Determinants and Welfare Impacts of Export Crop Cultivation – Empirical Evidence from Ghana

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Abstract
This paper investigates the determinants of farm households' participation in export cropping and the impact of export cropping on household welfare, using cross-sectional data obtained from the Ghanaian living standards survey 2005-6. Given the problem of selectivity bias that arise when households self-select into export cropping, we employ the full information maximum likelihood approach to analyze the participation decision, and generalized propensity matching approach to examine the welfare impacts of participation. The empirical results indicate that farmers facing lower transport costs and having better access to credit facilities are more likely to participate in export cropping. Estimates of the welfare impacts of export cropping generally reveal a positive relationship between engagement in export cropping and farm household welfare. However, a consideration of the impact of extent of export cropping shows a non-linear relationship with household welfare indicators, with per capita expenditures rising and poverty declining only at higher levels of export specialization.

Keywords: Export crops, Farm households, Household welfare, Poverty, Generalized propensity score

1. Introduction

Economic theory suggests that producers in developing countries benefit from productivity gains by participating in international trade (Grossman and Helpman, 1991). Benefits from agricultural exports are likely to be transmitted through the value chain from the exporting companies and cooperatives to farm households. For example, profitable export markets can induce exporting firms and marketing boards to assist farmers with concessional inputs and credits, or provide rural infrastructure such as feeder roads. Large export markets can also stimulate R & D of exporting firms in seed and farming practices, which increases the productivity of technology adopting farms (Pray and Umali-Deininger, 1998).

In spite of these potential benefits, a number of criticisms have been advanced against export promotion. In particular, they argue that export-oriented agriculture make developing countries dependent on raw products whose terms of trade tend to deteriorate over time (Prebisch, 1950). Furthermore, the usually high concentration of developing countries in very few export commodities makes them particularly vulnerable to price variation in international markets (Sheperd, 2010).

Despite agriculture's large contribution to export revenues for many developing countries, there is surprisingly scanty empirical evidence on the determinants of participation in export cropping and the impact of export crop production on household welfare (e.g. Balat and Porto, 2009; Coello, 2009). This paper contributes to the sparse empirical literature, using farm data from Ghana. Ghana's large agricultural sector and its pioneering role in export-led growth policies in sub-Saharan Arica makes its agricultural export sector particularly worth investigating. We employ a full information maximum likelihood (FIML) procedure to estimate both the probability of participating and the extent of participation in export cropping. We then use the usual propensity score method to examine the impact of participation on household welfare, and then the generalized propensity score method to examine the impact of extent of participation on household welfare. Both the FIML procedure and the propensity score approaches are used to account for selection bias that occurs when households self-select into participation. This is in contrast to previous research, which did not account for self selection in estimating the determinants of export cropping (Balat and Porto, 2006), or classified the extent of export cropping as a discrete choice variable (Balat and Porto, 2006; Coello, 2009), which may hide significant differences within the arbitrary treatment classes and therefore result in misleading conclusions.

The rest of the paper is structured as follows. The following section outlines the economic theory, and section 3 presents the empirical specification employed in the analysis. In section 4, the Ghana Living Standards Survey 5 dataset used in the analysis is described. Section 5 presents the results of our empirical investigation, and the final section concludes.

2. Theoretical model

We employ a simple model that captures potential gains (or drawbacks) from export farming as benefits (or losses) in the utility function of farm household members. Basically, we assume that farmers have to decide on the extent to which they participate in export cropping. We consider a risk-neutral farm household that maximizes expected utility dependent on net returns, Π, subject to competitive input and output markets and a single-output technology that is quasi-concave in the vector of variable inputs, I. This may be expressed as

$$\max_I \mathrm{E}[U(\Pi)] = \max_I \mathrm{E}[\mathrm{U}(PQ(I,Z) - T'I)] \tag{1}$$

where E is the expectation operator conditional on information available to farmers, U denotes utility, P represents product price and Q is the output level, which depends on the vector of input quantities I and on farm and household characteristics Z. Costs are represented as the multiplication of the vector of used inputs I with their corresponding input prices T'. Given that the intensity level of export cropping (ex) changes the farm's output supply and input demand patterns, export cropping will affect the net returns function of the farm. Net returns can then be expressed as a function of output price, household endowments, input prices and export cropping, i.e. $\Pi = \Pi(P, T, ex, Z)$. Following the above assumptions, it may be assumed that, in deciding whether to participate in export cropping, the household weighs up the expected utility of net benefits from participation represented as $U_{ex}^*(\Pi)$ and the expected utility of net benefits from non-participation (indicating production of crops for domestic markets or own consumption) represented as $U_d^*(\Pi)$, and participation occurs if $U_{ex}^*(\Pi) > U_d^*(\Pi)$. The parameters of this net benefits maximizing decision are not observable, but may be represented by a latent variable, such that $U(\Pi) = 1$, if $U_{ex}^*(\Pi) > U_d^*(\Pi)$ and $U(\Pi) = 0$, if $U_{ex}^*(\Pi) \leq U_d^*(\Pi)$. If we drop other subscripts for expositional purposes, the utility of participation can be related to a vector of farm and household characteristics, Z_i as follows

$$U(\Pi) = \alpha' Z_i + \mu_i \tag{2}$$

where α is a vector of parameters, i is an index for household, and μ is an error term with zero mean and a variance of σ_μ^2. Equation (2) may also be expressed as

$$\Pr(U(\Pi) = 1) = \Pr\big(U_{ex}^*(\Pi) > U_d^*(\Pi)\big) = Pr(\mu_i > -\alpha' Z_i) = 1 - \Phi(-\alpha' Z_i) \tag{3}$$

where Φ represents the cumulative distribution function for μ, which is assumed to be normally distributed in the present application. Given that planting export crops has a positive impact on expected utility, the farmer will extend the input usage for these crops until the expected marginal returns from export cropping equals the expected marginal returns from cultivating non-export crops, i.e. $\partial E(\Pi)_{ex}/\partial I_j = \partial E(\Pi)_d/\partial I_j$, where $E(\Pi)_{ex}$ and $E(\Pi)_d$ represent expected returns from export crops and non-export crops, respectively, and j is an element of input vector I. Input fixity or rationing, and various forms of imperfect markets may however hinder farms from reaching their optimum level of export crop cultivation.

3. Econometric Framework

3.1 Estimation of the determinants of export cropping

We define export cropping intensity as export revenue share, and denote it as t_i, while Z_i represents farm and household characteristics as in equation (3). Export cropping intensity can then be related to these characteristics in a regression such as:

$$t_i = Z_i\beta + \varepsilon_i \quad , \qquad \varepsilon \sim N(0, \sigma^2) \tag{4}$$

where ε_i is the error term. The export revenue share t_i can only be observed for farms that have actually chosen to participate in export cropping, i.e. $U(\Pi) = 1$. Since farms with specific advantages (e.g. in production efficiency or information acquisition) are more likely to participate in export markets, the choice of participation becomes endogenous. In this case, ordinary least square (OLS) estimates of equation (4) will suffer from sample selection bias, as the error terms of equations (2) and (4) are correlated, i.e. $\rho = \mathrm{corr}(\varepsilon, \mu) \neq 0$. We therefore employ a full information maximum likelihood (FIML) model that assumes a bivariate normal distribution of the error terms (Puhani, 2000). This approach allows the unbiased estimation of the parameters of equation (4) and is able to take complex survey design into account. It involves maximizing the following likelihood function:

$$\begin{aligned}\ln L = \sum\nolimits_{ex} w_i \ln \Phi \left[\frac{Z_i\beta + (t_i - Z_i\beta)\rho/\sigma}{\sqrt{1-\rho^2}}\right] - \frac{w_i}{2}\left(\frac{t_i - Z_i\beta}{\sigma}\right)^2 - w_i \ln\left(\sqrt{2\pi\sigma}\right) \\ + \sum\nolimits_{d} w_i \ln \Phi(-Z_i\alpha)\end{aligned} \tag{5}$$

where w_i are sample weights employed to account for the GLSS 5 survey, in which households in the northern parts of Ghana had a slightly higher probability of being interviewed. Clustering and stratification are taken into account in the calculation of standard errors. The selectivity effect is summarized by calculating $\lambda = (\rho\sigma)$, which is equivalent to the coefficient of the inverse Mills ratio.

3.2 Estimation of the determinants of export cropping

The problem of self selection also affects the analysis on impact of participation on household welfare. Thus, estimating a reduced-form relationship between the decision to choose a particular level of export crop intensity and the welfare outcome variable with an OLS regression would result in biased estimates even when household characteristics are controlled for. A common solution to this problem in impact analyses are matching approaches, in which individuals of a treatment group (participation in export cropping) are paired with individuals of a control group (non-participation in export cropping) that are similar in their observable characteristics. The theoretical underpinning is based on the counterfactual average treatment effect, which is defined as

$$\Delta_{\mathrm{i}} = Y_i^{ex} - Y_i^{d} \tag{6}$$

where Y_i^{ex} and Y_i^d represent the welfare outcome of household i if it cultivates export crops and if it does not cultivate export crops, respectively. This causal effect of export cropping cannot be calculated, as it is not observable how a farmer would have performed, in the case of non-participation in export cropping (Rosenbaum and Rubin, 1983). Given that selection into treatment is based on observable characteristics, Rosenbaum and Rubin (1983) show that individuals of different treatment groups but with similar characteristics can be compared as if treatment was randomly assigned. For the case of a dichotomous treatment, Rosenbaum and Rubin (1983) proposed propensity score-matching as a solution for this problem. Their approach involves estimating the propensity score, which is defined as the conditional probability of being selected into the treatment group given pre-treatment characteristics, and can be expressed as

$$p(Z_i) = \Pr[Ex = 1|Z_i] = \mathrm{E}[Ex|Z_i] \tag{7}$$

An underlying assumption of the propensity score-matching approach is the unconfoundedness, or conditional independence assumption (CIA). Another precondition is that the matched observations have to be within the area of common support, which implies that observations with the same covariates have both a positive probability of being in the group of participants as well as being in the group of non-participants (Heckman et al., 1997). When these assumptions hold, the average treatment effect of the treated (ATT) can then be estimated as follows:

$$\begin{aligned} ATT &= E\left[Y_i^{ex} - Y_i^d | Ex = 1, p(Z_i)\right] = \\ &E\left\{E[Y_i^{ex}|Ex = 1, p(Z_i)] - E\left[Y_i^d | Ex = 0, p(Z_i)\right] | Ex = 1\right\} \end{aligned} \tag{8}$$

Thus, outcomes between the treated and the untreated groups can be compared by matching individuals of the treatment group with untreated individuals who have similar propensity scores.

Considering export cropping as a dichotomous decision with two outcomes may be too simplistic, however, since farms usually specialize differently in export cropping, resulting in considerable differences in their net returns. We therefore employ the generalized propensity score (GPS) for continuous treatment case suggested by Hirano and Imbens (2004) to capture the impact of export crop intensity on household welfare. For each export farm household i, we observe the vector of pre-treatment variables Z_i, the actual level of treatment received T_i, and the outcome variable associated with this treatment level $Y_i = Y_i(T_i)$. Of interest is the average dose response function (DRF), which relates to each possible treatment level t_i, the unbiased potential outcome $Y_i(t)$ of farm household i:

$$\theta(t) = E[Y_i(t)] \quad \forall \ t \in \mathcal{T} \qquad \text{where } \ \mathcal{T} = (0, \dots, 1] \tag{9}$$

where θ represents the DRF. In line with Hirano and Imbens (2004), we presume that the assignment to the treatment is weakly unconfounded given pre-treatment variables,[3] i.e.

[3] This assumption is considered ‘weak’ due to the fact that it does not require joint independence of all potential outcomes, but instead requires conditional independence to hold for each value of the treatment (Hirano and Imbens, 2004). [5] Because the distribution of the export revenue share was highly skewed, we again followed Hirano and Imbens (2004) and took the logarithm of the treatment variable. This proceeding lead to very low skewness (-0.0002) and kurtosis (1.8515) values and yielded a positive Kolmogorov-Smirnov test for normality at the 5% level of significance.

$$Y_i(t) \perp T_i | Z_i \quad \forall \ t \in \mathcal{T} \tag{10}$$

Thus, the treatment assignment process is supposed to be conditionally independent of each potential outcome given the pre-treatment variables. Given that all observable characteristics are controlled for, this assumption essentially postulates that there is no systematic selection into specific levels of export intensity left that is based on unobservable characteristics (Flores et al., 2009). However, as the number of covariates in Z_i rise, simultaneously adjusting for all covariates becomes an increasingly difficult task. For this reason, Hirano and Imbens (2004) suggest estimating the generalized propensity score (GPS), which is defined as the conditional density of the actual treatment given the observed covariates. Formally, let $r(t, z) = f_{T|Z}(t|z)$ be the conditional density of potential treatment levels given specific covariates. Then the GPS of a household i is given as $R_i = r(T_i, Z_i)$. The GPS is a balancing score, i.e. within strata with the same value of $r(t, Z)$, the probability that $T = t$ does not depend on the covariates Z_i. Given this balancing property and weak unconfoundedness, Hirano and Imbens (2004) show that using the GPS to remove the selection bias allows the estimation of the average DRF of equation (9).

In our application, the GPS is estimated using a normal distribution of the logarithmic treatment given covariates Z_i.[5] The balancing property of the estimated GPS is tested by employing the method proposed by Hirano and Imbens (2004). Another key element of the propensity score approaches is the common support condition, i.e. households in one treatment group have to find comparable households in other treatment groups. We impose the common support condition by employing the method suggested and Flores et al. (2009). After estimating the GPS, the DRF is estimated using a flexible polynomial function (Bia and Mattei, 2008). The average potential outcome at treatment level t is estimated using a cubic approximation of the treatment variable and the GPS, and interaction terms. The specification is estimated using OLS regression for continuous welfare outcomes, and a Logit regression for poverty status. Confidence bounds at 95% level are estimated using the bootstrapping procedure. For the analysis of spillover effects, we use the original propensity score matching method to compare welfare indicators of non-export farm households located in districts with export cropping activity with non-export households of districts without any export cropping activity. In this analysis, we estimate the ATT by employing the nearest neighbor matching algorithm, which matches each participant with its closest neighbor with similar observed characteristics.

4. Data description

The data used in the analysis were obtained from the 5th round of the nation-wide Ghana Living Standards Survey (GLSS 5) from 2005-06. A total of 3253 farm households were included in the analysis, with 902 households having revenues from export crops. All monetary values reported afterwards are converted to the January 2006 Accra level and divided by 10,000 in order to be comparable to the new Cedi currency introduced in 2007.

We follow the strategy of Balat et al. (2009) and categorize crops into the categories export crops and non-export crops. Therefore, we define export crops as those crops that are mainly

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produced for exports. We identified the following export crops in the GLSS 5 dataset: cocoa, coffee, cashew nuts, pineapples, cotton and rubber. Farm produce for own consumption (valued at market prices) as well as any other farm revenues were considered as non-export agricultural revenues.

The farm characteristics included in the subsequent estimations contain variables that represent information on the attributes of the household head, household composition, ecological impacts, land tenure differences, access to financial resources, access to markets and information, as well as state engagement on input and output markets. We control for regional differences in export crop cultivation by introducing regional fixed effects in the analysis. Descriptive statistics and explanations of the used variables are provided in Table 1.

Table 1. Variable description

Variable	Description	Mean	Std. dev.
Welfare indicators			
Expenditures	Total *per adult equivalent* expenditures of household (hh)	652.10	640.06
Povertygap	Gap between hh's *p. a. e.* expenditures and the poverty line	24.95	53.53
Povertystatus	1 if hh falls below the poverty line, 0 otherwise	0.25	0.43
Independent variables			
Female	1 if hh-head is female, 0 otherwise	0.18	0.38
Age	Age of hh-head in years	47.02	14.94
Educ. none	1 if hh-head has no educational achievement, 0 otherwise	0.69	0.46
Educ. basic-middle	1 if hh-head completed primary or middle school, 0 otherwise	0.25	0.43
Educ. higher	1 if hh-head completed higher educational levels, 0 otherwise	0.06	0.24
Agric. main job	1 if agriculture is the main job of the hh-head, 0 otherwise	0.83	0.38
Children	Number of children in hh aged 14 or less	2.33	2.03
Household size	Number of persons in hh aged 15 or above	2.95	1.73
Eco-zone coastal	1 if farm is located in coastal area, 0 otherwise	0.10	0.30
Eco-zone forest	1 if farm is located in forest area, 0 otherwise	0.45	0.50
Eco-zone savannah	1 if farm is located in savannah area, 0 otherwise	0.44	0.50
Owned land value	Value of owned land that is operated by the farm	2459.75	13270.31
Deeded land (share)	Share of land that was acquired with deed in cultivated land	0.13	0.33
Rented land (share)	Share of rented land in cultivated land	0.06	0.24
Sharecropped l. (sh.)	Share of sharecropped land in cultivated land	0.12	0.31
Institutional loans	Value of loans from bank, gov't agency, NGO, moneylender	29.67	253.26
Private loans	Value of loans from family, friends or neighbors	27.34	252.23
Savings	Value of current savings, aggregated over all hh members	71.04	815.01
Off-farm	1 if hh had wage/nonfarm self-employment income, 0 otherwise	0.49	0.50
Cooperative	1 if co-op was trade partner or provided loan, 0 otherwise	0.08	0.27
Food availability	Number of food items rarely or not available at times (max. 7)	0.34	0.86
Phone access	1 if farm has access to telephone incl. mobile, 0 otherwise	0.55	0.50
Motor vehicle	1 if farm owns a motorcycle, car or tractor, 0 otherwise	0.05	0.22
Transport costs	Transport costs of produced crops in past 12 months	4.46	33.88
State input cost (sh.)	Costs of inputs provided by the state, share in overall costs	0.08	0.23
STE activity in district	Farms per district with State Trading Enterprise as main outlet	0.11	0.16

Note: Dummy variables of the ten administrative regions are not shown for the sake of brevity. All monetary values have been deflated to Jan. 2006 Accra prices and divided by 10,000. Source: GLSS 5

Three welfare measures are included in our analysis. The households' total expenditures represent its income level and indicate its standard of living. We related household expenditures to adult equivalents, which we later denote as *per capita* expenditures. The Ghana Statistical Service reported a food poverty line of 288.47 Cedis per adult equivalent, indicating the minimum requirement to cover an individual's dietary needs (GSS, 2007). Based on this poverty line and the actual household expenditures, we provide the poverty status and the poverty gap as measures for poverty. The former is a dummy variable that indicates whether a household falls below the poverty line or not, and the latter indicates the depth of poverty in terms of how much Cedis per capita a household is below the poverty line.

5. Results

5.1 Determinants of participation in export cropping

The determinants of participation in export cropping were estimated with Stata 10. Estimation results are presented in Table 2, with estimates of market participation in column 2, and *t*-values in column 3, while the estimates for export intensity are reported in column 4, with *t*-values in column 5. A glance at the *F*-statistic for joint maximization shows that the exogenous variables significantly explain variations of the endogenous variables in both the probability of participation and the extent of participation equations. The variable representing state trading enterprise (STE) activity served as an identifying instrument and has been left out in the extent equation. While this variable influences that probability of participation, there is no economic reason why it should affect the extent of participation. The significance of the lambda coefficient indicates the presence of selection bias, so that simple OLS regression would have yielded biased results. Further results of Table 2 reveal that participation in export cropping and the degree of export cropping are determined by the exogenous variables in considerably different ways. The results are described in detail below.

The decision to cultivate export crops is negatively affected when the household head is female, a finding that is consistent with the notion that women in Ghana tend to work more in subsistence food crops than in cash crops. There seem to be no entry barriers for farmers without formal education, as achievements in basic and middle school do not have any significant effect on participation in export cropping. The significantly positive effect of age on participation in export cropping and extent of export cropping, however, may hint at the role of experience gained over time on export market participation. Moreover, because the majority of export crops are perennial crops that require several years before harvesting, there is a natural delay between the farmer's planting decision and the date of the first export revenues from such crops. The results also reveal that households having agriculture as main source of income are more likely to engage in export cropping. However, once households participate in export cropping, its main occupation ceases to play a significant role in the extent of participation.

The significantly negative effect of children on the extent of participation suggests that, controlling for other factors including wealth, farmers with higher numbers of children probably have to invest more in food crops for self-sufficiency, rather than in export crops. The degree of specialization in export crops is considerably higher in Ghana's forest zone, where most of the country's cocoa, rubber and coffee production takes place. A significantly positive effect of owned land value in both equations confirms the common view that wealthier farmers find it easier to engage in export cropping and to devote more resources to the sector. Furthermore, property rights tend to influence the probability of participation in export cropping. Specifically, the likelihood of participation is positively and significantly affected by land ownership, but negatively influenced by shares in rented land. Sharecropping arrangements negatively affect the farmer's extent of export cropping. A high proportion of deeded land indicates secured land rights, which may stimulate export cropping by making it easier for farmers to make long-term investments in export crops, and to acquire loans to mitigate liquidity constraints. In contrast, the negative estimate for rented land indicates that sharecroppers and fixed-renters have a lower probability of investing in export crops such as cocoa and coffee.

Table 2. Determinants of participation in and extent of export crop cultivation

	Participation equation		Extent equation	
	Coefficient	(*t*-value)	Coefficient	(*t*-value)
Constant	-2.452984	(-6.91)***	0.174692	(2.23)**
Female	-0.269806	(-3.41)***	-0.037484	(-1.45)
Age	0.014717	(6.07)***	0.001691	(2.42)**
Educ. basic-middle	-0.054744	(-0.72)	0.005225	(0.31)
Educ. higher	-0.277907	(-1.90)*	0.016448	(0.42)
Agric. main job	0.252894	(2.80)***	-0.042615	(-1.63)
Children	-0.003116	(-0.18)	-0.021111	(-4.59)***
Household size	-0.032189	(-1.34)	0.007670	(1.16)
Eco-zone coastal	-0.310374	(-1.15)	-0.018234	(-0.27)
Eco-zone forest	0.257523	(1.24)	0.131823	(3.26)***
Owned land value	0.000043	(2.49)**	0.000002	(2.74)***
Deeded land (share)	0.290871	(2.50)**	-0.025851	(-0.87)
Rented land (share)	-0.671680	(-3.49)***	-0.059445	(-1.02)
Sharecropped land (share)	0.123672	(0.95)	-0.134646	(-4.23)***
Institutional loans	0.000091	(0.95)	0.000007	(0.33)
Private loans	0.000106	(1.40)	0.000020	(2.33)**
Savings	-0.000005	(-0.21)	0.000012	(2.05)**
Off-farm	0.017958	(0.25)	-0.048206	(-2.64)***
Cooperative	1.340942	(8.31)***	-0.069575	(-2.10)**
Food availability	-0.057659	(-0.87)	0.005212	(0.26)
Phone access	-0.278626	(-2.44)**	0.008682	(0.28)
Motor vehicle	0.207167	(1.38)	0.080824	(2.01)**
Transport costs	-0.000233	(-0.16)	-0.000478	(-1.91)*
State input cost (share)	0.442310	(2.60)**	-0.043936	(-1.21)
STE activity in district	4.068371	(8.77)***	-	-
Lambda λ	-	-	-0.101616	(-3.42)***
Rho ρ (*t*-value)	-0.4175	(3.68)***		
F-test [*p*-value]	11.15	[0.00]***		
Observations	3253			

Notes: For the sake of brevity, estimates for regional dummy variables are not reported but available on request from the authors. ***, **, and * indicate 1%, 5% and 10% significance levels, respectively. Source: Authors' estimation.

Despite government's efforts to support farmers cultivating export crops, institutional loans –that also include credits from state banks and government agencies– do not appear to have any significant effect on export cropping. Private risk-sharing networks tend to be better able to meet the credit demands of export crop extensions due to the fact that they have advantages in screening and monitoring the borrower as well as enforcing repayment. Savings represent a farmer's self-financing capacity and, according to our results, foster specialization in export cropping. In contrast, the presence of off-farm earnings impedes farms from increasing the revenues from export cropping, a finding that suggests that off-farm income sources compete with export cropping for the work time of the family members.

The estimates further reveal that cooperatives play a significant role in overcoming export market entry barriers. Their contribution to enhancing farmers' access to input and product markets, gathering market information, as well as sharing knowledge among farmers appear to facilitate farmers' participation in export cropping. Cooperatives are also mostly associated with farms that derive only a small fraction of their revenues from export crops. Since most services of cooperatives are explicitly laid out to make smaller and less experienced smallholders more competitive, these farmers are likely to have the largest gains from membership. The performance of local food markets is measured in our model by the number of food items that were rarely or not available when they were demanded. The estimates presented in Table 2 show that neither the decision to engage in export cropping nor the intensity of export cropping is affected by food unavailability. This may partly stem from the fact that export crop production does not only compete with food crop production for scarce resources, but can also induce considerable synergy effects (Govereh and Jayne, 2003). The importance of access to markets is indicated by the positive effect of owning a motorized vehicle and the negative influence of crop transport costs to markets or buyers on the revenue share of export crops. However, both factors do not significantly influence the participation decision. The findings also show that farms that receive relatively more inputs from state agents are more likely to participate in export crop markets. Interestingly however, the receipt of state provided inputs does not induce further export intensification. All regional dummy variables in the extent equation –and some in the participation equation– are significantly different from zero, indicating that Ghanaian farmers from different regions tend to specialize in different crops due to environmental and infrastructural factors.

5.2 Welfare impacts of participation in export cropping

Estimates of the welfare impacts of participating in export cropping were computed using a Stata program written by Leuven and Sianesi (2003). The results, which are presented in Table 3, show that the effect of export cropping, indicated by the average treatment effect for the treated (ATT), has the expected signs for all welfare indicators employed. Households participating in export cropping have on average 88 Cedis higher *per capita* expenditures compared to non-participants. This is an increase of approximately 15 percent for a non-export crop household, which has an average *per capita* expenditure of 588 Cedis. The results also show that participation in export cropping exerts a negative and significant impact on poverty, suggesting that households producing export crops are less likely to be poor, compared to their counterparts who produce food crops. Sensitivity analysis on hidden bias revealed gamma values of 1.10-1.15 for both significant estimates. These values indicate that, if households with the same Z_i-vector would differ in their odds of cultivating export crops by just 10-15%, the significance of the effect of export cropping on the welfare outcomes may be questionable (Rosenbaum, 2002). We conducted balancing tests, which indicated that the estimated balancing scores were able to considerably reduce imbalances among the covariates.[10]

Table 3. Welfare impact on export crop farmers: Average treatment effects and sensitivity analysis

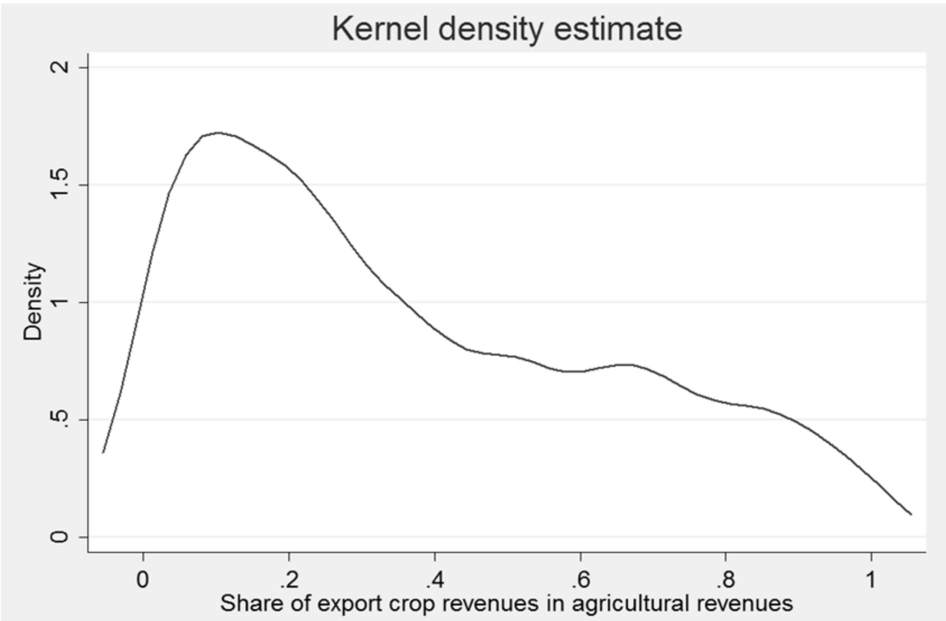
Outcome	ATT	Critical level of hidden bias (Γ)	No. of treated	No. of controls
Expenditures	88.44** (2.01)	1.10-1.15	432	2,351
Povertystatus	-0.0454* (1.86)	1.10-1.15	441	2,351
Povertygap	-3.55 (-1.64)	-	443	2,351

Notes: Numbers in parentheses are *t*-values. ** and * indicate significance at 5% and 10% levels, respectively. Source: Authors' estimation.

5.3. Welfare impacts of different intensities of export cropping

Kernel density estimates, which are reported in Figure 1, indicate that the majority of export crop farmers still rely on agricultural revenues from non-export activities. Most farmers have export revenue shares below 40% and only few have export crop shares of up to 80% or higher. In particular, the results suggest that it might be misleading to simply compare outcomes of the categories "non-export crop farmers" and "export-crop farmers" in welfare analysis, since export-crop farmers differ in terms of export revenue shares.

Figure 1. Ghanaian export crop farmers: intensity of export cropping



Notes: A Gaussian kernel type was used with a bandwidth of 0.055. Source: Authors' estimation.

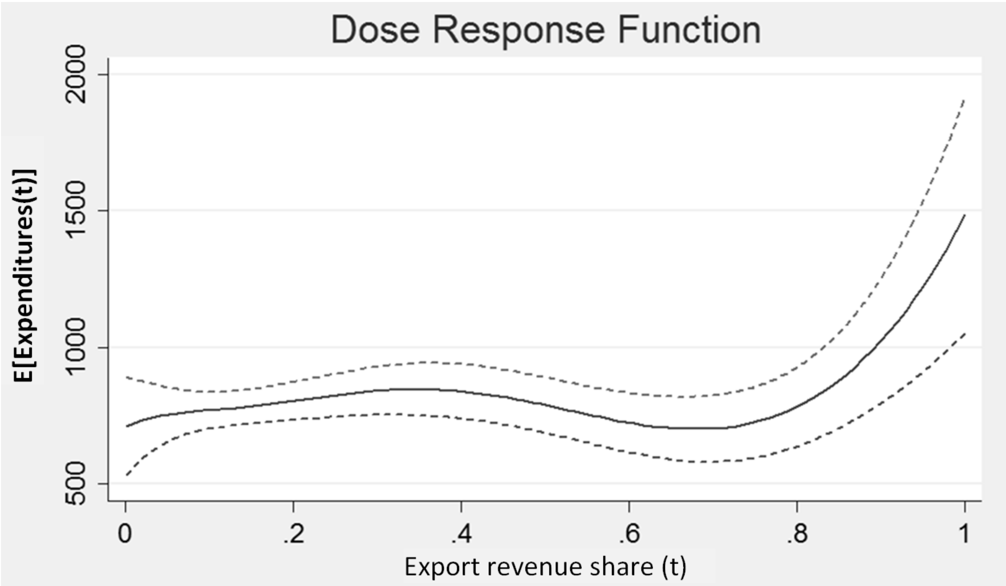
In the maximum likelihood estimation of the generalized propensity score (GPS), all independent variables of the FIML participation equation were included.[12] Balancing tests

[10] The test statistics are not reported for the sake of brevity, but available on request from the authors.
[12] The results of the GPS estimation are not reported, because they are just to derive an appropriate balancing score and not for interpretational purposes.

indicate that the GPS has quite well balancing properties.[13] Regarding the common support condition, 768 farms were on support, which represents 85% of the initial export farmer sample.

Figure 2 shows the DRF of the impact of export specialization on household *per capita* expenditures. The results show a non-linear relationship, whereby household welfare is hardly affected at low levels of export revenue shares, but tends to rise with increasing level of specialization. Relative to households with low levels of export crop cultivation, fully specialized farms substantially improve their standard of living, with the threshold occurring around 70% level of specialization. These results suggest that export crop cultivation cannot be considered as a magic bullet in increasing farmers' living standards. Marginal benefits from low and medium export intensity may be easily outweighed by immeasurable benefits of non-export agriculture, such as predictability of local markets and risk insurance through consumption of own produce. Uncertainties about foreign markets, self-sufficiency reasons as well as financial and infrastructural constraints may hinder most farmers from increasing their revenue shares from export cropping activities.

Figure 2. Impact of export crop cultivation on household expenditures



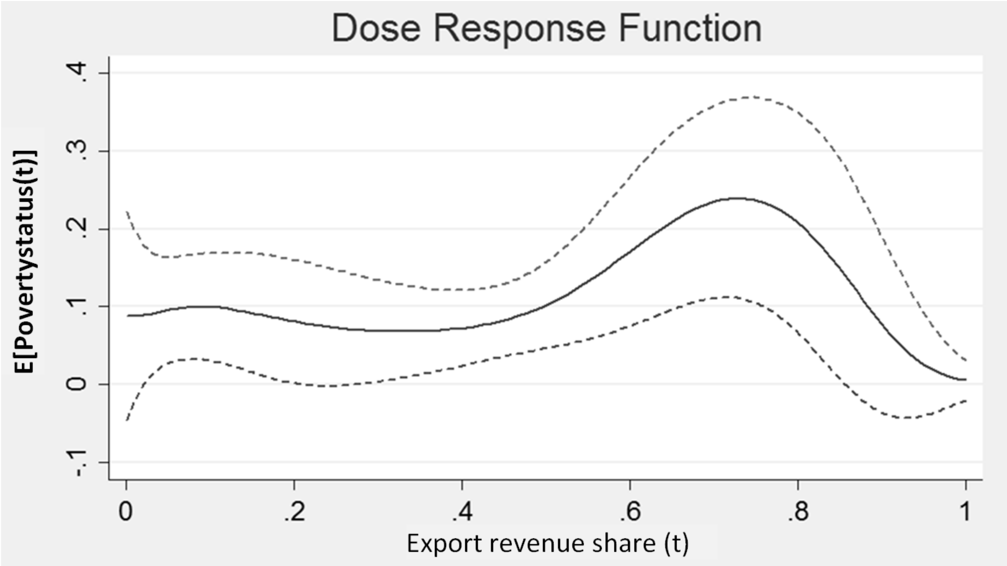
Notes: Continuous lines indicate the dose-response of *per capita* expenditures; dashed lines are the 95% confidence bounds. Source: Authors' estimations.

The impact of export cropping on poverty reduction is more ambiguous. Figure 3 presents the DRF for the effect of export cropping on the household's probability of falling below the poverty line. The relationship, which is also non-linear, reveals that the probability of falling below the poverty line is virtually similar for export share between zero and 40%, but begins to rise between 40% and 70%, only to decline after that threshold. Only for very high export

[13] For testing the balancing property of the GPS, the treatment variable was divided into 4 equally wide treatment intervals (0, 0.25], (0.25, 0.5], (0.5, 0.75] and (0.75, 1]. Without adjusting for the GPS, *t*-tests of mean difference between the intervals revealed that 36 of the 128 *t*-tests were significant at the 5% level. Then the GPS was sub-divided into 5 quintile blocks, and *t*-tests between the treatment intervals were conducted block-wise. When adjusting for the GPS in this way, only 2 *t*-tests remained significant at the 5% level.

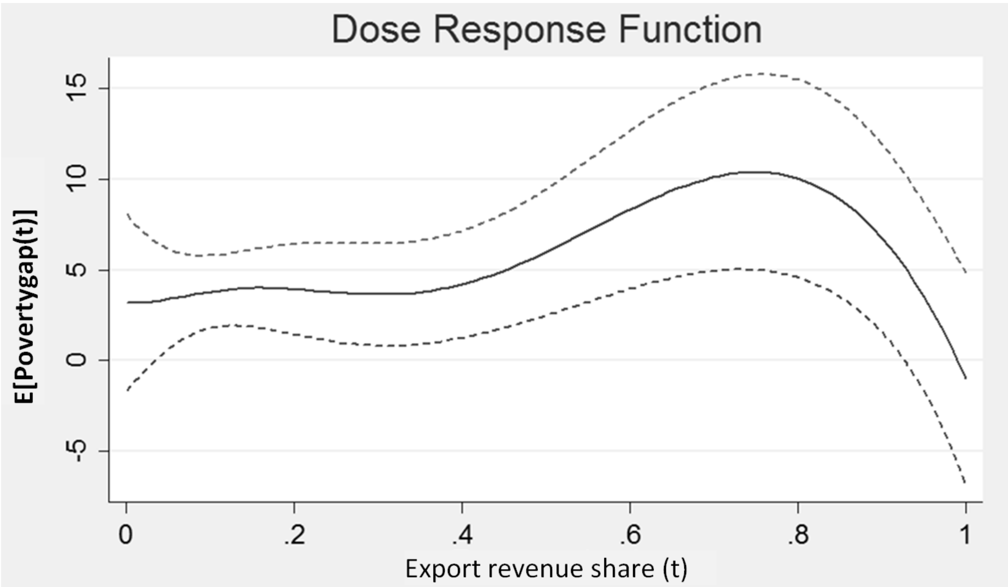
specialization levels of approximately 90% does the probability of being poor actually drop below non-export cropping levels.

Figure 3. Impact of export crop cultivation on poverty status



Notes: Continuous lines indicate the dose response, i.e. the effect on the probability of being poor; dashed lines are the 95% confidence bounds. Source: Authors' estimations.

Figure 4. Impact of export crop cultivation on the poverty gap



Notes: Continuous lines indicate the dose response; dashed lines are the 95% confidence bounds. Source: Authors' estimations.

Estimates of the DRF for the poverty gap index are presented in Figure 4. The figure virtually exhibits a similar pattern as the incidence of poverty in Figure 3. Thus, the poverty gap remains virtually stable until about 40% specialization and then begins to increase until 70%, after which it declines substantially. The wide confidence intervals for the poverty gap DRF suggest that impacts of export cropping are generally unclear among the poor. The results generally indicate that farmers who are highly specialized are less likely to fall below the poverty line.

6. Conclusions

This paper investigated the determinants of export cropping and its impact on household welfare, using cross-sectional data obtained from the Ghanaian living standards survey 2005-6. The empirical findings generally give some support to the recent call for "aid for trade" to support development efforts and reduce poverty in underdeveloped economies. As argued by Balat et al. (2009), there is a great potential to reduce poverty in rural areas of developing countries by promoting policies that facilitate exports. The findings are also in line with the idea of fair trade that aims to help producers of developing countries obtain better trading conditions and promote sustainability. Given the positive relationship between high specialization in export cropping and household welfare, the question remains as to why farmers fail to specialize to improve their welfare. On the one hand, risk-averse farmers may opt to sacrifice some revenue in order to diversify their production among export and non-export agriculture. On the other hand, financial and other constraints prevent some farmers from extending their engagement in export cropping to much higher levels.

The results of this study have some policy implications. First, it reveals that farmers could be supported to engage in export crop production and to intensify export cropping by improving their access to credit to enable them overcome liquidity constraints. Second, the finding that transport costs serve as a barrier to export crop intensification indicates that policies that reduce trade costs in rural areas may help facilitate export crop production and consequently improve household welfare. Measures that can reduce trade costs include road and transport infrastructure, as well as providing marketing information, as is being currently done by cooperatives particularly in the cocoa and pineapple sector. Generally, the findings indicate that the extent of participation is an important issue to consider when examining the welfare impacts of export cropping activities.

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