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Small producer participation in export vegetable supply chains and poverty: evidence from different export schemes in Tanzania

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ABSTRACT

With the rise and consolidation of modern supply chains, literature has put emphasis on the welfare effects for participating small producers but has often considered these effects through the comparison of participating producers with those not participating at all. Using an endogenous switching regression model, we assess in this paper the effects of small producer participation in export vegetable supply chains in Tanzania on household income and compare the effects of supplying two different types of French beans and snap peas export supply chains, defined as high-value (HVESC) and regular export supply chains (RESC), respectively. We find that participation in export supply chains increases producers' household per capita income. We also find evidence that these effects may vary from one type of export supply chains to the other and are mainly driven by HVESC, which confirms that participation in export supply chains may have varying effects depending on individual circumstances and participation conditions. We also disaggregate the analysis with respect to the producers' farm size and income level and find evidence that richer and larger producers benefit from supplying the HVESC while supplying the RESC can increase the household per capita income of some poorer producers.

Key words **–** small producers, export supply chains, horticulture, endogenous switching regression, household income, Tanzania

JEL Codes **–** C24, O12, O13, Q12, Q13

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1. Introduction

As part of the transformation process of the global agri-food systems, modern export supply chains have been expanding in sub-Saharan Africa, in a context particularly marked by, amongst others, a shift towards high-value products, an increase in trade volumes of food commodities from the continent and the consolidation of food quality standards (Reardon & Barrett, 2000; Maertens & Swinnen, 2009; Maertens, Minten, & Swinnen, 2012; Chiputwa, Spielman, & Qaim, 2015). These changes have had diverse implications for small producer participation in these supply chains as different levels and shares of sourcing from small producers can be found, depending on the commodity sector and country case examined (Maertens, Minten, & Swinnen, 2012). In cases where small producers remain suppliers of these export supply chains (ESC) and keep participating in the latter *via* product markets, contract farming schemes have in many cases been used to link small producers to these export markets (Maertens & Swinnen, 2009; Minten, Randrianarison, & Swinnen, 2009; Schipmann & Qaim, 2011; Barrett et al., 2012; Bellemare, 2012; Maertens, Minten, & Swinnen, 2012).

Literature has given significant attention to the potential livelihoods and poverty effects of these supply chains, showing that participation in the latter can have a positive income and poverty reduction effect (Maertens & Swinnen, 2009; Miyata, Minot, & Hu, 2009; Bellemare, 2012; Maertens, Minten, & Swinnen, 2012). Similar positive effects on poverty were found in domestic high-value supply chains (Rao & Qaim, 2011; Michelson, 2013; Andersson, Chege, Rao, & Qaim, 2015), which have similar characteristics than the abovementioned ESC (Rao & Qaim, 2011). Broader welfare effects have also been noted as participation in these supply chains can positively affect, amongst others, farm productivity and efficiency (Minten, Randrianarison, & Swinnen, 2007; Rao, Brümmer, & Qaim, 2012) as well as hired labour demand (Rao & Qaim, 2013).

Yet, building on the abovementioned literature, these modern supply chains and the related participation schemes may be heterogeneous and have different characteristics (Wang, Wang, & Delgado, 2014). First of all, as can be seen from examples from the literature, the very conditions of small producer participation and contract farming/supply schemes can take different forms from a country to the other and from a supply chain/commodity to the other (Barrett et al., 2012; Bellemare, 2012; Wang, Wang, & Delgado, 2014) as well as from a firm to the other within a single commodity supply chain (Narayanan, 2014). Likewise, the supply scheme agreements in a specific sector or provided by a same firm may evolve over time (Ochieng, Veettil, & Qaim, 2017), which could also bear a potential change in terms of the effects on participating producers. In general, one could assume that these differences and heterogeneity of the different supply schemes could also convey a difference in terms of their potential welfare effects.

Furthermore and as highlighted by Narayanan (2014), producers participating in these supply chains may also face different experiences and not all benefit in the same way. As a matter of fact, some producers face challenges and difficulties to remain in these supply chains and high exit rates in the latter can be noted (Narayanan, 2014; Andersson, Chege, Rao, & Qaim, 2015). In the case of Nicaragua, small producers supplying Walmart supermarkets were receiving lower price than their counterparts in the traditional markets (Michelson, Reardon, & Perez, 2012). In the context of Guatemala, producers supplying tomatoes to the supermarkets also incurred high expenditures for inputs, hence reducing their profitability (Hernández, Reardon, & Berdegué, 2007). There may thus be some heterogeneity of the effects and a potential absence of direct positive effects and benefits for some participating producers, who in turn leave the supply chains for alternative livelihoods.

Reflecting on the heterogeneity of these supply chains and modalities for small producer inclusion in the latter as well as the potentially different experiences faced by small producers, one could assume that the effects of participation in ESC can vary from a supply chain or supply agreement to the other (Narayanan, 2014). Some studies have so far compared the welfare effects of participation as employee with participation as a contract farmer (Maertens & Swinnen, 2009) or the effects of selling vegetables to supermarkets or wholesalers through contracts against the option to sell them through direct marketing (Wang, Moustier, & Loc, 2014). Related to the broader literature on modern supply chains, other research compared the effects of different types of product certification schemes (Ruben & Zuniga, 2011; Chiputwa, Spielman, & Qaim, 2015). However, to the best of our knowledge, besides the paper by Narayanan (2014) in the context of India, we are not aware of any other study that compares different participation schemes in modern ESC and their welfare effects for participating producers in a similar context.

This paper, through the case of French beans and snap peas export supply chains in Tanzania, will thus contribute to this literature by assessing the effects of small producer participation in ESC on household welfare, in particular through the comparison of the effects on producers supplying different types of exporters. These exporters differ in terms of the type of crop produce exported[1], their contract arrangements with producers, as well as the final shape and processing stage of the produce they export. This would allow us better understand which type of export supply schemes (and their characteristics) may benefit supplying producers the most. In this regard, our research question and approach is similar to and follows Narayanan (2014), although we concentrate on one group of commodities and look into a broader welfare outcome through the effects on household per capita income. Focusing on the effects on per capita income allows us to consider

[1] Among all the exporters, one of them is exclusively specialized in French beans export and does not export snap peas.

the various aspects and pathways through which participation in modern supply chains can affect household poverty, in particular with considerations to the labour and land allocated to the crop production for these supply chains (Miyata, Minot, & Hu, 2009). For instance, participation in modern supply chains may lead to a potentially reduced household time endowment available for off-farm activities, which would also affect household income. Furthermore, we will also disaggregate the results based on the characteristics of the producers in terms of farm size and income levels as there is some evidence that the extent to which participation in modern supply chains or adoption of food standards can affect producers may differ based on these characteristics (Rao & Qaim, 2011; Hansen & Trifković, 2014). This will be useful to understand which households and producers can benefit the most from these different types of export schemes.

Thus, the remainder of the paper is organized as follows: **Section 2** will briefly present the export vegetable supply chains in Tanzania and present some descriptive statistics for our sample as well as the contracts and supply agreements in our research study context; **Section 3** will elaborate on the econometric framework and approach used while the **Section 4** will present the main results of the econometric analysis. Finally, **Section 5** will discuss these results and **Section 6** will conclude the paper.

2. Context, data and descriptive statistics

The vegetable export supply chains in Tanzania

The horticultural sector has been growing extensively in the recent years and has been identified as a priority sector in the national development strategies in Tanzania (Horticultural Development Council of Tanzania, 2010). Among the different products in this commodity group, French beans and green peas[2] constitute a non-negligible share of the export value amounting to USD 7.97 million and USD 1.07 million in 2013, respectively (FAOSTAT, 2017), with the former being the highest-valued exported vegetable from the country and the latter being the third after onions in that same year.

Most of the currently active horticultural exporters in the country are located in the region of the Northern Highlands, where the most suitable environment for horticulture, in terms of climate, infrastructures and markets can be found (Horticultural Development Council of Tanzania, 2010). At the time of conducting our survey in 2015, four exporters were active in the area. While the list of commodities they process and export may vary from an exporter to the other, all of them export vegetables such as French beans and a majority export snap peas, mainly to Europe (Belgium, France, Germany, Netherlands, United Kingdom) and South Africa.

[2] Similar data for snap peas only were not available.

While some of these exporters obtain some of their supply from alternative sources such as their own farms and production units or medium-scale and large-scale commercial farms, all these exporters obtain a large share of their supply *via* contract farming arrangements from small producers in the districts of Arusha and Arumeru in the Arusha region, as well as in the district of Moshi in the Kilimanjaro region and in the district of Lushoto in the Tanga region for one of these exporters. This is also consistent with the fact that small producers still dominate the horticultural sector in Tanzania (Horticultural Development Council of Tanzania, 2010) and as such may constitute the major source of supply in the area. Most of these producers are organized in groups which serve as the main platform for interactions and the contract engagements between the exporters and the supplying producers.

However, behind the labels “exported produce” and “exporters”, one can find different finished shapes of the produce as well as different processing schemes and modalities of participation in ESC. A major distinction to be stressed between the different exporters relate to the processing of the produce. While three of the above-mentioned exporters process the produce on-site and ship it directly to the destination countries in a cold-packed form, the other exporter sends the produce to Kenya to be processed there mostly into cans and jars before being shipped to its final destination. For the remainder of this paper, we will refer to the former type of exporters and supply chains as high-value vegetable export supply chains (HVESC) and the second one as regular vegetable export supply chains (RESC), respectively.

Data collection and survey

The data for this study was collected between July and September 2015 in the abovementioned districts of Arumeru and Arusha in the region of Arusha of Tanzania. We selected these two districts as all the four exporters active in the area during the data collection period were located and sourced at least a substantial part of their supply from small producers in these two districts. We first conducted key informant interviews with staff from the four exporters, who provided us with the contact details of the producer groups supplying them at the time. We thus identified and purposively selected nine villages where these producer groups were located. These villages were located in four divisions, namely Kingo’ri, Mbuguni, Moshono and Poli. We obtained from these groups the list of their members supplying French beans and snap peas to the exporters. In parallel, we obtained from the local village authorities the list of vegetable producers in the same nine villages supplying the traditional markets (TM) only.

Based on these two lists, we proceeded with a stratified random sampling approach and distinguished between the producers supplying French beans and snap peas to the exporters from those selling their vegetables in the traditional markets only. We selected in total 349 producers, among which 159 were participating in the export supply chains and 190 were supplying the traditional markets. In order to consistently assess the actual effect of small producer participation in ESC, we only consider in this analysis the farmers who actually sold some of their vegetable produce and drawn income from the exporters or the local traditional markets in recall period prior to our data collection. This leaves us with a final sample of 320 observations/producers[3], among which 136 producers participate in the ESC and 184 supply the TM exclusively.

More detailed information regarding the distribution of these producers in the different types of ESC, *i.e.* high-value vs. regular export supply chains, can be found in table 1 below. Among these 136 export producers, 74 supplied the HVESC while 62 supplied the RESC. None of the producers supplying the HVESC were located in the Kingo'ri division, which could be consistent with evidence from the literature regarding the role played by agro-ecologic conditions and infrastructures in the choice of an area for procurement by the exporters (Barrett et al., 2012). Three of these producers supplied both types of ESC during the same period and will be considered as HVESC suppliers for this analysis as we assume that the effects of participation in the latter would overcome those of participation in the RESC.

[Table 1 about here]

We used a structured questionnaire to interview these producers and elicited data on their farm and household socio-characteristics as well as their vegetable and non-vegetable production and marketing, including the contract farming arrangements for participating producers.

Characteristics of the contract farming arrangements and transactions

Most of the contracts are signed between the different exporters and the producer organizations supplying the crop produce to them. All the exporters provide at least some inputs (seeds or fertilizers) and ensure the transportation of the produce from the village produce collection center to their processing facilities. However, reflecting on the key informant interviews performed in our research areas with the different exporters and the producers supplying them, the contract arrangements offered by the former to the latter differ from an exporter to the other as well as from the HVESC to the RESC type of exporter. To assess in more details these differences and similar to Bellemare (2012), table 2 displays detailed information on the production and marketing arrangements for producers participating in both types of ESC, using as a basis the numerous transactions through which these producers cultivated and sold French beans and snap

[3] We also had to remove two observations with missing values or non-reasonable values for important variables.

peas for the two types of exporters throughout the survey recall period. These represent a total amount of 203 transactions of vegetables with the exporters, of which 131 in the HVESC and 72 in the RESC. An important aspect to consider is the slightly higher diversification of the high-value exporters in terms of the types of vegetables outsourced, considering that 54 percent of the transactions were on French beans while 46 percent were for snap peas. On the other hand, the regular exporter focuses its activities on French beans only for the time being.

Interestingly, producers participating in the RESC receive more inputs from the exporter, in particular fertilizer, with respect to their counterparts supplying the HVESC. They also receive more monthly visits by the extension officers. This could be linked to the fact that many of these RESC producers are new entrants and as such may need more technical support from the exporter in order to meet export standards.

Most importantly, the price per kilogram received is twice larger for the produce sold to high-value exporters, amounting to TZS 1,430[4] against TZS 750 for the regular exporter[5], hence reflecting here a major difference between the two types of exporters and supply chains. All transactions in the RESC obey to a fixed price policy while some of the transactions with the high-value supply chains are subject to a floating price.

[Table 2 about here]

Household socioeconomic and farm characteristics

Descriptive information on the farm and household characteristics of the sample households can be found in table 3. While the these groups of producers do not differ much in terms of their household characteristics, the producers participating in the ESC are different from the exporters supplying the TM with respect to their access to socio-economic amenities. For instance, they have a higher access to electricity but lower access to piped water and live further away from tarmac roads. They also have a higher access to credit, which could also be facilitated by their participation in ESC as part of the services provided by the exporters or the producer organizations through which they participate in these markets. They also receive more services from non-governmental organizations (NGOs). With respect to their farm characteristics, producers in the ESC allocate a higher share of their farm land to vegetable production, which could stress a potential specialization of ESC producers in vegetable production, a situation

[4] At the time of the survey, the average quarterly exchange rate was USD 1 = TZS 2,088.82.
[5] French beans were bought by the HVESC at a price of TZS 1,100 per kilogramme (average over 70 transactions) while the snap peas were bought at a price of TZS 1,834 per kilogramme (average over 59 transactions). While these prices would lead us to assume that supplying snap peas might affect to a higher extent household per capita income, prices for both crops remain higher than the prices for the French beans supplied to the RESC.

similar than the one found by Rao and Qaim (2011) for producers supplying the supermarkets in Kenya.

[Table 3 about here]

The two groups of producers participating in the ESC also present differences between each other (columns 4 and 5 of table 3). In terms of household and socio-economic characteristics, producers in the HVESC have a higher access to electricity and mobile phone ownership, which could be a sign of higher welfare level. With respect to their farm characteristics, producers supplying the RESC have larger farms but are less specialized in vegetable cultivation than their counterparts in the HVESC. The farms of producers supplying the HVESC are located at a higher altitude than those of producers supplying the TM and RESC, the latter being also located at a lower altitude than the former.

Table 4 provides information on different poverty indicators for the different household groups in our sample. Overall, producers in the ESC have higher levels of household income and per capital income (although the difference is statistically significant for the former only). We also computed the poverty headcount ratio and gap for our sample, using as reference the official national basic needs poverty line, which amounts to TZS 36,482 per adult per month (The World Bank, 2015). The basic needs poverty rate of our complete sample is 16 percent, which is considerably lower than the national rural basic needs poverty rate of 33 percent in the country (The World Bank, 2015). The producers supplying the ESC are less poor than their counterparts supplying the TM exclusively, with basic needs poverty rates of 10 percent against 21 percent, respectively. The basic needs poverty gap is also larger in the group of producers in TM. With respect to the differences between the producers supplying the HVESC and those in the RVESC, no major statistically significant differences can be found in terms of income as well as basic needs poverty rates.

[Table 4 about here]

3. Econometric approach

Modelling participation in export supply chains

Considering the focus of the paper on the effects of producer participation in vegetable ESC on household income, we follow the approaches used by Rao and Qaim (2011) and Narayanan (2014) with respect to the perspective of supplying modern supply chains as well as the approaches used by Di Falco, Veronesi and Yesuf (2011), Asfaw, Shiferaw, Simtowe and Lipper (2012), Kleemann, Abdulai and Buss (2014) and Chiputwa, Spielman and Qaim (2015), for the decision and effects related to the participation in certification schemes or technology adoption and which follow a similar logic. Based on this literature, the decision from a household/producer *i* to supply a specific export supply chain *j* can be thought as a binary decision modeled as follows:

$$P_{ij}^{*} = \alpha_j Z_i + \varepsilon_{ij} \text{ with } P_{ij} = \begin{cases} 1 \; if \; P_{ij}^{*} > 0 \\ 0 \text{ otherwise} \end{cases} \quad (1)$$

where P_{ij} is a binary variable taking the value of 1 if a producer *i* decides to participate in a type of export supply chain *j* and the value of 0 otherwise, Z_i is a vector of observable variables determining this decision by the producer *i* and ε_{ij} is an error term.

Producers will participate in a specific export supply chain *j* or accept the related supply arrangement based on their subjective perception on the latter and the related expected utility, in particular in comparison with the expected utility from supplying alternative traditional markets *m* (Rao & Qaim, 2011; Barrett et al., 2012; Chiputwa, Spielman, & Qaim, 2015). In other words, the producers would participate in the export supply chain *j* if $U_{ij} > U_{im}$ (Rao & Qaim, 2011; Chiputwa, Spielman, & Qaim, 2015). Considering the evidence from the literature, the likelihood of a producer's decision to participate in the ESC can be influenced by a myriad of factors, related to both farm and socio-economic characteristics of the households, such as the size of the farmland, access to social amenities/infrastructures, membership in producer organizations, social capital of the household head (Hernández, Reardon, & Berdegué, 2007; Roy & Thorat, 2008; Blandon, Henson, & Cranfield, 2009; Neven, Odera, Reardon, & Wang, 2009; Rao & Qaim, 2011; Barrett et al., 2012) as well as the configuration of the participation offered to the producers and their perception of the latter, for instance with regard to their trust *vis-à-vis* the buyer or the risks associated to the transactions (Blandon, Henson, & Cranfield, 2009; Barrett et al., 2012).

Effects of participation in export supply chains on household income

Considering the above and the fact that producers will perceive and expect participation in modern supply chains to increase their welfare (Minten, Randrianarison, & Swinnen, 2009; Rao & Qaim, 2011; Barrett et al., 2012), as well as the evidence on its direct effect on agricultural profits (Roy & Thorat, 2008; Narayanan, 2014) and household income (Maertens & Swinnen, 2009; Miyata, Minot, & Hu, 2009; Rao & Qaim, 2011; Bellemare, 2012; Andersson, Chege, Rao, & Qaim, 2015), we can model the effects of participation in an export supply chain *j* on household per capita income as follows (Rao & Qaim, 2011; Bellemare, 2012) :

$$Y_{ij} = \beta P_{ij} + \gamma X_i + \mu_{ij} \quad (2)$$

where Y_{ij} is the household per capita, P_{ij} is a binary variable representing the participation of a producer i in an export supply chain j, X_i is a vector of observable variables and μ_{ij} is an error term.

Estimation of the effects of participation in ESC with an Ordinary Least Square (OLS) approach based on this model may lead to biased results due to a potential self-selection into these supply chains by the producers and unobservable characteristics that can affect both their income levels and decision to participate in these supply chains, leading to a situation of potential endogeneity (Maertens & Swinnen, 2009; Rao & Qaim, 2011; Barrett et al., 2012; Bellemare, 2012; Rao & Qaim, 2013). To address these specific econometric issues, literature in this specific research stream has successfully used endogenous switching regression models (Rao & Qaim, 2011; Kleemann, Abdulai, & Buss, 2014; Narayanan, 2014), which we also apply in this paper.

An endogenous switching regression model

Our methodological approach is based on Maddala (1983; 1986) as well as Lokshin and Sajaia (2004). We also carefully follow and get inspirations from the empirical applications of Di Falco, Veronesi and Yesuf (2011), Rao and Qaim (2011), Asfaw, Shiferaw, Simtowe and Lipper (2012), Kleemann, Abdulai and Buss (2014) and Narayanan (2014).

Following the abovementioned literature and framework for participation in ESC, household per capita income can be modeled for two regimes, namely for producers participating in a given type of ESC on the one hand, and on the other hand for producers not participating in the latter. This model can be presented as follows (Maddala, 1983; Maddala, 1986; Di Falco, Veronesi, & Yesuf, 2011; Rao & Qaim, 2011; Asfaw, Shiferaw, Simtowe, & Lipper, 2012; Kleemann, Abdulai, & Buss, 2014):

$$P_{ij}^{*} = \alpha_j Z_i + \varepsilon_{ij} \quad (3)$$

$$\text{Regime 1: } Y_{1i} = \gamma_1 X_{1i} + \mu_{1i} \text{ if } P_{ij}=1 \quad (4)$$

$$\text{Regime 2: } Y_{2i} = \gamma_2 X_{2i} + \mu_{2i} \text{ if } P_{ij}=0 \quad (5)$$

Where Y_{1i} and Y_{2i} are the household per capita income in the two regimes, X_{1i} and X_{2i} are the vectors of observable variables determining the household per capita income in each regime while the vector Z_i includes the observable variables determining the selection into a specific regime, in this case the participation in a given ESC.

Following Maddala (1983; 1986) and Lokshin and Sajaia (2004), the residuals μ_{1i}, μ_{2i} and ε_i are normally distributed, with a mean 0 and covariance matrix Σ defined as follows:

$$\Sigma=\begin{bmatrix} \sigma_\varepsilon^2 & \sigma_{1\varepsilon} & \sigma_{2\varepsilon} \\ \sigma_{1\varepsilon} & \sigma_1^2 & . \\ \sigma_{2\varepsilon} & . & \sigma_2^2 \end{bmatrix} \quad (6)$$

Where σ_ε^2 is the variance of the error term from the selection equation and is equal to one (Maddala, 1983), while σ_1^2 and σ_2^2 are the variances of the income equations. σ_{12}, $\sigma_{\varepsilon 1}$ and $\sigma_{\varepsilon 2}$ are the covariance between μ_{1i} and μ_{2i}, μ_{1i} and ε_I, and μ_{2i} and ε_i, respectively. σ_{12} is not defined since Y_{1i} and Y_{2i} are never observed simultaneously (Maddala, 1983; Lokshin & Sajaia, 2004).

The correlations between μ_{1i} and ε_i as well as between μ_{2i} and ε_i can be used to test for potential endogeneity and self-selection: following Maddala (1983), if $\sigma_{\varepsilon 1}=\sigma_{\varepsilon 2}=0$, then were are facing a switching regression model with exogenous switching; if one of these correlations is statistically different from zero, then we have a switching regression model with endogenous switching, in particular influenced by the role of unobservable factors (Rao & Qaim, 2011; Kleemann, Abdulai, & Buss, 2014). Concretely, the expected values of μ_{1i},and μ_{2i} conditioning on the sample selection can be modeled as follows, respectively (Maddala, 1983; Di Falco, Veronesi, & Yesuf, 2011; Rao & Qaim, 2011; Asfaw, Shiferaw, Simtowe, & Lipper, 2012) :

$$E\ [\mu_{1i}|P_i = 1] = \sigma_{1\epsilon}\frac{\phi(\alpha Z_i)}{\Phi(\alpha Z_i)} = \sigma_{1\epsilon}\lambda_{1i} \quad (7)$$

and

$$E\ [\mu_{2i}|P_i = 0] = -\sigma_{2\epsilon}\frac{\phi(\alpha Z_i)}{1-\Phi(\alpha Z_i)} = \sigma_{2\epsilon}\lambda_{2i} \quad (8)$$

where $\phi(.)$ is the standard normal probability density function (PDF) and $\Phi(.)$ is the standard normal cumulative density function (CDF). λ_{1i} and λ_{2i} are thus the Invert Mills Ratio at αZ_i (Lokshin & Sajaia, 2004; Greene, 2008; Rao & Qaim, 2011).

Endogenous switching regression models can be estimated with the Full Information Maximum Likelihood (FIML) method, which is the most efficient method, and for which the log-likelihood function can be expressed as follows (Lokshin & Sajaia, 2004; Di Falco, Veronesi, & Yesuf, 2011; Asfaw, Shiferaw, Simtowe, & Lipper, 2012):

$$Ln\ L_i = \sum_{i=1}^{N} P_i\left[\ln \emptyset\left(\frac{\mu_{1i}}{\sigma_1}\right) - ln\sigma_1 + ln\Phi(\partial_{1i})\right] + (1-P_i)\left[\ln \emptyset\left(\frac{\mu_{2i}}{\sigma_2}\right) - ln\sigma_2 + \ln\left(1-\Phi(\partial_{2i})\right)\right] \quad (9)$$

where $\partial_{ki} = \frac{(\alpha Z_i + \rho_j \mu_{ji}/\sigma_j)}{\sqrt{1-\rho_j^2}}$, j=1,2, and ρ_j being the correlation coefficient between the residuals of the selection equation and those of the income equations for the two regimes (Di Falco, Veronesi, & Yesuf, 2011; Asfaw, Shiferaw, Simtowe, & Lipper, 2012).

With respect to the configuration and pairwise comparisons of the regimes or treatments applied in our paper, we mainly follow the approach used by Narayanan (2014). Based on the latter, we thus apply the endogenous switching regression model to different sub-samples, with a disaggregation in terms of treatment group/regime and related counterfactual group/regime, defined as follows: (1) ESC suppliers vs. TM suppliers; (2) HVESC suppliers vs. TM suppliers; (3) RESC suppliers vs. TM suppliers; and (4) HVESC suppliers vs. all the other producers (RESC and TM suppliers). This will allow us to assess the effects of overall participation in ESC as well as well as compare the effects of the participation in different types of ESC, first with respect to the producers supplying the TM exclusively and second with each other.

For the identification of the model, we use a combination of two instruments, one at the village level and one at the individual level. With respect to the former, we follow Maertens and Verhofstadt (2013) who instrumented female wage employment in the export agro-industry with the share of households in the village with females working in the export agro-industry. We thus use in each village the share of households in our sample participating in the ESC, HVESC and RESC, depending on the type of export supply chain considered. We consider that this instrument would reflect the intensity of each type of exporters' supply activity in a village, as well as the suitability of the given area for contracting producers (Barrett et al., 2012). If this is the case it would then be correlated with producers' probability to supply these exporters. As an individual-level instrument, we use the number of neighbors (out of the five closest in our sample) who are aware of or informed about the ESC. In this respect, we find inspiration in the procedure used by Hansen and Trifković (2014) who instrumented the adoption of food standards with the individual producers' knowledge of these standards as well as a binary variable taking the value of one if at least one producer in the village applies food standards. We were also inspired by Andersson et al. (2015) who used the number of neighbors involved in the supermarket supply chains to instrument the participation in the latter. This is consistent with the evidence from the literature, showing that neighborhood effects can play a role in a household's decision to participate in a given market (Holloway & Lapar, 2007).

We thus assume that producers with more neighbors informed about the ESC[6] would, in part due to social network effects, have a higher exposure to the latter and increase their likelihood to participate in them. We also assume that both these instruments do not affect household income directly and checked their validity by following the approach used by Di Falco et al. (2011): first, as can be seen in table A1 in the Appendix, these instruments affect positively a producers' likelihood to participate in the different ESC, in all the pairwise comparisons implemented[7]. Furthermore, we assessed whether these instruments directly affect the household per capita income of non-participating households (*i.e.* the households in regime 2 in each pairwise comparison), which would lead us to reject their validity. As can be seen in table A2 in Appendix, none of these instruments affect directly the household per capita income levels of non-participating producers and we thus fail to reject their validity[8].

Conditional expectations of household income and treatment effects

Following Di Falco, Veronesi and Yesuf (2011) and Asfaw, Shiferaw, Simtowe and Lipper (2012), we can use the estimates and predictions from the endogenous switching regression models to compare the expected levels of household per capita income for producers participating in the different vegetable ESC and those in the respective counterfactual group. Furthermore, this model also allows for computation of the expected household per capita income for participating producers in the hypothetical case where they had not participated as well as for the non-participating producers in the hypothetical case where they had participated (Di Falco, Veronesi, & Yesuf, 2011). Concretely, the expectations in each of these cases could be presented as follows (Lokshin & Sajaia, 2004; Di Falco, Veronesi, & Yesuf, 2011; Asfaw, Shiferaw, Simtowe, & Lipper, 2012):

$$E(Y_{1i}|P_i = 1) = \gamma_1 X_{1i} + \sigma_{1\epsilon}\lambda_{1i} \quad (10a)$$

$$E(Y_{2i}|P_i = 0) = \gamma_2 X_{2i} + \sigma_{2\epsilon}\lambda_{2i} \quad (10b)$$

$$E(Y_{2i}|P_i = 1) = \gamma_2 X_{1i} + \sigma_{2\epsilon}\lambda_{1i} \quad (10c)$$

$$E(Y_{1i}|P_i = 0) = \gamma_1 X_{2i} + \sigma_{1\epsilon}\lambda_{2i} \quad (10d)$$

Following Heckman, Tobias and Vytlacil (2001), Di Falco, Veronesi and Yesuf (2011) and Asfaw, Shiferaw, Simtowe and Lipper (2012), the Treatment Effect on the Treated (TT), which

[6] In our sample, a large number of producers are informed/aware of the export markets but do not participate in the latter, so there should be no distributional concern regarding this variable with respect to the participation in ESC (Hansen & Trifković, 2014).
[7] This is also confirmed by the Wald Tests performed on the combined statistical significance on the coefficients of the instruments in all the models estimated (χ^2=49.030; χ^2=40.660;χ^2=36.810;χ^2=37.090, respectively and significant at the one percent level in all cases). Furthermore, we could reject at the five percent level the hypothesis that these instruments were weak following the critical values for the weak instrument test based on Limited Information Maximum Likelihood (LIML) estimator size as provided in Stock & Yogo, 2005.
[8] The F-Statistic on these instruments also confirms that they have no effect on non-supplying producers' household per capita income.

represents the effect of participation in the different ESC for producers who have actually supplied the exporters, can be computed from the difference between the expectations (*10a)* and (*10c)*:

$$TT = E(Y_{1i}|P_i = 1) - E(Y_{2i}|P_i = 1) = X_{1i}(\gamma_1 - \gamma_2) + (\sigma_{1\epsilon} - \sigma_{2\epsilon})\, \lambda_{1i} \qquad (11)$$

The Treatment Effect on the Untreated (TU), which corresponds to the effect of participation in the different ESC on non-participating producers, can then be calculated from the difference between the expectations (*10d)* and (*10b)* as follows:

$$TU = E(Y_{1i}|P_i = 0) - E(Y_{2i}|P_i = 0) = (X_{1i} - X_{2i})\gamma_{1i} + \sigma_{1\epsilon}(\lambda_{1i} - \lambda_{2i}) \qquad (12)$$

Finally, following Carter and Milon (2005), Di Falco, Veronesi and Yesuf (2011) and Asfaw, Shiferaw, Simtowe and Lipper (2012), we consider the heterogeneity effects to examine the differences due to the unobserved factors (Di Falco, Veronesi, & Yesuf, 2011). First, the "effect of base heterogeneity" for producers who decide to supply ESC can be expressed as (Carter & Milon, 2005; Di Falco, Veronesi, & Yesuf, 2011; Asfaw, Shiferaw, Simtowe, & Lipper, 2012) :

$$BH_1 = E(Y_{1i}|P_i = 1) - E(Y_{1i}|P_i = 0) = (X_{1i} - X_{2i})\gamma_{1i} + \sigma_{1\epsilon}(\lambda_{1i} - \lambda_{2i}) \qquad (13)$$

Similarly, the "effect of base heterogeneity" for producers deciding not to supply ESC can be expressed as:

$$BH_2 = E(Y_{2i}|P_i = 1) - E(Y_{2i}|P_i = 0) = (X_{1i} - X_{2i})\gamma_{2i} + \sigma_{2\epsilon}(\lambda_{1i} - \lambda_{2i}) \qquad (14)$$

The difference between the TT and the TU provides the "transitional heterogeneity effect" (TH), which allows assessing whether the effect of supplying ESC is larger or smaller for producers who actually supplied the ESC, with respect to the effect on non-supplying producers in the counterfactual case where they would have supplied the ESC (Carter & Milon, 2005; Di Falco, Veronesi, & Yesuf, 2011; Asfaw, Shiferaw, Simtowe, & Lipper, 2012).

4. Results of the econometric analysis

Tables 5 to 8 present the results of the endogenous switching regression models estimated with the FIML method[9] and applied to the different abovementioned pairwise comparisons, namely (1) ESC suppliers vs. TM suppliers; (2) HVESC suppliers vs. TM suppliers; (3) RESC suppliers vs. TM suppliers; and (4) HVESC suppliers vs. all the other producers (RESC and TM suppliers)[10],

[9] We used the Stata command *movestay* (Lokshin and Sajaia, 2004) to estimate these endogenous switching regression models with the FIML estimator.
[10] Since no HVESC suppliers were found in the Kingo'ri division, we replicated as a robustness check the estimations with the sub-samples (2) HVESC suppliers vs. TM suppliers as well as (4) HVESC suppliers vs. all the other producers (RESC and TM suppliers) without all the observations from this division. The results were not found to change drastically and we thus proceeded with the estimations with all observations from the respective sub-samples.

respectively. In each of these tables, the first column shows the estimated coefficients for the selection equation into a specific type of export supply chain/regime while the second and third columns show the estimated coefficients for the income regressions for non-participating and participating producers respectively[11].

Determinants of participation in the export supply chains

As can be seen in the first column of table 5, both household demographic characteristics and access to socio-economic infrastructures affect a producer's likelihood to participate in ESC. With respect to the former, larger households are more likely to enter ESC, which could be linked to the larger labour endowments from which these households can benefit. Furthermore, access to credit[12] affects positively the probability to supply vegetable exporters. This may be related to the important initial capital investments needed to participate in modern supply chains (Rao & Qaim, 2011; Andersson, Chege, Rao, & Qaim, 2015). On the other hand, membership in non-producer groups affects negatively the probability to enter these markets, which could be due to the fact that producer organizations are actually a major factor of participation in ESC in this research context, thus counterbalancing the effect of social capital *via* other groups. Access to electricity also has a positive effect on participation, as exporters may tend to access improved social amenities and infrastructural development when prospecting for areas where to concentrate their supply from small producers (Barrett et al., 2012). Finally, access to NGO services also tends to increase small producer participation in ESC. This is consistent with our qualitative assessment of the research context as many producers in the latter have been connected to exporters *via* this kind of institutional projects and actors. This is also consistent with previous empirical evidence from the literature (Rao & Qaim, 2011; Barrett et al., 2012; Otsuka, Nakano, & Takahashi, 2016).

[Table 5 about here]

We can also draw insights on the determinants of participation in both HVESC and RESC from the coefficients in the first column of tables 6 to 8. While various factors bear similar effects for both types of export supply chains (*e.g.* access to electricity and NGO services), some determinants vary from a type of ESC to the other. Indeed, access to credit positively influences participation in HVESC (tables 6 and 7) but does not have any statistically significant effect on the participation in the RESC (table 8). This could underline higher investment and capital requirements for the former in comparison to the latter. Similarly, mobile phone ownership

[11] In all these equations, the dependent variable is the log of household per capita income in thousands TZS.
[12] Since many producers were obtaining credit from the producer organizations through which they participate in export markets, we considered here all other sources of credit exclusively, in order to properly disentangle the effects of this variable.

increases the probability of supplying high-value exporters (table 6), which could reflect that more innovative, business-oriented or better off producers tend to supply these exporters.

[Tables 6 to 8 about here]

The estimated coefficient for the correlation terms $\rho_{1\varepsilon}$ and $\rho_{2\varepsilon}$ are not statistically significant in any of the models (lower rows of tables 5 to 8). We thus cannot reject the hypothesis of absence of sample selection bias in this analysis and assume that unobservable factors would not play a role in the behavior of the producers in our sample, should the export market opportunities not exist (Rao & Qaim, 2011).

Determinants of household per capita income

The estimated coefficients from the regime equations in the ESC vs. TM pairwise comparison (columns 2 and 3 of table 5) show that some heterogeneity and differences between the two groups of producers exist with respect to their income determinants. Indeed, TM suppliers' household per capita income increases with higher land and farm size. This could be linked to the fact that the income levels for these producers rely more on the quantity of crop cultivated and marketed. On the other hand, the income level for producers in the ESC regime is not affected by their farm size, pointing towards the fact that they would focus more on productivity and quality of the produce (Rao & Qaim, 2011). Similarly, the fact that livestock ownership increases income for producers in the TM regime could be the sign that the latter is used as a diversification strategy and income complement for these specific producers, in comparison to their counterparts in the ESC regime, who may thus be more specialized in vegetable production (Rao & Qaim, 2011).

In the HVESC vs. TM pairwise comparison (columns 2 and 3 of table 6), a similar income diversification strategy can be assumed from the fact that off-farm employment influences non-participating producers' income but not for those supplying the HVESC. Thus, TM suppliers rely to a larger extent on off-farm income, which is consistent with the results from the descriptive analysis (table 3) and can make sense considering that their revenues from vegetable and other cash crops may be lower. A higher magnitude of the coefficient on farm size as well as a significant coefficient on livestock units are also noted for TM producers in this comparison. Overall, similar differences are also noted when comparing HVESC export producers with the pooled sample gathering RESC and TM producers (columns 2 and 3 of table 7).

In the RESC vs. TM pairwise comparison (columns 2 and 3 of table 8), human capital *via* the household head education seems to have a larger influence on the regular export producers' household income, as well as access to off-farm employment, credit and extension services.

There thus seems to be a non-negligible heterogeneity with respect to these two groups' income determinants, as producers in the RESC may rely more extensively on institutional and non-farm sources of income.

Treatment effects of participation in export supply chains

Table 9 shows the treatment effects of participation in vegetable export supply chains on both the treated and the untreated as well as the heterogeneity effects, for all the aforementioned pairwise comparisons. In the ESC vs. TM comparison, participation in the ESC has a positive effect on participating producers' household per capita income since it increases it by 77 percent. Non-participating households would also be better off, had they participated in these ESC as we find a positive treatment effect on the untreated.

[Table 9 about here]

This effect is mostly driven by participation in HVESC, which – with both comparison groups used – has positive income effects for participating producers (income increases of 99 and 45 percent, respectively). It would also have stronger effects for non-participating producers, with effects on the untreated corresponding to an income increase of 127 and 99 percent respectively. There would thus be a larger room for income effect for producers supplying the TM, if these were to participate in the HVESC. On the other hand, participation in the RESC has a negative effect on household per capita income for participating producers, while it would benefit TM suppliers in the counterfactual case where they would have participated in the latter, although in a reduced magnitude (38 percent increase in household per capita income) compared to the effect on the untreated conveyed by HVESC. This shows that the producers supplying the RESC are not better off doing so and would possibly benefit more from supplying TM. The diverging nature of the effects of the different types of ESC stresses the importance of disaggregating the analysis and take into account the intra-group specificities and differences.

Furthermore, in both the comparison between ESC suppliers vs. TM suppliers and the comparison between HVESC suppliers vs. TM suppliers, the negative signs of the base heterogeneity effects show that, had they been in a similar situation and both groups of producers either participating in ESC or not, the TM suppliers would have higher per capita income levels and be better off than those supplying the (HV)ESC. This also stresses the potential development and importance of participating in the export supply chains for HVESC suppliers, who would have, without the later, possibly not been better off than the TM suppliers. On the contrary, in the RESC vs. TM suppliers comparison, the positive sign of the base heterogeneity effects in the non-export context shows that producers supplying the RESC would have, in the counterfactual case where they would have kept supplying the TM, a higher household per capita income than TM suppliers. This is consistent with the aforementioned negative TT effect for the RESC suppliers and the fact that they would be better off supplying the TM. One can thus assume that these producers were or would be among the better off and wealthier vegetable producers supplying the TM.

Finally, the TH effects have negative signs and are statistically significant for the comparisons HVESC suppliers vs. All other producers as well as RESC suppliers vs. TM suppliers. This shows that the effect of supplying these types of exporters on household per capita income would be larger for TM suppliers in the counterfactual case where they would have supplied these supply chains than for the producers who actually did so.

As mentioned in the introduction, we also follow Rao and Qaim (2011), Asfaw, Shiferaw, Simtowe and Lipper (2012) and Hansen and Trifković (2014) and check for potential heterogeneous effects among producers based on their farm size and income level[13]. These results are showed in tables 10 and 11, respectively. Regarding the disaggregation by farm size, the results from the overall comparison ESC vs. TM suppliers suggest that overall participation in ESC is more beneficial to producers with lower farm acreage, which is consistent with the results from Rao and Qaim (2011). However, participation in HVESC chains seems to have a larger income effect for larger producers, regardless of the comparison group used. On the other hand, participation in the RESC affects positively the income of the producers belonging to the third farm size quartile only, although the magnitude of the effect is smaller.

[Tables 10 and 11 about here]

Likewise, producers from the highest income quartiles benefit substantially from participating in the HVESC, in comparison to poorer producers – although it is noteworthy that producers in the lowest income quartile benefit significantly from participating in HVESC when compared to producers supplying the TM (Table 11). Interestingly, participation in the RESC benefits only producers belonging to the second income quartile, which potentially signals an effect targeting specifically some of the poorer farmers for this supply chain.

5. Discussion of the results

A gross margin analysis

Overall, participation in ESC seems to have a positive effect on producers' household per capita income, in particular participation in HVESC. On the contrary, participation in RESC seems to have an overall negative effect on income for participating producers, except for some of the

[13] In this specific part of the analysis, we follow Asfaw, Shiferaw, Simtowe, & Lipper2012 and consider the Average Treatment Effects (ATE) only.

poorer households. To further interpret and understand these results beyond the argument of the lower price received producers supplying the RESC (Table 2), we performed a cost and gross margin analysis for the producers in our sample. This analysis is displayed in table 12 and was performed at the plot level[14].

[Table 12 about here]

First of all, the gross revenue and margin per acre (0.40 ha) are significantly larger for HVESC producers in comparison to RESC producers. While the producers supplying the RESC receive a much lower price (gross revenue), their production costs are relatively similar to their counterparts in the HVESC, in particular in terms of hired labour costs and seeds costs, hence lowering their gross margin.

These high production costs also seem to play a role in the comparison with TM suppliers, since producers in the RESC spend almost twice more than the latter in seeds and hired labour inputs. Yet, this production intensity of French beans in the RESC does not translate into higher gross revenue and margin than the ones received by producers in TM. Actually, some other vegetables (*e.g.* tomato, nightshade, cucumber, sweet pepper) can be sold at a higher per kilogram price and for higher gross revenues per acre, as can be seen in table 13. Producers marketing these more profitable vegetables are thus in theory better off supplying the TM than if they would participate in the RESC.

[Table 13 about here]

These gross margins can also be helpful in further interpreting some of the heterogeneous effects presented in tables 10 and 11. First, hired labour is the most costly input for producers supplying the ESC, which is consistent with the high labour intensity of these lines of production (Weinberger & Lumpkin, 2007; Neven, Odera, Reardon, & Wang, 2009; Rao & Qaim, 2013). Small producers in sub-Saharan Africa usually have a lower labour productivity than larger-scale producers (Wiggins, 2009) and it can thus be expected that larger producers have higher returns on labour and thus receive greater benefits from supplying the HVESC. On the other hand, participation in HVESC is more beneficial to richer producers in our computed quantile distribution, as these may be more able than poorer producers to absorb these high upstream costs and generate higher returns to investment (Hansen & Trifković, 2014). There may also be a process of wealth accumulation (Chiputwa, Spielman, & Qaim, 2015) and productivity effects (Minten, Randrianarison, & Swinnen, 2007; Rao, Brümmer, & Qaim, 2012) taking place over

[14] For this part of the analysis, we use the data for one plot per farm, in which the most commercialized vegetable crop was produced during the reference survey period. For the non-export producers, we performed this gross margin analysis with the most commercialized vegetable crop produced for TM.

time and which may also participate in the higher benefit perceived by better off producers. Furthermore, we saw that poorer producers could benefit from participating in the RESC. We may consider that these specific producers' main or "best alternative" (Narayanan, 2014) to supplying these RESC could be to cultivate and market some of the vegetables from the table 13 sold in the TM at a lower price and potentially less profitable than the cultivation of French beans for the RESC. They would thus be better off in supplying produce to the RESC rather than staying in the TM.

A Gini-coefficient decomposition analysis

To complement these results, we performed an analysis of the Gini-coefficient decomposition by income source for the three groups of producers in our sample, following the approach used by Lerman and Yitzhaki (1985). According to the latter, the Gini coefficient of household per capita income inequality can be represented as follows (Lerman & Yitzhaki, 1985; López-Feldman, 2006):

$$G = \sum_{k=1}^{K} S_k G_k R_k \tag{15}$$

where S_k represents the share of income source k in total household per capita income, G_k is the Source Gini corresponding to the income source k and R_k is the Gini correlation of income source k with the distribution of total household per capita income.

Following this, the effect of a percentage change e in an income source k on the total household per capita income Gini coefficient and inequality can thus be expressed as (Lerman & Yitzhaki, 1985; López-Feldman, 2006):

$$\frac{\partial G/\partial_e}{\partial G} = \frac{S_k G_k R_k}{G} - S_k \tag{16}$$

Table 14 displays the results of the household per capita income Gini-coefficient decomposition by income source as well as the marginal effects on inequality for each of these income sources[15]. For brevity, we only focus here on the contribution of the income from vegetables sold to the ESC to total household per capita income inequality and related marginal effects. The results of the Gini-coefficient decomposition analysis seem to be in line with the aforementioned treatment effects disaggregated by income quartile. In particular, we observe that the income derived from the participation in the HVESC contributes to 43.7 percent of the inequality in terms of household per capita income. Also, a ten-percent increase in the income from supplying the HVESC would result in a 0.43 percent increase in the Gini coefficient on total household per capita income,

[15] We used the Stata command *descogini* (López-Feldman, 2006) to perform this analysis and generate the related marginal effects.

which would translate into an increase in inequality. This is consistent with the fact that larger and richer producers would benefit the most from supplying the HVESC, which would thus increase inequality between the HVESC suppliers, albeit at a rather low magnitude.

On the other hand, the income derived from supplying the RESC contributes to a lesser extent to household per capita inequality (about 23.2 percent) and has a negative effect on the Gini coefficient as a ten-percent increase in this income source results in a 0.44 percent decrease in the Gini coefficient, hence reducing the overall inequality in this specific sub-group. Although these marginal effects remain low in terms of their absolute magnitude, they remain non-negligible with respect to the other income sources and their computed marginal effects on the overall inequality in terms of household per capita income.

[Table 14 about here]

Study limitations

Besides the usual caveats of cross-section analysis, some limitations of this paper should also be acknowledged at this point. First, our sample may lack variation in terms of exporters, in particular for the RESC, consisting in this case of only one exporter. This could be seen as a drawback and it could be interesting to include more exporters in this treatment group, which was unfortunately not possible in our case as all the exporters in the research area were already included. Also, at the time of the survey, this exporter had recently started to outsource their supply from this area, including the sampled producers. As some adjustment time might be needed from both parties and a typical learning curve still to develop, this leads us to consider some of these results with caution.

Also, a difficulty in this type of analysis often lies in the disentanglement of the effects between those linked to the cultivation of a new/different crop and those linked to the participation in modern supply chains and their characteristics (Barrett et al., 2012; Narayanan, 2014). This is also the case in this paper as this disentanglement could not be done; although since French beans and snap peas are barely sold and consumed at the local level in Tanzania, we assume that those effects can be assessed together in this context. Furthermore, since we compared the effects of two different types of ESC for almost similar crops, we can assume that this somehow helps in disentangling these effects and interpret them under the supply chain perspective[16].

Finally, as can be seen from table 12, while the difference in terms of gross revenue between the three groups of producers are quite important, the difference in terms of gross margin is less

[16] Although we can assume that part of the effect is also driven by the higher price received for snap peas with comparison to the price received for French beans, even when considering the transactions with the HVESC only.

significant due to the higher inputs costs inherent to production for the producers in the export supply chains. Some of these coefficients and treatment effects on household per capita income may thus seem quite high in comparison to the differences in terms of gross margin. However, they are grossly in line with the literature on the effects of contract farming on farm and household income in developing countries and some of the coefficients and magnitude gathered and presented in the review performed by Otsuka, Nakano and Takahashi (2016).

6. Conclusion

Using an endogenous switching regression model, we analyzed the effects of small producer participation in vegetable export supply chains on household per capita income, and compared the effects of participation in high-value supply chains with those of participation in what we define in this paper as regular supply chains. We find that small producer participation in export supply chains (ESC) has overall a positive effect on household per capita income. We also find that this effect is mostly driven by small producer participation in high-value export supply chains (HVESC) which has a strong effect on their household per capita income, in particular through a higher price received than the average prices received for the main vegetables marketed in the local traditional markets (TM). However, participation in regular export supply chains (RESC) has a negative effect on participating producers' household per capita income, suggesting that such producers would be better off selling vegetable produce in traditional markets. This could be the consequence of the low price they receive in comparison to the high production costs incurred. Yet, the disaggregated average treatment effects show that some of the poorer farmers benefit from the participation in regular export supply chains while richer producers would be the ones benefiting most from a higher effect of high-value export supply chains.

As mentioned in the previous section, our sample only relies on one starting/new exporter for the regular export supply chain; and these results would thus need to be considered cautiously as they strongly depend on the specificities of this research context. It could thus be interesting to further extend this research in a context with a higher number of well-established exporters, so that the analysis would rely on more information and potentially include a higher level of variation for both groups of exporters. The analysis from such a context may thus provide results for which external validity may be easier to assert.

Our results and considerations are still important as they confirm that different situations can be experienced by small producer participating in export supply chains, including depending on the type of exporter they supply. Thus, a variety of realities and welfare effects may lay behind the concept of export supply chains and this paper can provide some insights on which kind of export supply scheme can better affect positively participating producers' welfare. By relating the characteristics of the contract and supply arrangements of the different exporters in our sample (Table 2) with the corresponding welfare effects, these results can also help in better informing and crafting policies on the different requirements and characteristics these export supply schemes should feature to better ensure or increase the probability that small producers benefit from participation in export and modern supply chains.

References

Andersson, C. I.M., Chege, C. G.K., Rao, E. J.O., & Qaim, M. (2015). Following Up on Smallholder Farmers and Supermarkets in Kenya. *American Journal of Agricultural Economics, 97*(4), 1247–1266.

Asfaw, S., Shiferaw, B., Simtowe, F., & Lipper, L. (2012). Impact of modern agricultural technologies on smallholder welfare: Evidence from Tanzania and Ethiopia. *Food Policy, 37*(3), 283–295.

Barrett, C. B., Bachke, M. E., Bellemare, M. F., Michelson, H. C., Narayanan, S., & Walker, T. F. (2012). Smallholder Participation in Contract Farming: Comparative Evidence from Five Countries. *World Development, 40*(4), 715–730.

Bellemare, M. F. (2012). As You Sow, So Shall You Reap: The Welfare Impacts of Contract Farming. *World Development, 40*(7), 1418–1434.

Blandon, J., Henson, S., & Cranfield, J. (2009). Small-scale farmer participation in new agri-food supply chains: Case of the supermarket supply chain for fruit and vegetables in Honduras. *Journal of International Development, 21*(7), 971–984.

Carter, D. W., & Milon, W. J. (2005). Price Knowledge in Household Demand for Utility Services. *Land economics : a quarterly journal of planning, housing & public utilities, 81*(2), 265–283.

Chiputwa, B., Spielman, D. J., & Qaim, M. (2015). Food Standards, Certification, and Poverty among Coffee Farmers in Uganda. *World Development, 66*, 400–412.

Di Falco, S., Veronesi, M., & Yesuf, M. (2011). Does Adaptation to Climate Change Provide Food Security?: A Micro-Perspective from Ethiopia. *American Journal of Agricultural Economics, 93*(3), 829–846.

FAOSTAT (2017). *Food and Agriculture Data,* from http://www.fao.org/faostat/en/#home.

Greene, W. H. (2008). *Econometric analysis* (6th ed.). Upper Saddle River, N.J.: Pearson Prentice Hall.

Hansen, H., & Trifković, N. (2014). Food Standards are Good – For Middle-Class Farmers. *World Development, 56*, 226–242.

Heckman, J., Tobias, J. L., & Vytlacil, E. (2001). Four Parameters of Interest in the Evaluation of Social Programs. *Southern Economic Journal, 68*(2), 210.

Hernández, R., Reardon, T., & Berdegué, J. (2007). Supermarkets, wholesalers, and tomato growers in Guatemala. *Agricultural Economics, 36*(3), 281–290.

Holloway, G., & Lapar, M. L. A. (2007). How Big is Your Neighbourhood? Spatial Implications of Market Participation Among Filipino Smallholders. *Journal of Agricultural Economics, 58*(1), 37–60, from http://onlinelibrary.wiley.com/doi/10.1111/j.1477-9552.2007.00077.x/full.

Horticultural Development Council of Tanzania (2010). *Tanzania Horticultural Development Strategy (2012-2021).* Horticultural Development Council of Tanzania (HODECT).

Jahnke, H. E., Tacher, G., Keil, P., & Rojat, D. (1988). Livestock production in tropical Africa with special reference to the tsetse-afferent zone. In ILCA & ILRAD (Eds.), *Livestock production in tsetse affected areas of Africa. Conference : Proceedings* (pp. 3–21).

Kleemann, L., Abdulai, A., & Buss, M. (2014). Certification and Access to Export Markets: Adoption and Return on Investment of Organic-Certified Pineapple Farming in Ghana. *World Development, 64*, 79–92.

Lerman, R. I., & Yitzhaki, S. (1985). Income Inequality Effects by Income Source: A New Approach and Applications to the United States. *The Review of Economics and Statistics, 67*(1), 151.

Lokshin, M., & Sajaia, Z. (2004). Maximum likelihood estimation of endogenous switching regression models. *The Stata Journal, 4*(3), 282–289, from http://www.stata-journal.com/article.html?article=st0071.

López-Feldman, A. (2006). Decomposing inequality and obtaining marginal effects. *The Stata Journal, 6*(1), 106–111.

Maddala, G. S. (1983). *Limited-dependent and qualitative variables in econometrics. Econometric Society monographs in quantitative economics: Vol. 3.* Cambridge: Cambridge University Press.

Maddala, G. S. (1986). Disequilibrium, self-selection, and switching models. In Z. Griliches & D. (E.)I. Michael (Eds.), *Handbook of Econometrics* (pp. 1633–1688). The Netherlands: Elsevier.

Maertens, M., Minten, B., & Swinnen, J. (2012). Modern food supply chains and development: Evidence from horticulture export sectors in sub-Saharan Africa. *Development Policy Review, 30*(4), 473–497.

Maertens, M., & Swinnen, J. F.M. (2009). Trade, Standards, and Poverty: Evidence from Senegal. *World Development, 37*(1), 161–178.

Maertens, M., & Verhofstadt, E. (2013). Horticultural exports, female wage employment and primary school enrolment: Theory and evidence from Senegal. *Food Policy, 43*, 118–131.

Michelson, H. C. (2013). Small Farmers, NGOs, and a Walmart World: Welfare Effects of Supermarkets Operating in Nicaragua. *American Journal of Agricultural Economics, 95*(3), 628–649.

Michelson, H., Reardon, T., & Perez, F. (2012). Small Farmers and Big Retail: Trade-offs of Supplying Supermarkets in Nicaragua. *World Development, 40*(2), 342–354.

Minten, B., Randrianarison, L., & Swinnen, J. (2007). Spillovers from high-value agriculture for exports on land use in developing countries: Evidence from Madagascar. *Agricultural Economics, 37*(2/3), 265–275.

Minten, B., Randrianarison, L., & Swinnen, J. F.M. (2009). Global Retail Chains and Poor Farmers: Evidence from Madagascar. *World Development, 37*(11), 1728–1741.

Miyata, S., Minot, N., & Hu, D. (2009). Impact of Contract Farming on Income: Linking Small Farmers, Packers, and Supermarkets in China. *World Development, 37*(11), 1781–1790.

Narayanan, S. (2014). Profits from participation in high value agriculture: Evidence of heterogeneous benefits in contract farming schemes in Southern India. *Food Policy, 44*, 142–157.

Neven, D., Odera, M. M., Reardon, T., & Wang, H. (2009). Kenyan Supermarkets, Emerging Middle-Class Horticultural Farmers, and Employment Impacts on the Rural Poor. *World Development, 37*(11), 1802–1811.

Ochieng, D. O., Veettil, P. C., & Qaim, M. (2017). Farmers' preferences for supermarket contracts in Kenya. *Food Policy, 68*, 100–111.

Otsuka, K., Nakano, Y., & Takahashi, K. (2016). Contract Farming in Developed and Developing Countries. *Annual Review of Resource Economics, 8*(1), 353–376.

Rao, E. J. O., Brümmer, B., & Qaim, M. (2012). Farmer Participation in Supermarket Channels, Production Technology, and Efficiency: The Case of Vegetables in Kenya. *American Journal of Agricultural Economics, 94*(4), 891–912.

Rao, E. J.O., & Qaim, M. (2011). Supermarkets, Farm Household Income, and Poverty: Insights from Kenya. *World Development, 39*(5), 784–796.

Rao, E. J.O., & Qaim, M. (2013). Supermarkets and agricultural labor demand in Kenya: A gendered perspective. *Food Policy, 38*, 165–176.

Reardon, T., & Barrett, C. B. (2000). Agroindustrialization, globalization, and international development: An overview of issues, patterns, and determinants. *Agricultural Economics, 23*(3), 195–205.

Roy, D., & Thorat, A. (2008). Success in High Value Horticultural Export Markets for the Small Farmers: The Case of Mahagrapes in India. *World Development*, *36*(10), 1874–1890.

Ruben, R., & Zuniga, G. (2011). How standards compete: Comparative impact of coffee certification schemes in Northern Nicaragua. *Supply Chain Management: An International Journal*, *16*(2), 98–109.

Schipmann, C., & Qaim, M. (2011). Supply chain differentiation, contract agriculture, and farmers' marketing preferences: The case of sweet pepper in Thailand. *Food Policy, 36*(5), 667–677.

Stock, J. H., & Yogo, M. (2005). Testing for Weak Instruments in Linear IV Regression. In D. W. K. Andrews & J. H. Stock (Eds.), *Identification and Inference for Econometric Models* (pp. 80–108). Cambridge: Cambridge University Press.

The World Bank (2015). *Tanzania Mainland Poverty Assessment* (No. AUS6819). Washington, D.C.: The World Bank.

Wang, H. H., Wang, Y., & Delgado, M. S. (2014). The Transition to Modern Agriculture: Contract Farming in Developing Economies. *American Journal of Agricultural Economics, 96*(5), 1257–1271.

Wang, H., Moustier, P., & Loc, N. T. T. (2014). Economic impact of direct marketing and contracts: The case of safe vegetable chains in northern Vietnam. *Food Policy, 47*, 13–23.

Weinberger, K., & Lumpkin, T. A. (2007). Diversification into Horticulture and Poverty Reduction: A Research Agenda. *World Development, 35*(8), 1464–1480.

Wiggins, S. (2009). *Can the smallholder model deliver poverty reduction and food security for a rapidly growing population in Africa?* Rome: Overseas Development Institute.

Tables

Table 1. Distribution of the sample

TOTAL SAMPLE		
320 households		
Export supply chains		**Traditional markets**
136 households		184 households
High-value export supply chains	***Regular export supply chains***	
74 households	62 households	

Table 2. Characteristics of the contract schemes

	All transactions (N=203)		RESC transactions (N=72)		HVESC transactions (N=131)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Crops grown and sold						
French beans	0.699***	0.460	1.000	0.000	0.534	0.501
Snap peas	0.295***	0.457	0.000	0.000	0.458	0.500
Inputs and extension services received						
Seeds (dummy)	0.946***	0.227	1.000	0.000	0.916	0.278
Fertilizers (dummy)	0.517***	0.501	0.972	0.165	0.267	0.444
Pesticides (dummy)	0.029	0.170	0.028	0.165	0.030	0.173
Visits by the extension officer (monthly)	1.733***	1.663	2.121	1.877	1.528	1.506
Transaction						
Quantity supplied (kilograms)	1565.485	2510.013	1499.743	1182.107	1601.618	3003.764
Price received (TZS per kilogram)	1187.336***	496.612	750.000	0.000	1429.552	467.331
Fixed price (dummy)	0.788***	0.410	1.000	0.000	0.672	0.471
Floating price (dummy)	0.211***	0.409	0.000	0.000	0.328	0.471
Timing of payment (weeks after delivery)	3.310***	2.307	2.667	1.592	3.664	2.556
Observations	203					

Notes: RESC: Regular export supply chains; HVESC: High-value export supply chains.
Mean coefficients. S.D.: Standard deviations. *Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level.

Table 3. Socioeconomic and farm characteristics

	Total sample (N=320)		TM suppliers (N=184)		ESC suppliers (N=136)		RESC suppliers (N=62)		HVESC suppliers (N=74)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Household characteristics										
Household size	4.338**	1.425	4.190†	1.438	4.537	1.387	4.532	1.501	4.541	1.295
Household head age (years)	47.187	11.300	47.081	11.465	47.331	11.115	46.581	10.479	47.959	11.654
Household head male (dummy)	0.931	0.253	0.940	0.238	0.919	0.274	0.903	0.298	0.932	0.253
Household head education (years)	7.528	2.190	7.391†	2.048	7.713	2.363	7.500	2.281	7.892	2.430
Farming experience of the household head (years)	22.418	10.956	21.978	11.510	23.015	10.171	22.500	9.149	23.446	10.998
Dependency ratio (in percent)	58.344	58.021	59.891	55.832	56.252	61.004	57.289	75.465	55.383	46.062
Member of a non-producer organization (dummy)	0.181*	0.386	0.212††	0.410	0.140	0.348	0.210	0.410	0.081§§	0.275
Access to credit (dummy)	0.269***	0.444	0.185†††	0.389	0.382	0.488	0.323##	0.471	0.432	0.499
Off-farm employment (dummy)	0.419	0.494	0.380†††	0.487	0.471	0.501	0.403	0.495	0.527	0.503
Share of off-farm income (percent)	17.886	27.894	18.825	29.896	16.614	24.982	16.276	25.940	16.897	24.325
Access to NGO services (dummy)	0.294***	0.456	0.196†††	0.398	0.426	0.496	0.387###	0.491	0.459	0.502
Mobile phone ownership (dummy)	0.830**	0.376	0.786†††	0.411	0.890	0.314	0.839	0.371	0.932§	0.253
Motorbike ownership (dummy)	0.263	0.441	0.228	0.421	0.309	0.464	0.290	0.458	0.324	0.471
Access to piped water (dummy)	0.738***	0.441	0.826†††	0.380	0.618	0.488	0.548###	0.502	0.676	0.471
Access to electricity (dummy)	0.48***	0.500	0.413†††	0.494	0.574	0.496	0.419	0.497	0.703 §§§	0.460
Distance to tarmac road (kilometers)	10.90**	9.781	9.949	10.09	12.195	9.219	13.345##	8.780	11.205	9.530
Distance to public transportation (kilometers)	1.561	2.459	1.611	2.096	1.496	2.881	1.560	2.182	1.442	3.371
Farm characteristics										
Farm size (acres)	2.761	2.602	2.603	2.377	2.974	2.874	3.875###	3.427	2.220§§§	2.048
Share of vegetable area (percent)	44.189***	28.482	37.920 †††	26.458	52.671	29.016	38.617	26.705	64.446§§§	25.549
Access to irrigation (dummy)	0.956	0.205	0.951	0.216	0.963	0.189	0.935	0.248	0.986	0.116
Share of irrigated area (percent)	80.337	34.170	77.664 ††	35.941	83.933	31.402	78.879	35.424	88.167§	27.114
Use of modern irrigation (dummy)	0.056	0.231	0.071†	0.257	0.037	0.189	0.064	0.248	0.013	0.116
Distance to the collection center (kilometers)	1.222	1.061	1.240††	0.848	1.198	1.297	1.526#	1.411	0.919§§§	1.127
Distance to agricultural input market (kilometers)	4.229	6.637	4.270	5.610	4.174	7.825	4.175	7.036	4.174	8.477
Access to extension services (dummy)	0.581**	0.494	0.527 †	0.501	0.654	0.477	0.661#	0.477	0.649	0.481
Livestock ownership (dummy)	0.919	0.274	0.918	0.274	0.919	0.274	0.903	0.298	0.932	0.253
Livestock units [a]	2.485	2.252	2.498	2.348	2.467	2.122	2.790	2.576	2.193	1.609
Altitude (meters)	1242.744	279.602	1256.181††	266.965	1224.630	295.829	1076.774###	189.348	1350.205§§§	312.548
Observations	320									

Notes: [a] The livestock units were calculated using the following weights: cattle =0.70; pigs=0.20; goat, sheep and donkey= 0.1; and poultry=0.01 (Jahnke, Tacher, Keil, & Rojat, 1988).
TM: Traditional markets; ESC: Export supply chains; RESC: Regular export supply chains; HVESC: High-value export supply chains.
Mean coefficients; S.D.: Standard deviations. The statistical significance of the differences between the mean values of the different groups is presented as follows:
*Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level for the differences between ESC suppliers and TM suppliers.
†Significant at the 10 percent level, ††significant at the 5 percent level, †††significant at the 1 percent level for the differences between HVESC suppliers and TM suppliers.
#Significant at the 10 percent level, ##significant at the 5 percent level, ###significant at the 1 percent level for the differences between RESC suppliers and TM suppliers.
§Significant at the 10 percent level, §§significant at the 5 percent level, §§§significant at the 1 percent level for the differences between HVESC suppliers and RESC suppliers.

Table 4. Poverty indicators

	Total sample (N=320)		TM suppliers (N=184)		ESC suppliers (N=136)		RESC suppliers (N=62)		HVESC suppliers (N=74)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Household per capita yearly income (‘000 TZS)	1326.907	1782.611	1190.125††	1742.277	1511.965	1825.914	1293.549	1636.323	1694.961	1963.078
Household yearly income (‘000 TZS)	5203.162**	7034.363	4452.28††	6136.391	6219.052	8004.546	5416.117	7400.177	6891.782	8469.994
Head count index	0.163***	0.369	0.212††	0.410	0.095	0.295	0.113$^{\#}$	0.319	0.081	0.275
Poverty gap	0.057***	0.161	0.077††	0.186	0.030	0.113	0.042	0.139	0.020	0.084
Observations	320									

Notes: TM: Traditional markets; ESC: Export supply chains; RESC: Regular export supply chains; HVESC: High-value export supply chains.
Mean coefficients; S.D.: Standard deviations. The statistical significance of the differences between the mean values of the different groups is presented as follows:
*Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level for the differences between ESC suppliers and TM suppliers.
†Significant at the 10 percent level, ††significant at the 5 percent level, †††significant at the 1 percent level for the differences between HVESC suppliers and TM suppliers.
$^{\#}$Significant at the 10 percent level, $^{\#\#}$significant at the 5 percent level, $^{\#\#\#}$significant at the 1 percent level for the differences between RESC suppliers and TM suppliers.
§Significant at the 10 percent level, §§significant at the 5 percent level, §§§significant at the 1 percent level for the differences between HVESC suppliers and RESC suppliers.

Table 5. FIML Endogenous Switching Regression (ESC suppliers vs. TM suppliers)

			TM suppliers		**ESC suppliers**	
	Participation in ESC		*Log per capita income*		*Log per capita income*	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Household head age	-0.010	0.008	-0.011*	0.007	-0.007	0.006
Household head education	-0.030	0.036	0.099***	0.028	0.101***	0.026
Household head male	-0.880**	0.361	0.088	0.309	0.360	0.273
Household size	0.162**	0.070	-0.240***	0.052	-0.331***	0.066
Dependency ratio	-0.001	0.002	-0.000	0.001	0.001	0.001
Farm size	0.020	0.037	0.153***	0.032	0.041	0.027
Off-farm employment	0.166	0.184	0.319**	0.135	0.480***	0.125
Access to credit	0.578**	0.262	-0.118	0.333	0.213	0.155
Membership in a non-PO organization	-0.997***	0.290	-0.177	0.223	-0.372	0.236
Access to electricity	0.421**	0.187	0.204	0.128	-0.066	0.164
Access to piped water	-0.555**	0.245	0.466**	0.190	0.399**	0.186
Distance to public transportation	-0.005	0.031	0.037	0.024	-0.020	0.025
Distance to the produce collection center	-0.004	0.096	0.057	0.071	0.060	0.066
Access to extension services	0.077	0.198	-0.210	0.168	-0.103	0.149
Access to NGO services	0.873***	0.211	-0.344*	0.189	0.141	0.171
Mobile phone ownership	0.021	0.283	-0.129	0.167	-0.282	0.287
Motorbike ownership	0.090	0.208	0.237	0.151	-0.015	0.151
Livestock units	-0.029	0.043	0.084***	0.030	0.036	0.029
Altitude in meters	-0.001**	0.001	0.000	0.000	-0.001	0.000
Division Kingo´ri [a]	0.309	0.413	-0.221	0.265	-0.349	0.379
Division Mbuguni [a]	-0.984**	0.485	0.443	0.302	0.077	0.373
Division Moshono [a]	0.151	0.307	-0.095	0.232	0.235	0.330
Share of export producers in the village	3.039***	0.771				
Neighbors aware of the export markets	0.409***	0.080				
ln σ_2			-0.225***	0.079		
ln σ_1					-0.356***	0.070
ρ_2			-0.214	0.273		
ρ_1					-0.231	0.237
Constant	-0.879	0.999	5.598***	0.798	7.776***	0.625
Observations	311		311		311	
Log-Likelihood			-493.820			
Wald χ^2			196.870***			
Wald Test of independent equations (p-value)			1.561 (0.458)			

Notes: [a] The reference division is Poli. The dependent variables are participation in ESC and log household per capita income TM: Traditional markets; ESC: Export supply chains.
$\rho1$ and $\rho2$ are the correlation coefficients between the error term ε_i (equation 3) and the error terms μ_{1i} and μ_{2i} (equations 4 and 5), respectively.
S.E.: Robust standard errors.*Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level.

Table 6. FIML Endogenous Switching Regression (HVESC suppliers vs. TM suppliers)

			TM suppliers		HVESC suppliers	
	Participation in HVESC		*Log per capita income*		*Log per capita income*	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Household head age	0.004	0.016	-0.011*	0.007	-0.016	0.012
Household head education	0.111	0.069	0.099***	0.029	0.167***	0.044
Household head male	-1.280**	0.621	0.065	0.312	0.106	0.339
Household size	0.182	0.136	-0.237***	0.050	-0.335***	0.096
Dependency ratio	0.000	0.004	-0.000	0.001	-0.001	0.002
Farm size	-0.012	0.089	0.156***	0.031	0.085*	0.047
Off-farm employment	0.428	0.376	0.327**	0.135	0.196	0.155
Access to credit	0.787**	0.386	-0.116	0.330	0.027	0.231
Membership in a non-PO organization	-3.276***	0.574	-0.187	0.217	-0.466	0.525
Access to electricity	0.950**	0.401	0.214	0.130	-0.187	0.188
Access to piped water	-0.475	0.401	0.419**	0.175	0.243	0.269
Distance to public transportation	0.099	0.075	0.034	0.024	-0.017	0.015
Distance to the produce collection center	0.184	0.198	0.056	0.071	0.071	0.088
Access to extension services	0.122	0.366	-0.196	0.161	-0.246	0.153
Access to NGO services	1.085***	0.321	-0.298*	0.174	0.215	0.264
Mobile phone ownership	1.125**	0.531	-0.131	0.167	-0.892*	0.460
Motorbike ownership	0.145	0.368	0.227	0.151	-0.051	0.187
Livestock units	0.045	0.074	0.082***	0.029	0.032	0.042
Altitude in meters	-0.007***	0.002	0.000	0.000	-0.001	0.001
Division Kingo´ri [a]	-1.250	1.664	-0.195	0.263		
Division Mbuguni [a]	-3.800***	1.151	0.447	0.308	-0.161	0.437
Division Moshono [a]	1.030	0.935	-0.071	0.233	0.493	0.481
Share of high-value export producers in the village	14.137***	3.054				
Neighbors aware of the export markets	0.627***	0.140				
ln σ_2			-0.230***	0.073		
ln σ_1					-0.595***	0.069
ρ_2			-0.223	0.356		
ρ_1					0.086	0.924
Constant	-1.587	2.636	5.740***	0.807	9.789***	0.965
Observations	249		249			
Log-Likelihood			-323.906			
Wald χ^2			195.100***			
Wald Test of independent equations (p-value)			0.424 (0.809)			

Notes: [a] The reference division is Poli. The dependent variables are participation in HVESC and log household per capita income. TM: Traditional markets; HVESC: High-value export supply chains.
$\rho 1$ and $\rho 2$ are the correlation coefficients between the error term ε_i (equation 3) and the error terms μ_{1i} and μ_{2i} (equations 4 and 5), respectively.
S.E.: Robust standard errors. *Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level.

Table 7. FIML Endogenous Switching Regression (HVESC vs. All other producers)

	Participation in HVESC		Non-HVESC suppliers Log per capita income		HVESC suppliers Log per capita income	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Household head age	0.004	0.012	-0.008	0.006	-0.016	0.013
Household head education	0.054	0.087	0.061***	0.021	0.168***	0.046
Household head male	-1.091	0.718	0.241	0.247	0.068	0.574
Household size	0.055	0.151	-0.253***	0.051	-0.332***	0.109
Dependency ratio	0.000	0.003	0.000	0.001	-0.001	0.002
Farm size	-0.076	0.116	0.100***	0.035	0.082	0.054
Off-farm employment	0.384	0.454	0.503***	0.124	0.212	0.249
Access to credit	0.862**	0.342	0.157	0.359	0.051	0.403
Membership in a non-PO organization	-2.330***	0.458	-0.244	0.376	-0.519	0.880
Access to electricity	0.723	0.562	0.188	0.173	-0.165	0.327
Access to piped water	-0.123	0.568	0.277*	0.152	0.242	0.262
Distance to public transportation	0.110	0.099	-0.003	0.029	-0.015	0.021
Distance to the produce collection center	0.118	0.173	0.062	0.079	0.060	0.160
Access to extension services	0.257	0.420	-0.067	0.159	-0.239	0.192
Access to NGO services	0.791***	0.262	-0.058	0.192	0.247	0.504
Mobile phone ownership	0.700	0.601	-0.219	0.169	-0.869	0.549
Motorbike ownership	0.077	0.291	0.107	0.209	-0.045	0.208
Livestock units	0.070	0.072	0.069***	0.024	0.032	0.043
Altitude in meters	-0.005	0.004	-0.000	0.001	-0.001	0.001
Division Kingo´ri [a]	-3.026	2.202	-0.029	0.348		
Division Mbuguni [a]	-2.940*	1.699	0.495	0.358	-0.179	0.468
Division Moshono [a]	0.797	1.469	0.306	0.199	0.459	0.623
Share of high-value export producers in the village	10.659**	4.559				
Neighbors aware of the export markets	0.450***	0.113				
ln σ_2			-0.213***	0.058		
ln σ_1					-0.589***	0.143
ρ_2			0.160	1.821		
ρ_1					0.195	1.794
Constant	-1.881	4.469	6.422***	0.977	9.700***	1.502
Observations	311		311			
Log-Likelihood			-425.612			
Wald χ^2			173.610***			
Wald Test of independent equations (p-value)			0.013 (0.994)			

Notes: [a] The reference division is Poli. The dependent variables are participation in HVESC and log household per capita income. HVESC: High-value export supply chains.
$\rho 1$ and $\rho 2$ are the correlation coefficients between the error term ε_i (equation 3) and the error terms μ_{1i} and μ_{2i} (equations 4 and 5), respectively.
S.E.: Robust standard errors. *Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level.

Table 8. FIML Endogenous Switching Regression (RESC suppliers vs. TM suppliers)

			TM suppliers		RESC suppliers	
	Participation in RESC		*Log per capita income*		*Log per capita income*	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Household head age	-0.019*	0.010	-0.012*	0.007	-0.017	0.011
Household head education	-0.071	0.048	0.091***	0.029	0.021	0.029
Household head male	-0.970**	0.380	-0.016	0.325	1.108***	0.374
Household size	0.193***	0.073	-0.224***	0.050	-0.307***	0.079
Dependency ratio	-0.003	0.002	-0.000	0.001	0.001	0.001
Farm size	0.013	0.041	0.171***	0.034	0.049**	0.025
Off-farm employment	0.226	0.227	0.361**	0.144	0.858***	0.162
Access to credit	0.084	0.345	-0.089	0.303	0.748***	0.267
Membership in a non-PO organization	-0.202	0.281	-0.271	0.190	-0.226	0.240
Access to electricity	0.440*	0.230	0.309**	0.142	-0.261	0.203
Access to piped water	-0.571**	0.283	0.218	0.219	0.499*	0.302
Distance to public transportation	-0.037	0.048	0.022	0.029	-0.135**	0.064
Distance to the produce collection center	0.126	0.089	0.059	0.069	0.096	0.071
Access to extension services	0.269	0.235	-0.120	0.148	0.357*	0.210
Access to NGO services	0.588**	0.249	-0.151	0.189	0.224	0.196
Mobile phone ownership	-0.135	0.309	-0.106	0.176	-0.175	0.299
Motorbike ownership	-0.107	0.282	0.239	0.157	-0.023	0.202
Livestock units	-0.032	0.042	0.065**	0.029	0.038	0.034
Altitude in meters	-0.001*	0.001	0.000	0.000	-0.002**	0.001
Division Kingo´ri [a]	0.507	0.501	-0.158	0.273	0.003	0.372
Division Mbuguni [a]	-0.312	0.611	0.502	0.322	0.130	0.500
Division Moshono [a]	0.148	0.449	-0.028	0.248	0.668*	0.342
Share of regular export producers in the village	2.492***	0.939				
Neighbors aware of the export markets	0.324***	0.125				
ln σ_2			-0.161	0.121		
ln σ_1					-0.514***	0.143
ρ_2			0.891	0.605		
ρ_1					-0.451	0.337
Constant	0.387	1.320	6.424***	1.029	8.280***	1.153
Observations	240		240			
Log-Likelihood			-356.313			
Wald χ^2			184.390***			
Wald Test of independent equations (p-value)			4.169 (0.124)			

Notes: [a] The reference division is Poli. The dependent variables are participation in RESC and log household per capita income. TM: Traditional markets; RESC: Regular export supply chains.
$\rho 1$ and $\rho 2$ are the correlation coefficients between the error term ε_i (equation 3) and the error terms μ_{1i} and μ_{2i} (equations 4 and 5), respectively.
S.E.: Robust standard errors. *Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level.

Table 9. Average expected household per capita income (log-transformed), treatment and heterogeneity effects

	Observations	Regime				Treatment effect		Percentage change
		Export		Non-Export				
		Mean	*S.E.*	*Mean*	*S.E.*	*Treatment effect*	*S.E.*	
ESC vs. TM								
Export producers (ATT)	133	6.88	0.05	6.31	0.06	0.57***	0.05	77
Non-export producers (ATU)	178	7.09	0.05	6.53	0.05	0.56 ***	0.03	75
Heterogeneity effects (TH)	311	-0.21***	0.07	-0.22***	0.08	0.01	0.06	
HVESC vs. TM								
High-value export producers (ATT)	71	7.05	0.08	6.36	0.09	0.69***	0.06	99
Non-export producers (ATU)	178	7.35	0.08	6.53	0.05	0.82***	0.05	127
Heterogeneity effects (TH)	249	-0.30**	0.13	-0.17*	0.10	-0.13	0.09	
HVESC vs. All								
High-value export producers (ATT)	71	7.05	0.08	6.68	0.07	0.37***	0.05	45
Non-export producers (ATU)	240	7.26	0.06	6.57	0.04	0.69 ***	0.04	99
Heterogeneity effects (TH)	311	-0.21	0.13	0.11	0.08	-0.32***	0.08	
RESC vs. TM								
Export producers (ATT)	62	6.69	0.09	7.46	0.11	-0.77***	0.10	-116
Non-export producers	178	6.85	0.07	6.53	0.05	0.32***	0.06	38
Heterogeneity effects (TH)	240	-0.17	0.13	0.92***	0.11	-1.09***	0.12	

Notes: The treatment effects of the log-transformed dependent variable are computed in percentage change as $100(e^{ATT}-1)$ (Asfaw et al., 2012)
ESC: Export supply chains; TM: Traditional markets; RESC: Regular export supply chains; HVESC: High-value export supply chains.
S.E.: Standard errors. *Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level.

Table 10. Average treatment effects on household per capita income (log-transformed) disaggregated by farm size

	Observations	Farm size (acres)	Treatment effect		Percentage change
			Treatment effect	*S.E.*	
ESC vs. TM					
Quartile 1	110	< 1	0.70***	0.03	101
Quartile 2	55	1 – 2	0.63***	0.06	88
Quartile 3	69	2 – 3.5	0.59***,d	0.06	80
Quartile 4	78	> 3.5	0.30***,c,g,h	0.07	35
HVESC vs. TM					
Quartile 1	97	< 1	0.73***	0.05	107
Quartile 2	50	1 – 2	0.82***	0.09	127
Quartile 3	46	2 – 3.5	0.82***	0.12	127
Quartile 4	57	> 3.5	0.82***	0.10	127
HVESC vs. All					
Quartile 1	110	< 1	0.49***	0.04	63
Quartile 2	55	1 – 2	0.66***,a	0.08	93
Quartile 3	69	2 – 3.5	0.70***,e	0.09	101
Quartile 4	78	> 3.5	0.68***,f	0.08	97
RESC vs. TM					
Quartile 1	79	< 1	0.06	0.06	6
Quartile 2	40	1 – 2	0.15	0.10	16
Quartile 3	57	2 – 3.5	0.15*	0.09	16
Quartile 4	64	> 3.5	-0.14[b]	0.13	-15

Notes: The treatment effects of the log-transformed dependent variable are computed in percentage change as $100(e^{ATE}-1)$ (Asfaw et al., 2012).
ESC: Export supply chains; TM: Traditional markets; RESC: Regular export supply chains; HVESC: High-value export supply chains.
S.E.: Standard errors. *Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level for the ATEs.
[a] Significant at the 5 percent level for the difference between the first and second quartiles.
[b] Significant at the 10 percent level, [c] significant at the 1 percent level for the ATE differences between the third and fourth quartiles.
[d] Significant at the 10 percent level, [e] significant at the 5 percent level for the ATE differences between the first and third quartiles.
[f] Significant at the 5 percent level, [g] significant at the 1 percent level for the ATE differences between the first and fourth quartiles.
[h] Significant at the 1 percent level for the ATE differences between the second and fourth quartiles.

Table 11. Average treatment effects on household per capita income (log-transformed) disaggregated by household per capita income level

	Observations	Income ('000 TZS)	Treatment effect		Percentage change
			Treatment effect	*S.E.*	
ESC vs. TM					
Quartile 1	72	< 390	0.56***	0.06	75
Quartile 2	78	390 – 732	0.60***	0.05	82
Quartile 3	79	732 – 1333	0.55***	0.06	73
Quartile 4	83	>1333	0.55***	0.06	73
HVESC vs. TM					
Quartile 1	59	< 390	0.75***	0.08	111
Quartile 2	60	390 – 732	0.68***	0.08	97
Quartile 3	63	732 – 1333	0.87***	0.09	139
Quartile 4	68	>1333	0.82***	0.08	127
HVESC vs. All					
Quartile 1	72	< 390	0.53***	0.07	70
Quartile 2	78	390 – 732	0.52***	0.06	68
Quartile 3	79	732 – 1333	0.65***	0.08	91
Quartile 4	83	>1333	0.74***,a,b	0.06	110
RESC vs. TM					
Quartile 1	66	< 390	0.01	0.10	0
Quartile 2	61	390 – 726	0.13**	0.06	14
Quartile 3	58	726 – 1333	0.03	0.09	3
Quartile 4	55	>1333	0.00	0.12	0

Notes: The treatment effects of the log-transformed dependent variable are computed in percentage change as $100(e^{ATE}-1)$ (Asfaw et al., 2012)
ESC: Export supply chains; TM: Traditional markets; RESC: Regular export supply chains; HVESC: High-value export supply chains.
S.E.: Standard errors. *Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level.
[a] Significant at the 5 percent level for the ATE differences between the first and fourth quartiles.
[b] Significant at the 5 percent level for the ATE differences between the second and fourth quartiles.

Table 12. Costs and gross margin analysis of vegetable production

	Total sample (N=318)		TM suppliers (N=184)		ESC suppliers (N=134)		RESC suppliers (N=62)		HVESC suppliers (N=72)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Costs										
Costs purchased manure (in '000 TZS/acre)	1.235	14.336	2.135	18.817	0.000	0.000	0.000	0.000	0.000	0.000
Costs chemical fertilizers (in '000 TZS/acre)	106.692	142.475	110.059	151.543	102.069	129.406	105.279	162.343	99.304	93.323
Costs organic fertilizers (in '000 TZS/acre)	0.126	2.242	0.217	2.948	0.000	0.000	0.000	0.000	0.000	0.000
Costs chemicals (in '000 TZS/acre)	94.007	151.356	97.562	141.998	89.124	163.757	73.469	72.250	102.605	212.956
Costs seeds (in '000 TZS/acre)	86.822***	106.238	51.677†††	103.374	135.080	90.235	121.327###	94.484	146.923	85.294
Costs hired labour (in '000 TZS/acre)	234.033***	246.629	170.717†††	199.897	320.975	277.187	320.056###	263.136	321.766	290.579
Other costs (in '000 TZS/acre)	44.829***	139.743	27.324†††	95.816	68.867	181.401	16.892	29.678	113.623§§§	237.686
Revenue										
Gross revenue (in '000 TZS/acre)	1821.544	2160.120	1750.525	2447.921	1919.064	1691.118	1507.070	968.543	2273.836§§§	2067.710
Gross margin (in '000 TZS/acre)	1253.800	2002.583	1290.833	2250.195	1202.948	1608.438	870.047	901.530	1489.613§§	1991.937
Observations	318									

Notes: TM: Traditional markets; ESC: Export supply chains; RESC: Regular export supply chains; HVESC: High-value export supply chains.
Mean coefficients; S.D.: Standard deviations. The statistical significance of the differences between the mean values of the different groups is presented as follows:
*Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level for the differences between ESC suppliers and TM suppliers.
†Significant at the 10 percent level, ††significant at the 5 percent level, †††significant at the 1 percent level for the differences between HVESC suppliers and TM suppliers.
#Significant at the 10 percent level, ##significant at the 5 percent level, ###significant at the 1 percent level for the differences between RESC suppliers and TM suppliers.
§Significant at the 10 percent level, §§significant at the 5 percent level, §§§significant at the 1 percent level for the differences between HVESC suppliers and RESC suppliers.

Table 13. Gross revenue per acre and price per kilo of vegetables sold in the traditional markets

	Gross revenue (in '000 TZS/acre)		Price (in TZS/kilogram)		Observations
	Mean	S.D.	Mean	S.D.	
Tomato	1792.773	1289.360	798.369	1916.298	60
Nightshade	1107.101	1073.715	1282.085	4804.600	43
Cabbage	1788.782	2320.086	375.749	510.998	41
African eggplant	2068.986	2179.480	348.417	273.961	31
Okra	1139.608	757.674	542.698	304.543	17
Cucumber	2588.961	2404.127	1244.729	2975.544	14
Sweet Pepper	4002.627	6733.186	1138.654	754.537	11
Eggplant	979.067	739.198	601.829	455.128	8
Broccoli	2143.458	1232.314	1074.127	816.978	8
Ethiopian Mustard	415.429	338.486	571.667	364.368	7
Chinese Cabbage	4620.600	4884.821	1250.000	606.218	5
French beans	857.200	551.342	1275.000	618.466	4

Notes: Analysis based on all the vegetables sold in the traditional markets by at least four of the producers in our sample.
Mean coefficients; S.D.: Standard deviations.

Table 14. Gini-coefficient decomposition analysis

Income sources [a]	Share total income (percent)	Gini coefficient	Correlation with total income	Contribution to total inequality (percent)	Percentage change
TM suppliers					
Vegetables supplied to ESC	0.000				
Vegetables supplied to TM	0.398	0.693	0.818	0.408	0.010
Non-vegetable crops	0.237	0.784	0.760	0.256	0.019
Off-farm activities	0.195	0.837	0.645	0.190	-0.004
Others [b]	0.170	0.765	0.612	0.145	-0.024
Total household per capita income		0.553			
HVESC suppliers					
Vegetables supplied to ESC	0.430	0.670	0.858	0.473	0.043
Vegetables supplied to TM	0.141	0.823	0.654	0.145	0.004
Non-vegetable crops	0.080	0.761	0.560	0.065	-0.015
Off-farm activities	0. 206	0.794	0.755	0.237	0.030
Others [b]	0.138	0.647	0.453	0.077	-0.061
Total household per capita income		0.523			
RESC suppliers					
Vegetables supplied to ESC	0.276	0.596	0.736	0.232	-0.044
Vegetables supplied to TM	0.139	0.759	0.592	0.120	-0.019
Non-vegetable crops	0.281	0.807	0.837	0.364	0.083
Off-farm activities	0.183	0.822	0.699	0.202	0.018
Others [b]	0.120	0.729	0.492	0.083	-0.038
Total household per capita income		0.522			

Notes: [a] All the income sources are computed in per capita income in thousands TZS.
[b] The other income sources include agricultural and non-agricultural rental, remittances, pensions and income from NGOs and governmental actors.
TM: Traditional markets; HVESC: High-value export supply chains; RESC: Regular export supply chains.

Appendix

Table A1. Validity of the instruments - Determinants of participation in export supply chains

	ESC vs. TM		**HVESC vs. TM**		**HVESC vs. All**		**RESC vs. TM**	
	Participation in ESC		*Participation in HVESC*		*Participation in HVESC*		*Participation in RESC*	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Household head age	-0.010	0.008	0.006	0.015	0.004	0.011	-0.017	0.011
Household head education	-0.030	0.037	0.127**	0.061	0.047	0.055	-0.078*	0.044
Household head male	-0.899**	0.356	-1.380**	0.569	-1.033**	0.455	-1.010**	0.397
Household size	0.171**	0.070	0.189	0.131	0.044	0.096	0.167**	0.080
Dependency ratio	-0.001	0.002	0.000	0.003	0.001	0.002	-0.003	0.002
Farm size	0.018	0.037	-0.016	0.074	-0.067	0.068	0.014	0.042
Off-farm employment	0.158	0.184	0.429	0.334	0.421	0.261	0.197	0.235
Access to credit	0.527**	0.253	0.731*	0.392	0.873***	0.297	0.289	0.313
Membership in a non-PO organization	-0.964***	0.284	-3.335***	0.543	-2.308***	0.423	-0.314	0.301
Access to electricity	0.429**	0.187	1.037***	0.341	0.678**	0.275	0.516**	0.236
Access to piped water	-0.558**	0.248	-0.520	0.393	-0.082	0.328	-0.644**	0.298
Distance to public transportation	-0.005	0.032	0.109	0.073	0.102*	0.055	-0.034	0.051
Distance to the collection center	-0.006	0.095	0.176	0.192	0.117	0.179	0.110	0.103
Access to extension services	0.069	0.194	0.165	0.329	0.242	0.269	0.228	0.232
Access to NGO services	0.867***	0.210	1.106***	0.309	0.795***	0.245	0.649**	0.260
Mobile phone ownership	-0.018	0.275	1.143**	0.533	0.648	0.447	-0.164	0.284
Motorbike ownership	0.074	0.213	0.172	0.357	0.085	0.281	0.038	0.258
Livestock units	-0.028	0.043	0.049	0.075	0.072	0.065	-0.038	0.045
Altitude in meters	-0.001**	0.001	-0.007***	0.002	-0.005***	0.002	-0.001*	0.001
Division Kongo´ri [a]	0.361	0.399					0.279	0.487
Division Mbuguni [a]	-0.943*	0.483	-3.641***	1.082	-3.066***	0.905	-0.631	0.582
Division Moshono [a]	0.177	0.306	0.985	0.744	0.930	0.678)	0.003	0.469
Share of export producers in the village	3.086***	0.757						
Neighbors aware of the export markets	0.402***	0.080	0.627***	0.138	0.448***	0.112	0.359***	0.111
Share of high-value export producers in the village			14.039***	2.720	11.017***	2.516		
Share of regular export producers in the village							2.784***	0.912
Constant	-0.865	0.988	-2.125	2.360	-1.502	1.853	0.594	1.416
Observations	311		214		265		240	
Wald Test on the instruments (χ^2)	49.030***		40.660***		36.810***		37.090***	
χ^2	99.710***		90.680***		86.520***		79.44***	
Log-likelihood	-143.409***		-54.592***		-78.230		-93.831	

Notes: [a] The reference division is Poli.
ESC: Export supply chains; TM: Traditional markets; HVESC: High-value export supply chains; RESC: Regular export supply chains. The dependent variables are Participation in ESC (1); in HVESC (2 and 3); in RESC (4). Probit estimation. S.E.: Robust standard errors. *Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level.

Table A2. Validity of the instruments - Effects of the instruments on household per capital income of non-participating producers

	ESC vs. TM		HVESC vs. TM		HVESC vs. All		RESC vs. TM	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Household head age	-0.010	0.007	-0.012*	0.007	-0.009	0.006	-0.011	0.007
Household head education	0.091***	0.030	0.097***	0.031	0.059***	0.022	0.094***	0.032
Household head male	0.017	0.349	0.029	0.359	0.220	0.267	0.039	0.347
Household size	-0.226***	0.054	-0.227***	0.055	-0.254***	0.050	-0.224***	0.052
Dependency ratio	-0.000	0.001	-0.000	0.001	0.000	0.001	-0.000	0.001
Farm size	0.145***	0.036	0.154***	0.036	0.101***	0.030	0.153***	0.036
Off-farm employment	0.325**	0.144	0.315**	0.145	0.496***	0.122	0.309**	0.145
Access to credit	-0.083	0.328	-0.068	0.323	0.163	0.252	-0.082	0.321
Membership in a non-PO organization	-0.217	0.210	-0.254	0.205	-0.230	0.167	-0.241	0.202
Access to electricity	0.235*	0.136	0.219	0.136	0.170	0.126	0.214	0.137
Access to piped water	0.410**	0.186	0.431**	0.185	0.305**	0.151	0.420**	0.188
Distance to public transportation	0.043	0.029	0.033	0.029	-0.003	0.027	0.037	0.028
Distance to the collection center	0.074	0.080	0.060	0.078	0.066	0.078	0.074	0.080
Access to extension services	-0.186	0.171	-0.212	0.178	-0.090	0.145	-0.199	0.170
Access to NGO services	-0.293	0.191	-0.258	0.191	-0.057	0.152	-0.261	0.185
Mobile phone ownership	-0.140	0.179	-0.133	0.183	-0.238	0.170	-0.126	0.179
Motorbike ownership	0.262	0.165	0.244	0.161	0.095	0.131	0.249	0.162
Livestock units	0.085***	0.032	0.084***	0.032	0.072***	0.025	0.085***	0.032
Altitude in meters	0.001	0.000	0.000	0.001	-0.000	0.000	0.000	0.000
Division Kongo´ri [a]	-0.307	0.316	-0.095	0.313	0.048	0.249	-0.197	0.275
Division Mbuguni [a]	0.559	0.341	0.344	0.346	0.395	0.301	0.517*	0.311
Division Moshono [a]	-0.128	0.253	-0.074	0.241	0.305	0.201	-0.118	0.242
Share of export producers in the village	-0.425	0.513						
Neighbors aware of the export markets	0.049	0.067	0.045	0.065	0.039	0.057	0.074	0.071
Share of high-value export producers in the village			0.427	0.597	0.189	0.406		
Share of regular export producers in the village							-0.955	0.600
Constant	5.474***	0.840	5.878***	0.913	6.518***	0.743	5.920***	0.849
Observations	178		178		240		178	
F-Statistic on the instruments (p-value)	0.490 (0.616)		0.410 (0.664)		0.300 (0.742)		1.310 (0.273)	
R^2	0.426		0.426		0.373		0.433	
F-Statistic	7.572***		7.218***		6.380***		7.329***	

Notes: [a] The reference division is Poli.
TM: Traditional markets; ESC: Export supply chains; RESC: Regular export supply chains; HVESC: High-value export supply chains. The dependent variable is log household per capita income. OLS estimation.
S.E.: Robust standard errors. *Significant at the 10 percent level, **significant at the 5 percent level, ***significant at the 1 percent level.