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Revenue effects of participation in smallholder organic cocoa production in tropical Africa: a case study

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CONTENTS

ABSTRACT

This paper examines the revenue effects of certified organic contract farming and of use of organic farming methods in a tropical African context. These are compared with 'organic by default' conventional farming systems without contractual relations. Survey data from a medium-size cocoa-vanilla contract farming scheme in Uganda is reported using a standard OLS regression and propensity score matching approaches. The analysis finds that there are positive revenue effects for the certified crops from both participation and, more modestly, from using organic farming techniques.

INTRODUCTION

Over the last fifteen years the market for certified organic agricultural products has grown rapidly, albeit from a base close to zero. In Europe for example, organic sales in 2007 were worth $21.6 billion or 2.5 percent of all food sales by value (Willer et al. (eds.), 2008). Rising demand both for organic tropical products and for year-round supply of some organic temperate products has encouraged organic activists, NGOs and some donors to promote certified organic export production in a number of tropical African countries.

Emerging alongside global market growth for certified organic agricultural products has been a small but generally consistent literature on the economics of organic farming in developed countries. The latter's main subject is the relative revenue effects of organic and conventional agriculture. Its conclusions converge on a finding of broadly similar levels of profitability for the two farming systems, where price premiums and lower non-labor input costs compensate for organic agriculture's normally lower yields (for recent overviews see Nieberg and Offerman, 2003 for Europe; and Dmitri and Greene, 2006 for the US).

Transposing the focus on the revenue effects of organic agriculture to experiences in tropical countries – and Africa in particular - allows an evaluation of the case for promoting organic export production there. However, only a handful of economic studies of organic farming anywhere in the tropics have been published to date (Damiani, 2002; Lyngbaek et al., 2001; Bray et al., 2002; Carpenter, 2003; Bacon, 2005; Van der Vossen, 2005). None of these report comprehensive farm budget-related survey data, or use analytical statistical methods.

Systematic study of the revenue effects of certified organic relative to conventional (non-organic) farming in tropical Africa has to take into account two substantial differences between farming systems there and in developed countries. Firstly, conventional agriculture in developed countries is industrial in character while that in tropical Africa is generally semi-industrial or non-industrial. For example, synthetic fertilizer consumption levels in tropical Africa are a fraction of those in other developing regions, and are falling[1]. This has implications both for changes in farmers' outlays on synthetic inputs and for whether changes in yields can be expected, when conversion takes place from conventional to organic agriculture. Also it has implications for the extent to which African farmers certified to organic standards really have to adopt a radically new set of farming practices in order to maintain soil fertility and remain economically viable, as they must in developed countries when synthetic inputs are forsaken.

Secondly, the institutional context for not only conventional but also organic agriculture in developed countries is deeper and more extensive than it is in tropical Africa. Amongst other things, no public assistance is available for conversion in Africa, while private credit and domestic savings are generally too low to support independent conversion. This in turn implies that certified organic farming is a realistic option only for large-scale commercial opera-

[1] World Development Indicators (2006) gives Sub-Saharan African fertilizer consumption of 12.3 kg./hectare for 2002-03, as against 106.6 kg. for South Asia and 89.5 kg. for Latin America. Sub-Saharan Africa fertilizer consumption in 1989-91 was 14.2 kg./hectare.

tors or in the context of privately financed and coordinated contract farming schemes[2]. However, participants in such schemes may be deliberately selected by scheme owners rather than self-recruited, just as scheme owners may require them to conform to standards over and above organic ones once they become members. In other words, transposing a revenue effect focus to tropical Africa requires close attention to variables confounding measurement of the effects of adoption of organic agricultural systems. These variables include the prevalence of non-(certified) organic farming systems that are 'organic by default', as well as the organisation of smallholder certified organic agriculture in contract farming schemes.

Recent years have also seen an increase in academic and policy interest in all types of contract farming arrangements for smallholders in tropical Africa. Whereas the background for growing interest in organic certification is market expansion in developed countries, in the case of contract farming it is usually a concern that African smallholders are becoming excluded from more remunerative value chains, whether these are for agricultural exports or for higher-value products sold on domestic markets (Hazell et al., 2007; Reardon and Berdegué, 2007). The trend toward exclusion is usually seen as a consequence of declining public investment in infrastructure and extension, as well as of private market failure in respect of inputs and sometimes also output. Contract farming or similar arrangements may solve such problems, since they increase economies of scale and thereby reduce private traders' transaction costs (Simmons, 2002; Warning and Key, 2002; Poulton et al., 2004; Dorward et al., 2004). On the other hand, a number of reservations concerning the benefits of smallholder contract farming arrangements are also aired in the literature. Key and Runsten (1999) claim that these tend to increase rural inequalities since only better-off smallholders are recruited to them, while Little and Watts (eds., 1994) and Havnevik et al. (2007) have challenged whether contract farming schemes generate sustainable income benefits for participants.

According to Neilson (2008), sustainable income benefits are probably absent even in cases of smallholder contract farming schemes specifically designed to meet the requirements of 'sustainability' standards such as those for organic production. In contrast to Little and Watts (1994), who argue that benefits from participation are subject to secular decline as a result of participants' decreasing bargaining power (due to increasing investment in scheme-specific assets and thereby reduced ability to withdraw from schemes), Neilson claims that benefits from participation in such contract farming schemes are not likely to arise at all. This is because such schemes are necessarily embedded in value chains driven by the large multinational trading companies uniquely able to command the resources necessary to enter sustainability markets and earn the rents arising within them. These same resources translate into the power to retain 100 percent of these rents, not least by transferring to participants the costs of setting up and running such schemes. Credible product differentiation

[2] In tropical Africa, organically certified large-scale commercial farming is found in Kenya (see Gibbon and Bolwig 2007, 25-38), Zambia (Parrott and van Elzakker, 2003, 110), and Gambia. In all cases production is for fresh vegetables for the UK market. In 2007 the total number of farms involved was not more than five or six.

along sustainability lines requires incorporation of smallholders, but the associated power relations between principal and agents are so asymmetrical that smallholders are likely to lose through participation in them, relative to participation in competitive conventional markets. Neilson illustrates this via a contrast between certified sustainable and market-based coffee chains in Indonesia. The latter are characterised by high levels of competition between local traders, both on price and on producer credit, by free supply of extension by government agencies, and by high producer shares of the export price. However, no survey data is provided to directly back-up the contention that the participation effects of certified sustainable chains are negative.

This paper aims to establish whether certified organic contract farming schemes run by multinational companies have (positive) revenue effects for smallholders relative to non-participation, a question pertinent to the evaluation of both organic agriculture and multinational-led contract farming as possible routes out of Africa's well-advertised problem of agricultural stagnation and decline[3]. In doing so, we explicitly take into account the potential problem of non-random selection into such schemes. This entails controlling for the possibility that, if revenue differences between participants and non-participants are observed, these will reflect differences in farmers' factor endowments or abilities, rather than the unique impact of participation itself[4]. A second research question concerns the unique contribution of organic farming methods, as opposed to scheme participation as such, to any revenue benefits that might be found.

These two questions are examined here in relation to survey data collected in Uganda in late 2005 from participants in an organic cocoa and vanilla contract farming scheme run by a multinational trading company, as well as from a control group of non-organic cocoa smallholders in the same area. The survey data is analysed using a standard OLS regression and propensity score matching approaches. This combination of analytical approached is used to bolster the reliability of the estimates made, which are based on results from a small sample. A limiting factor for the validity of findings in relation to the second research question above is the relatively short period since the scheme effectively came into operation (in 2001-02). This means that smallholder rates of adoption of genuinely organic farming methods and experience in using them, is likely have been relatively restricted. Therefore, their full potential benefits arguably remain to be seen.

The remainder of the paper is organised in four sections. Section 2 describes the scheme and its context in greater detail, and provides some descriptive statistics on characteristics of its participants relative to the control group. Section 3 describes the methods of sampling, data collection and analysis used. Section 4 presents the empirical analyses of the two hypotheses and discusses the results. Section 5 concludes.

[3] For recent discussions of the extent and basis of African agriculture's crisis – and solutions to it – see inter alia World Bank (2007), Havnevik et al. (2007) and Koning (2002).

[4] See Warning and Key (2002) and Benfica et al. (2006) for a parallel research question in relation to contract farming schemes per se.

2. THE BUNDIBUGYO ORGANIC COCOA-VANILLA SCHEME AND IT'S CONTEXT

Uganda is one of the two leading exporters of certified organic produce by value in tropical Africa (the other being Kenya). At the time of the survey there were about 20 certified organic exporters, while total organic exports were worth between $6 and $7 million annually (Gibbon, 2006). These exports were dominated by the traditional cash crops, led by coffee, and were overwhelmingly to the European market. With a few exceptions, all organic export operations were organised as smallholder contract farming schemes. Most such schemes were supported by one or more donor[5].

Cocoa is a relatively minor export crop in Uganda. Production dates from the 1950s but was never systematically promoted by government. Nevertheless, it has risen since the start of the new century. Exports stood at only 2,130 tons in 2001, but reached 5,386 tons by 2005[6]. Production is entirely by smallholders, mostly in Bundibugyo district bordering DR Congo in western Uganda. In late 2005 there were four private companies buying cocoa in Uganda, all of which were primarily coffee exporters and two of which were (subsidiaries of) multinational companies. Unlike in the case of Ugandan coffee, where there are several contract farming schemes certified to one or more different sustainability standards, the scheme considered in this paper is the only contract farming scheme for cocoa and represents the only Ugandan cocoa production certified to any sustainability standard.

Vanilla production in Uganda also dates from the 1950s, although it did not become really established until the late 990s. Exports rose from five tons in 1996 to 183 tons in 2005 (7-10% of the global trade) (Clive Drew, personal communication 2006). Vanilla prices oscillated wildly during this period, peaking in 1999 and again at a much higher level in 2002-03 during the political crisis in Madagascar. Production is also entirely by smallholders, spread across several districts in central and western Uganda. There were 12-15 vanilla exporters active at the end of 2005, a large majority of which were locally-owned. Five of these were certified to export organic vanilla, although only two exported organic cocoa on their own account at the time of fieldwork. As in the case of Ugandan coffee and cocoa, organic certification by vanilla exporters occurred partly in response to drastically falling international prices (Gibbon, 2006), in this case following Madagascar's re-entry to the market at the end of 2003.

The scheme considered is operated by Esco (U) Ltd, a subsidiary of the Swiss commodity trading house Schluter SA. Schluter SA's main business is trading coffee from the Great Lakes region, although it had withdrawn from the Ugandan coffee market at the time of fieldwork. Esco is Uganda's largest cocoa trader and one of its two largest vanilla traders.

The scheme is located in a physically continuous area in the foothills of the Rwenzori Mountains in Bundibugyo district. Cocoa has been the main export crop in Bundibugyo District since 1994-95,

[5] The Export Promotion of Organic Products from Africa (EPOPA) programme, funded by Sida, was the most important contributor to the development of the sector. It was supporting 18 organic exporters in 2005, including Esco.

[6] By 2007 Uganda was exporting 10,158 tons of cocoa to the EU (EU Market Access Database). EU 27 imports are used as a proxy for Ugandan exports; Ugandan export data gives systematically lower volumes.

when most of the local coffee crop was destroyed by wilt disease. Cocoa smallholders were originally registered and certified by a Sudanese company in 1998, whose owner fled the area shortly afterwards as it became affected by insurgency. The Ugandan authorities then ordered the entire population of the district to move to camps for internally displaced persons (IDPs). The insurgents were eventually defeated, and the scheme area resettled, in 2001. Later the same year, Esco assumed control of the scheme. Esco added vanilla to the scheme's certification and the first exports of organic cocoa and vanilla occurred in October 2002. None of the other crops grown by scheme members are subject to certification.

The scheme is located at an altitude of 635-900 metres with average rainfall of 2150 mm. per year and average temperatures of 28-35 degrees Celsius. Land degradation is pronounced and higher parts of the area are subject to landslides. Mobile phone network coverage is poor, the nearest tarmac road to the scheme office is 54 km distant and access to Bundibugyo district from the rest of Uganda is often difficult. At the time of fieldwork there was only one other buyer of vanilla operating in the area. Nevertheless, since it is the main cocoa producing area in Uganda, competition between cocoa buyers is intense. Esco operated five dedicated buying posts for organic cocoa and vanilla in the scheme area in 2005. Esco's competitors were supplied by smallholders delivering crop to buying posts elsewhere in the district, as well as by middlemen who bought unfermented cocoa at the farm gate for resale.

The Esco scheme comprised 1,721 organic farmers in 2005. Except for location in the scheme area, there were no barriers to entry and as a result a large majority of cocoa-growing households in the area were members. Organic certification is to the standards embodied in the EU regulation and is paid for by Esco. A group certification system is used, based on an internal control system (ICS) whose central component is an annual or semi-annual farm inspection performed by locally-recruited company field officers trained in organic farming methods. During this, farmers' compliance with organic standards and other scheme requirements is monitored and farmers are provided with technical advice. In addition, the field officers also train contact farmers, who run demonstration plots in each of the 44 villages in the scheme area. Very few farmers have been evicted from the project on account of non-compliance. The annual third party certification consists of reviewing records of cocoa purchases from individual farmers against ICS production estimates, as well as visits to selected farms. In 2002 Esco's contact farmers were given access to implements, drying tarpaulins and seedlings (cocoa and shade trees) at subsidised prices. International relief organizations also allowed families leaving the IDP camps, including those from the scheme area, to retain tarpaulins earlier distributed free of charge as shelters.

Besides the production and on-farm processing practices necessary to conform to organic standards, farmers are required to follow other practices known to improve the physical quality of cocoa beans in terms of moisture content, appearance and aroma. In addition, the technical advice disseminated emphasises farm practices – mainly but not exclusively organic - that should enhance yield. Esco purchases from scheme farmers only cocoa that has been fully fermented and dried. In rare cases co-

coa is rejected on suspicion that it was harvested on non-certified farms. Vanilla is purchased in an unprocessed state; curing is carried out on Esco premises in Mukono, central Uganda.

In 2005 Esco procured 269 tons of organic cocoa and 50 tons of uncured vanilla from the scheme. Theoretically, the farmer is paid cash on delivery and Esco buys all cocoa and vanilla offered for sale by its organic farmers, irrespective of the size of its organic orders. However, some farmers complained that Esco buying posts ran short of cash during the peak buying season, and of having to sell to conventional buyers as a result. It was generally accepted that full fermentation and drying of cocoa meant that farmers had to wait at least two weeks from harvest until reaching the quality level necessary to sell to Esco, whether Esco had cash available or not. In addition, cocoa can only be fermented effectively from raw beans in volumes of 50 kg. or greater, meaning that producers with smaller volumes either had to group together to undertake fermentation or sell their crop in an unfermented state to middlemen.

The contract obliges Esco to pay an organic premium if the cocoa or vanilla is deemed to be of suitable quality. The size of the premium is not specified and there has been no direct price negotiation between Esco and the farmers. In 2004 Esco paid a price premium of about 20% percent above the prevailing ('conventional') price in Bundibugyo for fully processed cocoa and 100% for vanilla. In 2005 it increased the cocoa premium to about 30% while retaining a 100% premium for vanilla.

In summary, Esco employs various means to enable and induce growers to comply with its organic and quality standards: regular farm inspections, training of contact farmers, individual advice by contact farmers, rejection of sub-standard and suspected off-scheme cocoa, a price premium, and a procedure for de-registering farmers who consistently or grossly violate project rules.

Table 1 compares the mean values of selected variables, for a sample of scheme participants and a control group of non-participant farmers in the same area (see Section 3 below). All data refers to 2005. The two groups do not differ significantly in their endowments of certain key production factors such as farm size and number of productive cocoa trees. Nor did they differ in the proportion of household members engaged in non-farm activities or in terms of wealth indicators such as cattle ownership, recent purchase or renting of land, or membership of savings or credit schemes or banks. They did however differ in terms of size of the potential household labour pool (household members aged six years or more), in their number of vanilla vines and in the farming experience (age) of household heads. As may be expected, a significantly larger proportion of scheme participants used organic practices for cocoa and vanilla farming, although as many as 30 percent used no such practice. While no significant difference is found in the total crop revenue earned by scheme members and non-members, participant farmers earned higher revenue from the sale of cocoa and from cocoa and vanilla jointly. Finally, scheme members were expanding cocoa production by planting significantly more new trees than non-members (not shown).

Table 1.
Summary descriptive statistics for full sample, by scheme membership

Variable	Unit	Certified	Non-certified	chi-sq./z stat.
(a) Sample characteristics:				
Respondents	count	30	30	-
No use of organic practices	% group	30.0	86.7	19.8***
Use of >2 organic practices	% group	10.0	0.0	3.2***
(b) Household characteristics (means):				
Size whole farm	1000 m^2	2.4	2.1	-0.6
Productive cocoa trees	count	1250.6	1200.6	-0.5
Productive vanilla vines	count	262.6	89.5	-2.5**
Age of household head	years	48.9	40.1	-2.6**
Persons in household > 6 yrs old	count	7.1	5.5	-2.3**
Adults engaged in non-farm work	% adults	2.4	1.8	0.1
Dependency ratio (< 6 years)	% household	27.5	25.3	-0.3
(c) Household revenue (means):				
Gross crop revenue	1000 USh	1434.7	960.7	-1.6
Net cocoa revenue	1000 USh	1106.2	575.6	-2.2**
Net cocoa & vanilla revenue	1000 USh	1148.8	581.7	-2.4**
(d) Production expenses (means):				
General equipment costs	1000 USh	24.3	38.7	1.8
General labour costs	1000 USh	87.0	175.9	0.7
Additional cocoa costs	1000 USh	56.9	136.8	1.2
Additional vanilla costs	1000 USh	7.2	0.7	-0.6

Significant at: ** 5%, *** 1% levels

Notes: USh are Ugandan Shillings (the average exchange rate for 2005 was US$1 : 1778 USh); for variable group (a), significance tests report Chi-sq. statistic from cross-tabulation; for groups (b) - (d) significance tests report the z-stat. from a Wilcoxon ranksum test.

Source: calculations from author survey.

3. METHODOLOGY

The survey reported here was based on a small sample size. This section discusses the sampling, data collection and analysis procedures followed in this light.

(a) Sampling and data collection methods

Cocoa is grown by about 8-10,000 households in Bundibugyo. About half of these are found in four parishes close to Bundibugyo town. Two of these parishes to the east the town, Burondo and Ngamba, are the location of the Esco scheme. The other two (conventional) parishes, Mirambi and Busaru, lay to the west of the town. Remaining cocoa growing households are scattered over a further 17 parishes (all data based on estimates by Esco and Bundibugyo district agricultural office). The four leading cocoa-growing parishes are all at lower and medium altitudes (635-750 meters) with relatively good access to the district's main road. The approximately 4,500 cocoa-growing households of these parishes formed the population for this study.

From this population a sampling frame of six villages was established. In the two

organic cocoa-growing parishes and the two leading conventional cocoa-growing parishes, all villages were listed and then categorized into one of three altitude bands. Following this exercise, one organic and one conventional village were chosen at random from each band.

Within each of the six chosen villages, systematic sampling was then used to select 10 households for interview. This used lists of certified organic households provided by the scheme for each of the three organic villages chosen in Burondo and Ngamba parishes. In the conventional cocoa-growing villages chosen in Mirambi and Busaru parishes, it used lists of farmers provided by village leaders who were asked to provide the names of 'all cocoa-growing households, rich and poor'. The sample of farmers from the conventional villages forms the control group.

The household survey of scheme participants and the control group used a detailed questionnaire administered to heads of households by one of the authors, assisted by a translator familiar with local languages. It covered information on household demographics, farm area, number of cocoa trees and vanilla vines, farm equipment, expenditure over the previous two seasons on labour and other inputs and assets and on processing and marketing, as well as production, sales, farm income and selected aspects of consumption. In order to assess the extent to which organic and other farm practices were adopted and/or enforced as a result of contracts, data also was collected on farmers' use of a range of farm practices recommended during inspections and training, in most cases through physical observation. In a few cases where household heads were unavailable, spouses were interviewed instead. In two or three cases in each group, where neither household heads nor their spouses were available for interview, substitute households were used. For both organic farmers and the control group, these were households whose names appeared on village lists immediately following those of originally selected households.

(b) Analytical methods

For empirical analysis, two specific null hypotheses were formulated. These are: *Hypothesis I* – there is no significant difference in revenues between farmers participating in the certified organic scheme and those who are not, controlling for other relevant determinants; and *Hypothesis II* – there is no significant revenue effect from application of organic farming practices, controlling for participation in the organic contract farming scheme and other relevant factors. Together these indicate we are concerned with evaluating the effects of different farming activities on household revenue. If we conceive of these activities as kinds of policy interventions (analogous to, say, a labour training programme), it is evident we face a treatment evaluation problem.

Taking the evaluation literature as a starting point, the choice of appropriate analytical methods to test the above hypothesis turns on how the treatment and control groups have been selected. Random selection from the same population ensures there should be no systematic differences between the two groups that would confound the identification of treatment effects. However, because the sample under consideration is non-experimental, random assignment to the treatment group cannot be assumed. Indeed, while Table 1 shows that households in the two groups are similar to each other across a number of di-

mensions, the existence of systematic differences indicates the possibility that selection effects may be present (Caliendo and Hujer, 2005). On this basis, the question is whether selection can be traced to observable or unobservable differences between the treatment and control group. Where the former holds, linear regression or propensity score matching techniques can be applied. If not, the standard approach is to employ a Heckman selection model which enables testing and adjustment for unobserved selection bias (Heckman, 1979). Alternatively, where valid exogenous variable can be found to explain participation in the scheme, instrumental variables (IV) estimators may be used.

From an *a priori* standpoint, there is no reason to reject the existence of unobserved selection effects in the present sample. Consequently, the methodology proceeds in three main stages. Firstly, the question of systematic selection effects is investigated for both the organic certification and organic practices variables. For the former this is undertaken via a binomial probit regression model; for the latter a Poisson regression model is used, reflecting the count (interval) nature of the choice variable. Secondly, in order to test the two hypotheses jointly, a parsimonious model of household revenue determination is estimated using a two-step Heckman selection estimator and a simple OLS estimator. Note that while the Heckman approach generally is seen to be more robust than IV estimators for dealing with (unobserved) selection bias, particularly in smaller samples, it remains sensitive to model specification and distributional assumptions (Blundell and Costa Dias, 2000; Heckman et al., 1999). For this reason, additional variables are included in the selection specification equation (to be reviewed in stage one, as above) that do not enter the outcome equation.

Thirdly, both due to the small sample size and in order to verify the robustness of the results from the second stage analysis, propensity score matching is used to investigate the first hypothesis, namely the effect of organic certification on household revenue outcomes. This is undertaken in standard fashion. Specifically, the selection model developed in the first analytical stage is used to estimate propensity scores for each household. These scores will be then used to match (or identify similar) treatment and control households, over whom differences in outcome variables, such as revenues, can be compared. A number of different matching algorithms (e.g., one-to-one, nearest neighbor, radius and kernel matching) are employed to ensure that matching results are not dependent on specific assumptions regarding how the similarity between treatment and control households is judged.

Before proceeding, some details concerning variable construction and model specification are in order. While the two hypotheses direct attention to household revenue outcomes, it is not clear at what level of revenue disaggregation one might expect to discern an impact from organic certification and/or use of organic practices. As a result, three alternatives are chosen – (i) gross revenue from all crop sales; (ii) net revenue from sales of cocoa only; and (iii) net revenue from sales of both cocoa and vanilla. Net revenue is defined as gross revenue from sales of relevant crops minus expenditure on general farm equipment and labour costs plus additional crop-specific costs such as on marketing, pur-

chase of trees or vines, or on specialised labour inputs[7].For both revenue and cost items, the time period covered is the two seasons prior to the survey. Organic farming practices are defined as the number of specific organic practices employed by each farmer. Notably this does not encompass general good practices, such as regular weeding of cocoa groves, which are relatively widely applied across organic and non-organic farmers. Rather, organic practices *only* include use of organic fertiliser (including manure), bio-pesticides, mulching of vanilla vines and use of a soil conservation technique such as terracing or digging drainage ditches[8].

Variables used to model selection into the treatment groups (stage one of the analysis) and revenue determinants (stage two) are found in the existing literature (Warning and Key, 2002, Benfica et al., 2006) and need little justification. They comprise household endowments (farm area, productive trees and vines, labourers) as well as other household characteristics (age of head of household etc.) that may proxy for human capital and productivity factors. The final choice of variables not only represents a parsimonious list, but also reflects both the small sample size and limited coverage of the survey in terms of broader non-agricultural household information.

[7] 'Hired labour' comprises labour paid in cash and in kind, where the latter is computed into cash equivalents. 'Work' comprises land clearance, land preparation, planting, weeding, mulching, pruning, harvesting and drying.

[8] Certain other farm practices that can be technically construed as organic were excluded from the analysis since during the fieldwork it was observed that they were not adopted on technical grounds. Cover plants (legumes) were planted on a seasonal basis wherever there was land available, for income generating purposes and without reference to their soil fertilization properties. Likewise, a large majority of shade trees present had seeded themselves or remained present from when land was first cleared since they were considered too large to fell.

4. EMPIRICAL FINDINGS AND INTERPRETATION

(a) Selection equations

To investigate the extent to which the treatment and control groups may differ systematically, observed household endowments and characteristics are used to predict participation in both treatments of interest. Table 2 shows the results of a binomial probit model for organic certification and a Poisson model for the number of organic practices used. The latter includes certification as an additional predictor (regressor), reflecting the point that there should be enhanced opportunities and incentives to employ organic practices once a household is a scheme member.

For organic certification, the results suggest that systematic selection effects cannot be ignored; in other words, we cannot treat households *as-if* they were randomly assigned to the two groups. Indeed, the differences between certified and non-certified farmers highlighted in Table 1 are also significant in the selection equation. The number of productive vines, age of household head and total number of farm workers in the household are positively and significantly associated with scheme participation as might be expected. Turning to the use of organic practices, the predominant determinant is organic scheme certification rather than (observed) household endowments or characteristics. Thus, it would seem that the decision to apply these practices is a second-order question which may be much less subject to selection bias once we have controlled for scheme

Table 2.
Binomial selection and Poisson count regressions

	Certified organic		Number of practices	
Organic certified	-	-	1.78***	(0.59)
Farm size (log.)	0.39	(0.44)	0.28	(0.44)
Trees (sq. root)	-0.08	(0.06)	0.03	(0.05)
Trees (number)	0.00	(0.00)	-0.00	(0.00)
Vines (sq. root)	0.05**	(0.03)	0.02	(0.02)
Age (head of h/h)	0.05**	(0.02)	0.01	(0.01)
Farm workers in h/h (N)	0.29***	(0.10)	0.05	(0.07)
Non-farm workers (% adults)	0.19***	(0.07)	0.00	(0.06)
Dependency ratio	1.67	(1.50)	2.36*	(1.42)
H/hs without non-farm workers	3.91***	(1.32)	0.32	(1.15)
Savings society/Bank member	-0.55	(0.46)	0.21	(0.55)
Constant	-6.62***	(1.93)	-4.43**	(1.89)
N	56		56	
Log-like	-25.2		-45.0	
Chi-square	31.0***		34.8***	
Pseudo R-square	0.35		0.25	

Standard errors in parentheses. Significant at: * 10%, ** 5%, *** 1% levels

Note: farm size is stated in logarithms; robust (Huber/White/Sandwich) standard errors given; samples exclude missing observations and outliers, defined as households with net cocoa and vanilla revenue ±5 standard deviations from the sample mean.

Source: authors' calculations.

participation and other household characteristics. Consequently, concerns regarding selection bias can be focussed on the first hypothesis or that of scheme participation only.

(b) Regression and propensity score matching results

Results for the models encompassing the two main hypotheses are set out in Table 3 (columns I – VI). Each specification includes a dummy for organic certification and the number of organic practices used. The reported coefficients on these treatment variables thus report the partial correlation between the individual treatment and the dependent variable. For the three revenue variables, OLS and (two-step) Heckman estimates are reported. Note that the latter specification contains an additional variable (lambda), which is the inverse Mills ratio or hazard ratio calculated for both treatment and control households using fitted values from the probit selection equation. The significance of the lambda indicates whether unobserved selection bias can be treated as material. For none of the models is this found, meaning that the simple OLS estimates should be unbiased. Indeed, for each revenue variable the coefficients across the two sets of models (excluding certification which is not directly comparable due to inclusion of lambda) are almost identical as are the summary statistics.

In terms of the overall findings, four points can be highlighted. Firstly, the models display strong goodness-of-fit as given by the relatively high R^2 and F statistics; in all cases the models appear to explain over

Table 3.
OLS and Heckman regressions for revenue variables (logarithms)

	Gross crop revenue		Net cocoa revenue		Net cocoa & vanilla revenue		Cocoa yield
	OLS (I)	Heckman (II)	OLS (III)	Heckman (IV)	OLS (V)	Heckman (VI)	Heckman (VII)
Organic certified	0.22 (0.23)	0.45 (0.47)	0.52** (0.25)	1.01** (0.44)	0.67** (0.27)	1.12** (0.55)	0.31 (0.26)
Practices (no.)	0.27** (0.12)	0.26** (0.12)	0.32** (0.14)	0.30** (0.14)	0.28* (0.15)	0.26* (0.15)	0.14* (0.07)
Farm size (log.)	0.20 (0.25)	0.19 (0.25)	0.04 (0.28)	-0.02 (0.29)	-0.06 (0.30)	-0.10 (0.31)	0.05 (0.11)
Trees (sq. root)	0.10*** (0.03)	0.11*** (0.03)	0.15*** (0.03)	0.16*** (0.03)	0.15*** (0.04)	0.16*** (0.04)	0.02 (0.01)
Trees (count)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00* (0.00)
Vines (sq. root)	0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.02)	-0.00 (0.01)
Age (head of h/h)	-0.02** (0.01)	-0.02** (0.01)	-0.02 (0.01)	-0.02** (0.01)	-0.01 (0.01)	-0.02* (0.01)	-0.01*** (0.00)
Farm wkrs in h/h (N)	0.03 (0.04)	0.02 (0.04)	0.04 (0.04)	0.02 (0.04)	0.04 (0.04)	0.02 (0.05)	0.01 (0.02)
Non-farm workers %	0.03*** (0.01)	0.03*** (0.01)	0.03** (0.01)	0.03** (0.01)	0.01 (0.02)	0.01 (0.02)	0.02*** (0.01)
Lambda [a]	-	-0.15 (0.28)	-	-0.34 (0.27)	-	-0.31 (0.33)	-0.19 (0.16)
Constant	10.95*** (0.50)	10.96*** (0.50)	9.65*** (0.71)	9.56*** (0.73)	9.41*** (0.74)	9.36*** (0.75)	0.62** (0.25)
N	58	58	55	55	56	56	56
F-stat.	29.2***	26.7***	14.9***	15.3***	13.2***	11.3***	5.0***
R-square	0.73	0.73	0.68	0.68	0.66	0.66	0.37
AIC	128.7	130.5	137.1	138.1	143.0	144.2	56.0

Standard errors in parentheses; Significant at: * 10%, ** 5%, *** 1% level

Note: [a] refers to Heckman's lambda, otherwise known as the inverse Mills' ratio, calculated from first stage selection regressions not reported (see Table 2); farm size is stated in logarithms; all other variables are as per Table 2; robust (Huber/White/Sandwich) standard errors given; samples exclude missing observations and outliers, defined as households ±5 standard deviations from the mean of the dependent variable.

Source: authors' calculations

two thirds of observed variation in revenues across households. Secondly, the estimated coefficients run in their expected directions. For example, the number of productive trees is both significantly and positively associated with crop revenues (note the square root of productive trees and vines is included due to the skewed nature of their distributions).

Thirdly, we note a consistent positive significant effect from scheme certification on net cocoa revenue, as well as net cocoa and vanilla revenue. Given the empirical strategy used, these estimates con-

Table 4. Regression-based estimated treatment effects for net cocoa and vanilla revenues

		Organic certified?		
		No	Yes	All
Organic practices in use?	No	204.5 (31.3)	176.4 (58.1)	197.4 (38.0)
	Yes	120.4 (21.4)	738.5 (106.0)	657.9 (95.0)
	All	195.1 (30.2)	577.9 (92.3)	390.0 (61.8)
Median test, over organic (*C*):		3.08	(pr = 0.079)	
Median test, over practice (*P*):		2.19	(pr = 0.139)	

Notes: for each group, figures give the (mean) estimated revenue increment in 1000 Ush arising from participation in the scheme calculated using observed data and the relevant counterfactual (i.e., no participation for participants, and participation for non-participants) holding all other factors constant, including number of organic practices; figures in parentheses report the raw value as a percentage of estimated net cocoa and vanilla revenue in the non-participation scenario; median test reports the relevant chi-sq. statistic.

Source: authors' calculations.

trol for other observed determinants of revenue, including use of organic techniques. In other words, we can reject the null of Hypothesis I and conclude there is a positive treatment effect *ceteris paribus*. Even so, the positive revenue effect of certification is not noticeable at the level of gross crop revenue, suggesting that revenue gains from organic certification are likely to be specific to certified crops and also that they are not offset by higher crop-specific costs. This finding would seem to corroborate the descriptive data in Table 1 as well as the discussion in Section I.

Fourthly, the application of organic practices is consistently significant and positive, also making it appropriate to refute Hypothesis II. Moreover, the fact that this is observed across all revenue variables suggests that the adoption of organic practices may have a generalised beneficial impact, possibly through spill-overs to other crops or farming techniques.

It is all very well finding statistically significant results. However, it is also necessary to verify they are interesting from an economic perspective. Economic significance can be evaluated by calculating the revenue effect of participation for each household, controlling for its observed characteristics. As we observe each household in only one state (treatment / control), the counterfactual state (no treatment / treatment) must be estimated. This can be undertaken using the regression coefficient estimates whereby the certification dummy is switched as appropriate. Using the Heckman estimates for net cocoa and vanilla revenue, Table 4 reports results from this exercise and tabulates the estimated revenue effect according to households' observed treatment status. The benefit of doing so allows one to distinguish between different types of estimated treatment effects. For example, the average revenue effect of certification for participants in the certification scheme (the average treatment effect on the treated – ATT) is estimated as equal to 92.3% of revenue in the counterfactual state. The average treatment effect on the untreated (ATU), however, is much lower at only 30.2% of revenue. As the table indicates, this difference seems to derive from the combination of participation in the scheme alongside the use of organic practices.

Although these are both economically

Table 5.
Propensity score matching results for revenue variables (logs.)

	Matching estimator					
	One-to-one[a]	One-to-one (NR)[b]	Nearest-neighbour[c]	Radius	Kernel	Average (weighted)
Gross crop	0.63 (0.64)	0.52 (0.41)	0.64 (0.47)	0.71 (0.47)	0.72 (0.48)	0.64 -
Net cocoa	0.93** (0.50)	0.85*** (0.40)	0.97*** (0.44)	0.88** (0.50)	0.92** (0.51)	0.91 -
Net cocoa & vanilla	0.99** (0.50)	1.03*** (0.40)	1.06*** (0.44)	0.98** (0.50)	1.02** (0.50)	1.02 -

Analytical standard errors in parentheses; Significant at: ** 5%, *** 1% levels

Notes: [a] one-to-one matching with replacement; [b] one-to-one matching without replacement; [c] nearest neighbour matching using 4 nearest observations; cells give estimates of the average treatment effect on the treated (ATT) in log. percentages; matching undertaken using the Stata command psmatch2; in each case a common support is imposed by dropping 20% of the treatment observations for which the propensity score density of the control observations is the lowest; average is calculated using inverse standard errors as weights.

Source: authors' calculations.

and statistically significant effects, it is important to note that the standard errors around the regression estimates are relatively wide. For example, taking the results from column VI of Table 3, the 90% confidence interval around the estimate for scheme certification ranges from 0.2 to 2.0 which, given the semi-log specification, translates into a positive effect from certification ranging from 20% to over 500% of household net cocoa and vanilla revenue. Similarly, while the point estimates for organic practices suggest there is approximately a 30% revenue gain for each additional organic practice used, the standard errors indicate undue stress should not be placed on the precision of these results.

In light of this concern as well as the small sample size, it is useful to check the robustness of results by a propensity score matching (PSM) approach. Due to the absence of selection bias (as tested above), this method would appear appropriate for use here. However, standard PSM is only suitable for binary treatment-control classifications such that it is not possible (in this simple case) to separate the effects of certification from use of organic practices. Even so, it is possible to validate the magnitude and significance of the previously-estimated ATT for the 'treatment' of certification. Table 5 gives the results for all three revenue variables using a range of different matching algorithms. As can be seen, the direction, magnitude and significance of the results provide clear support for the regression results. For example, the weighted ATT for net cocoa and vanilla revenue is 1.02 which corresponds to an effect from scheme participation of over 150% of household revenue for scheme members. However, once again the analytical standard errors remain large, meaning that the direction and locus of results should be given greater attention than their precision. Even so, the broad point is that OLS, Heckman selection and PSM methodologies provide consistent evidence for posi-

Figure 1a.
Distribution of average price received

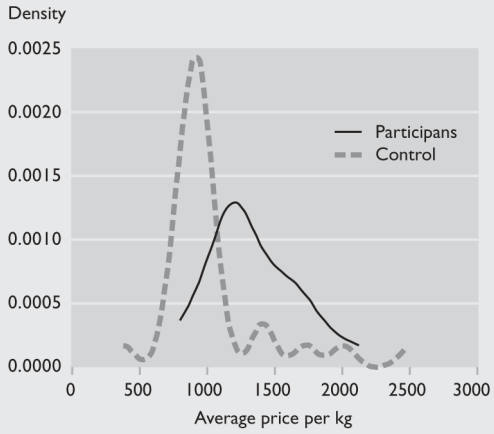
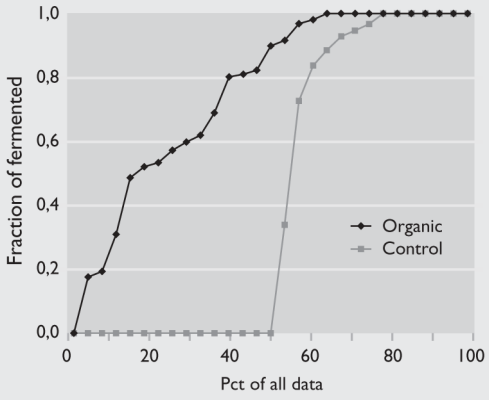


Figure 1b.
Fraction of fermented cocoa sold of all sold cocoa



tive revenue effects arising from scheme certification and use of organic practices.

(c) Discussion

The positive scheme participation effects reported are most obviously explained with reference to the price premium offered to scheme members in the context of the workings of the cocoa market. For scheme members, a price premium from selling organic cocoa is only available for produce that has been fully processed. While in the conventional market processed cocoa beans also command a premium, this is subject to the vagaries of the market and is usually lower. Processing is costly in terms of time and labour. It further requires the processor to have a critical mass of raw beans or to cooperate with other farmers in pooling raw beans (opening up for possible distributional disputes later). Above all, it involves deferring receipt of revenue until processing is completed. This implies that it is an investment with uncertain returns. A price premium for scheme members may offset these risks and thus increase the extent to which farmers engage in adding value through processing.

This interpretation is supported by an examination of the distribution of average prices received by the two groups, as well as of the proportion of their cocoa crops that were fully processed. The average prices received by both groups, plotted in Figure 1 (a) show the control group's average prices to be bunched tightly at a lower level than scheme members and to be more dispersed overall. However, the prices received by scheme members are also quite dispersed, reflecting a degree of dampening of the effect of premium prices. This may be the result of a weakening of price incentives by Esco's occasional cash shortages.

The cumulative distribution of the proportion of the cocoa crop fully processed is plotted in Figure 1 (b). There are clearly stronger incentives for scheme members to process their cocoa: only three percent of certified organic farmers process none of their crop (even if some sell part of their processed crop off scheme), as against 53 percent of conventional ones. The distribution of processing within the two groups is also quite different, with a smooth distribu-

tion for scheme members and a highly disjointed one for the control group (suggesting that in the control group, processing is confined to the larger producers). Besides the price premium, a further explanation for this pattern may be that the scheme introduces more transparent measurement of quality (and perhaps volume) than in the conventional market. This may also act to reduce the risks of processing – thus increasing the proportion of farmers accessing higher prices. On this basis, the effect of scheme participation supports the view that contract farming schemes can correct for classic market failures in developing country agricultural contexts, thus yielding positive welfare effects (cf. Section 1).

While the revenue effects of organic practices are more modest than those of organic certification, it is interesting that they apply to all the indicators of revenue used and not simply to net revenue from certified crops. This suggests adoption of such practices for certified crops has spillover effects applying to farm management generally.

5. CONCLUSION

This paper reports analyses of the revenue effects of both participation in an organic smallholder contract farming scheme organised by a multinational trading company and the application of recognised organic farming techniques. After establishing the absence of non-random selection into the scheme, positive effects were found in relation to both these variables. Scheme participation is associated with increases in household net cocoa revenue and in household net cocoa and vanilla revenue taken jointly of around 150 percent on average. The effect of applying organic farming techniques is more modest, but increases depending upon how many techniques are applied simultaneously.

In terms of the issues raised in the introduction to this paper, evidence has been generated in favour of the superior profitability of certified organic farming for Sub-Sahara African smallholders, compared to the common alternative situation of organic by default farming systems. On the other hand, this superiority is bound up with the organisation of certified organic production in contract farming schemes. Such schemes can provide normally reliable product marketing guarantees in the form of a premium when a given quality requirement is met. This seems to reduce smallholders' lack of certainly about net returns to (in this case) fully fermented cocoa. In other words the evidence here supports the case for contract farming systems with specific contract design features (notable price premiums for good quality) rather than for contract farming schemes as such, whether these are organic or conventional. At the same time, it is evident that organic farming techniques have positive revenue effects, while a question for further research is whether greater strictly 'organic' effects than those observed here can be observed in longer-established schemes (the establishment of schemes over longer periods should lead to both wider and deeper diffusion of organic techniques and greater availability of the materials necessary to apply them).

Concerning the argument of Neilson (2008) that contract farming schemes linked to sustainability standards will be associated with a restructuring of value chains in ways that allow full capture of sustainability rents by multinational trading companies, the results reported point to a

need to consider the restructuring of value chains along sustainability lines firstly as a less finished process than Neilson suggests, and secondly as having outcomes that are more ambiguous. In relation to the first point, competitive 'conventional' market structures typically continue to exist alongside and in an interactive relation to organic contract farming ones, rather than simply being displaced. This would appear to be the case not only for this scheme but for almost all organic contract farming schemes in Uganda (Gibbon, 2006). As a result, any attempt by a scheme organiser to monopolise resulting rents and transfer scheme costs are almost certain to be counter-productive, since participants would defect to the competitive conventional market (or switch to other crops). In relation to the second point, this study shows that the main way that a buyers may use their quasi-monoponistic status mainly to transfer to farmers those post-harvest processing practices that it is practicable to carry out on-farm, rather than to simply press down prices. Esco certainly chose the former course of action, doing so by restricting payment of a premium price to cocoa that was fully fermented. This meant that scheme participants could obtain a share of the rent deriving from product differentiation by adding value through committing labour to processing. Of course, this option was also available for farmers in the competitive conventional market. The differences in supply response between scheme members and non-members observed in Figure 1b (a response amongst scheme members that was both greater in magnitude and by a more heterogeneous population) did not derive from the superior 'buyer power' enjoyed by Esco relative to conventional buyers, however. Instead it appears to have derived from the higher level of transparency of quality requirements in the organic chain, imparted by contractualisation. Finally, as already noted, inclusion in the organic contract farming chain also facilitated scheme participants' exposure to certain yield enhancing farming techniques, thus enabling both parties to the contract to increase their revenues from cocoa and vanilla.

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