko district dummy	452	**	161		237.7	**	6,174	***
	(227)		*(141.7)*		*(112.9)*		*(1423)*	
Constant	1,840	***	-127.6		4,317	***	-4,630	
	(647)		*(351)*		*(345.7)*		*(3688)*	
N-observations	595		595		595		595	
Chi2-stat / F-stat	4.76		127.2		51.12		14.16	
p-value	0.00		0.00		0.00		0.00	
Pseudo-R2 / R2	0.139		0.887		0.6307		0.6018	

Notes: Standard errors in parentheses; Significant effects indicated with * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; For poverty a probit estimation is used and marginal effects, a Chi^2 test for joint exclusion of variables and the Mc Fadden Pseudo R^2 are reported; For Total household income, Income per capita, Coffee income, Coffee income per hectare, Coffee production, Coffee yield and Labour productivity an OLS estimation is used and coefficient, an F-test for joint exclusion of variables and the R^2 are reported.

Table A5: Results of IV-probit and 2 SLS estimations on different outcome indicators

	Poverty		Total household income		Income per capita		Coffee income	
Utz_RA_4C	-0.16	**	922	***	132	*	421	***
	(0.064)		*(347)*		*(68.8)*		*(120)*	
FT_Org	0.120		-1,090	*	-278		-336	*
	(0.111)		*(650)*		*(176)*		*(192)*	
Education of head	-0.0053	*	24.1		2.63		4.51	
	(0.0032)		*(18.7)*		*(4.17)*		*(6.95)*	
Female head	0.018		-176		56.8		9.34	
	(0.061)		*(339)*		*(87.4)*		*(153)*	
Age of head	-0.0003		65	**	2.51		-2.98	
	(0.0056)		*(30.9)*		*(8.33)*		*(9.38)*	
Age of head^2	0.000002		-0.646	**	-0.119		0.063	
	(0.00005)		*(0.284)*		*(0.080)*		*(0.083)*	
Number of adults	0.029	***	86.9		-24.2		5.65	
	(0.011)		*(77.2)*		*(15.8)*		*(22.1)*	
Number of children	0.023	**	13.3		-63.7	***	14	
	(0.010)		*(62.6)*		*(14.2)*		*(20.3)*	
Total area	-0.198	***	1,360	***	215	***		
	(0.050)		*(425)*		*(83.4)*			
Total area^2	0.021	**	-49.4		-12.6			
	(0.0098)		*(98.8)*		*(18.5)*			
Coffee area							2,710	***
							(416)	
Coffee area^2							301	
							(254)	
Livestock units	-0.037	***	214	***	33.9	***	-17.7	
	(0.0083)		*(68.5)*		*(11.5)*		*(14.2)*	
Weighted plot slope	0.0014		-10.8		-4.24		-3.36	
	(0.0031)		*(17.7)*		*(3.92)*		*(7.13)*	
Weighted plot altitude	0.000005		-0.303		-0.007		0.26	
	(0.0001)		*(0.483)*		*(0.130)*		*(0.198)*	
Weighted topographic wetness index	0.017		-54.8		-0.786		-25.9	
	(0.012)		*(64.1)*		*(16.9)*		*(25.8)*	
Weighted heat load	-0.243		164		-329		-265	
	(0.320)		*(1700)*		*(317)*		*(623)*	
Primary school dummy	-0.062	*	626	***	138	***	131	*
	(0.037)		*(220)*		*(45.2)*		*(78.8)*	
Weekly market dummy	0.042		-16.4		41.2		-73.4	
	(0.037)		*(240)*		*(50.5)*		*(92.7)*	
Health Centre dummy	0.0002		-185		-32.6		10.6	
	(0.063)		*(412)*		*(73.9)*		*(137)*	
All season road dummy	-0.022		-267		-18.5		-118	
	(0.044)		*(301)*		*(60.7)*		*(95.8)*	
Distance to trading centre	-0.0015		-9.02		-0.655		-10.8	
	(0.0036)		*(22)*		*(4.79)*		*(7.5)*	
Distance to Mbale	0.0097	*	-69.9	**	-14.9	**	12.1	
	(0.0054)		*(30.81)*		*(.593)*		*(13.2)*	
Bulambuli district dummy	0.072		-528		68.0		-212	
	(0.096)		*(646)*		*(116)*		*(265)*	
Kapchorwa district dummy	-0.0059		1,010		306	*	-338	
	(0.146)		(946)		(173)		(386)	
Manafa district dummy	0.024		265		226	**	-379	*
	(0.075)		*(538)*		*(111)*		*(1960)*	
Sironko district dummy	0.071		-578		10.6		107	
	(0.073)		*(441)*		*(84.2)*		*(166)*	
Constant	0.335	*	2,650	**	1,030	***	-245	
	(0.195)		*(1040)*		*(260)*		*(395)*	
N-observations	595		595		595		595	
Model Wald Chi2	6.92							
Wald P-value	0.074							
Wald Chi2 exog test	2.20							
Exog Wald P-value	0.087							
F test joint significance			11.33		5.94		45.96	
P-value			0.00		0.00		0.00	
Hansen J Chi2 statistic			0.43		1.224		0.27	
Hansen J P-value			0.51		0.2694		0.601	
Endogeneity Chi2 statistic			12.64		7.88		16.97	
Endogeneity test p-value			0.006		0.049		0.0007	

Notes: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; For poverty – marginal effects are reported; World Bank International poverty line = $3.10/day (ppp-2011 = Ush. 2,935.40); In 2014 equivalent to = Ush. 3,473.80 /day & Ush. 1,250,568.00/year.

Table A5: Results of IV-probit and 2 SLS estimations on different outcome indicators (continued)

	Coffee income/ha		Coffee production		Coffee Yield		Labour productivity	
Utz_RA_4C	387	*	694.6	***	1109	***	7,430	***
	(203)		*(97.52)*		*(105.9)*		*(1290)*	
FT_Org	-606		-740.4	***	-935.5	***	-3,260	***
	(370)		*(138.7)*		*(151.9)*		*(1490)*	
Education of head	5.47		3.07		-0.601		73.07	
	(8.42)		*(4.82)*		*(4.105)*		*(50.844)*	
Female head	-20.6		-72.28		-112.0		1,411	
	(196)		*(137.8)*		*(107.1)*		*(1226)*	
Age of head	-0.199		8.35		8.41		-68.31	
	(16.3)		*(10.67)*		*(9.01)*		*(103.4)*	
Age of head^2	0.071		-0.043		-0.077		0.744	
	(149)		*(0.092)*		*(0.079)*		*(0.939)*	
Number of adults	38.9		-21.07		1.66		-534.8	***
	(36.9)		*(17.32)*		*(15.84)*		*(203.5)*	
Number of children	35.5		23.41		9.72		169.3	
	(34.0)		*(16.05)*		*(13.11)*		*(190.2)*	
Total area								
Total area^2								
Coffee area	143		3,725	***	-812.2	***	7,380	*
	(389)		*(414.8)*		*(183.9)*		*(3,829)*	
Coffee area^2	44.9		-7.33		209.7	**	3792.6173*	*
	(154)		*(252.9)*		*(82.95)*		*(2255)*	
Livestock units	-36.2	*	-7.66		-19.15	*	-165.2	
	(21.4)		*(10.55)*		*(10.77)*		*(126.5)*	
Weighted plot slope	7.81		-8.68	*	-8.01	*	-37.79	
	(16.0)		*(4.51)*		*(4.62)*		*(38.49)*	
Weighted plot altitude	0.325		0.127		0.147		-1.417	
	(0.383)		*(0.153)*		*(0.138)*		*(1.68)*	
Weighted topographic wetness index	-57.4		-23.69		-54.8	***	446.4	*
	(44.8)		*(19.66)*		*(18.86)*		*(241.4)*	
Weighted heat load	-107		-116.5		202.6		-7,450	*
	(1140)		*(520.6)*		*(517.75)*		*(4438)*	
Primary school dummy	56.8		161.09	***	75.96		188.5	
	(125)		*(60.09)*		*(52.68)*		*(674.2)*	
Weekly market dummy	-308	**	6.24		-50.73		-235.0	
	(128)		*(68.74)*		*(55.22)*		*(689.2)*	
Health Centre dummy	58.5		36.98		40.87		-1,340	
	(197)		*(115.8)*		*(90.86)*		*(1003)*	
All season road dummy	-263	*	-92.06		-62.53		899	
	(144)		*(73.9)*		*(65.47)*		*(819)*	
Distance to trading centre	-30.9	**	-12.47	**	-17.38	**	-27.76	
	(15.1)		*(6.16)*		*(7.60)*		*(57.51)*	
Distance to Mbale	42.8	**	15.04		20.70	**	324.6	***
	(19.7)		*(11.27)*		*(8.11)*		*(111.7)*	
Bulambuli district dummy	-323		-377.7		-453.9	***	-2,500	
	(285)		*(231.6)*		*(136.1)*		*(2062)*	
Kapchorwa district dummy	-499		-300.2		-120.5		-5,450	*
	(578)		*(320.6)*		*(207.2)*		*(2969)*	
Manafa district dummy	-801	***	-417.0	**	-843.1	***	-1,610	
	(255)		*(171.5)*		*(104.7)*		*(1301)*	
Sironko district dummy	540	**	198.8		252.5	**	6,174	***
	(229)		*(139.8)*		*(113.1)*		*(1387)*	
Constant	1,740	***	-207.6		4,245	***	-5,060	
	(656)		*(363.2)*		*(355.8)*		*(3760)*	
N-observations	595		595		595		595	
Model Wald Chi2								
Wald P-value								
Wald Chi2 exog test								
Exog Wald P-value								
F test joint significance	4.29		125.3		37.78		13.94	
P-value	0.00		0.00		0.00		0.00	
Hansen J Chi2 statistic	1.156		0.020		0.093		1.93	
Hansen J P-value	0.282		0.89		0.76		0.165	
Endogeneity Chi2 statistic	8.57		87.48		103.5		34.64	
Endogeneity test p-value	0.036		0.00		0.00		0.00	

Notes: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; For poverty – marginal effects are reported; World Bank International poverty line = $3.10/day (ppp-2011 = Ush. 2,935.40); In 2014 equivalent to = Ush. 3,473.80 /day & Ush. 1,250,568.00/year.