AGRICULTURAL ECONOMICS

Agricultural Economics (2017) 1–11

Dynamics of smallholder participation in horticultural export chains: evidence from Ecuador

Cristina Romero Granja, Meike Wollni*

Department of Agricultural Economics and Rural Development, Research Training Group "GlobalFood," University of Göttingen, Platz der Göttinger Sieben 5, 37073, Göttingen, Germany

Received 28 February 2017; received in revised form 6 May 2017; accepted 2 September 2017

Abstract

We study the dynamics of smallholder participation in export value chains focusing on the example of small-scale broccoli producers in the highlands of Ecuador. Combining cross-sectional data from a household survey with 11-year longitudinal data on export market transactions, we explain the hazards of dropping out of a high-value export chain. We apply a multispell cox duration model that allows us to consider multiple entries and exits from the supply chain. We also provide evidence on the welfare impacts associated with participation. The results suggest that small-scale farmers' exit from the export sector is accelerated by high transaction risks experienced in the past. While we find no particular evidence for the exclusion of small-scale farmers from the export sector, we do find that poorer households and female-headed households tend to drop out faster, especially as long as the sector is still prospering. Finally, when considering welfare effects, we do not find evidence that participation translates into tangible benefits for broccoli farmers. We discuss some measures that could help improve the long-term sustainability of smallholder integration in high-value chains.

JEL classifications: D23, D81, Q12

Keywords: Export market participation; Transaction costs; Duration model; Longitudinal data; Impact analysis

1. Introduction

During the past three decades, growing demand for high-quality food has led to the modernization of agri-food systems inducing a shift from spot market transactions to vertical coordination (Reardon et al., 2009; Swinnen and Maertens, 2007). These structural changes have opened up new marketing opportunities for small-scale farmers in developing countries. Farmers' inclusion in global agri-food markets through producer groups and contract farming schemes is often considered a promising way to increase farm incomes and thus foster rural development (Bellemare, 2012; Hernández et al., 2007; Maertens and Swinnen, 2009).

While the export of fresh products from developing to high-income countries has increased over the past decades, smallholders often face major barriers in their access to high-value markets. An extensive set of literature dealing with the determinants of smallholder participation in modern food markets offers mixed results. Dolan and Humphrey (2000), Rao and Qaim (2011), and Schuster and Maertens (2013) show evidence for the exclusion of small-scale farmers from high-value markets and reveal that export companies or local supermarkets source only a small percentage of their produce from smallholders. In contrast, Henson et al. (2005), Minten et al. (2009), and Bellemare (2012) describe successful cases of smallholder inclusion that rely on institutional innovations, such as contract farming schemes.

While these studies provide some evidence on the determinants of participation at a particular point in time, little research has been done on the sustainability of smallholder inclusion in high-value chains over time. This is of particular relevance as some evidence suggests that in the long run contract farming schemes regularly lose participants or collapse entirely (Ashraf et al., 2009; Barrett et al., 2012; Fold and Gough, 2008). Using data from five Indian contract schemes, Narayanan (2013) provides evidence for episodic participation of smallholders in contract arrangements and discusses different reasons for dropping out. Thus, the dynamics of participation may be much more complex than suggested by cross-sectional studies and they may also explain to some extent seemingly contradictory results. A few recent studies have investigated the dynamics of market participation focusing on domestic supermarkets in Kenya (Andersson et al., 2015), export-related standard

*Corresponding author. Tel.: +49-551-394843. *E-mail address*: mwollni1@gwdg.de (M. Wollni).

DOI: 10.1111/agec.12411

adoption and disadoption in Thailand (Holzapfel and Wollni, 2014), disadoption of horticultural export crops in Guatemala (Carletto et al., 2010), and neighborhood effects on farmers' entry and exit decisions in Nicaragua (Michelson, 2015). With the notable exception of Michelson (2015), who uses seven-year panel data, most of the above studies rely on two-year panel or recall data, due to the difficulty of obtaining consistent data on farmers' market choices over several years. These data are usually too short or not precise enough to reveal the complex dynamics of (multiple) entries and exits from a high-value chain and the relative importance of transaction risks for contract performance.

The aim of this study is to address this research gap by analyzing the factors influencing smallholders' decisions to supply and withdraw from the export chain, considering that farmers may enter and exit the chain multiple times. We place particular emphasis on the role of transaction risks (i.e., payment delays and product rejections) that may influence and shape the farmers' market decisions. Our analysis is based on a unique data set consisting of original household survey data collected in 2012 and the records of a collection center to which all broccoli from small-scale farmers destined for the export market is delivered. The records of the collection center represent a longitudinal data set containing transaction-level information for every transaction of all the suppliers during the past 11 years (i.e., since it was established). Our data show that a large percentage of small-scale farmers do not participate continuously in the high-value export channel, but instead decide to abandon it temporarily or completely and return to the local market. Using longitudinal data, we can investigate the dynamic relationships between 2002 and 2012 within the supply chain, while controlling for yearly shocks that may affect production.

The primary rationale for promoting smallholder participation in high-value export chains rests on the argument that participation can improve incomes and alleviate poverty. From a policy perspective, it is therefore important to investigate the welfare implications associated with the decision to enter or exit the high-value export chain. If nonparticipating farmers are indeed deprived of remunerative income opportunities, policy interventions may be warranted to support smallholder upgrading. However, if participation does not translate into tangible benefits for smallholders or if alternative market opportunities pay just as well, interventions may not be necessary or justified. Or, as Carletto et al. (2010) put it, early participation in high-value chains may be seen by farmers as a stepping-stone to build networks and engage in other business ventures. Against this background, we evaluate the welfare effects of export market participation in order to place our analysis of supplier dynamics into a broader context and derive policy recommendations.

2. The broccoli market in Ecuador

Broccoli was introduced as an export crop in Ecuador in the 1990s and since then its cultivation has spread rapidly until it became the country's second most important nontraditional export product. In 2008, Ecuador became the sixth largest exporting country of broccoli and cauliflower with around 60,000 tons sent to North American and European markets (FAOSTAT, 2013). However, in the following years exports started to fall despite increasing international prices, and by 2011 export volumes were down to 23,000 tons.[1] Initially, broccoli was cultivated exclusively on large plantations and exported by a few vertically integrated processors, but since the year 2001 small-scale farmers were linked to the export market through contract farming. A few years later, small-scale farms[2] represented one-third of the total broccoli area planted for international markets (Gall, 2009).

Farmers were linked to the export market through a producer organization[3] that served as an intermediary between farmers and the export firm. The producer organization established a collection center in the production area in order to collect the broccoli and send it to a private processing-exporting firm (from here on referred to as exporter). During the first eight months, only members of the producer organization supplied the export sector through the collection center. Over the following years, the number of members of the organization remained constant and no new members were admitted. However, hundreds of producers from neighboring villages joined the chain as broccoli suppliers.

Between the exporter and the producer organization a written contract was signed, in which a fixed price, volumes, quality, and payment conditions were specified. The producer organization relied on verbal agreements with smallholder farmers regarding the quantity and quality specifications of broccoli deliveries as well as the payment conditions. A typical production contract system was put into operation with the exporter providing the plants through the collection center and facilitating access to inputs, credit, and technical information. Farmers on the other hand were in charge of growing broccoli on their land and had to deliver the product to the collection center in return for the services received.

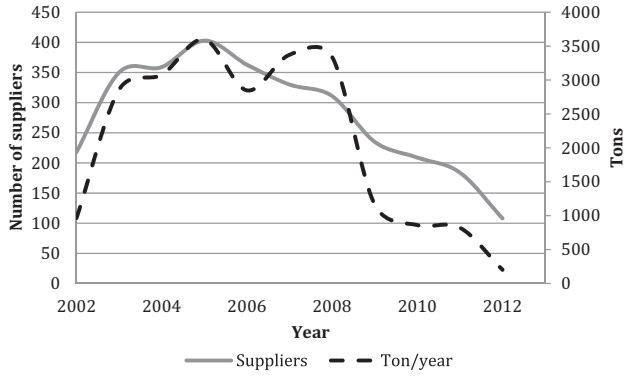
Essentially, the broccoli harvest and post-harvest process consists of the following stages: (i) prior to the harvest, a collection center's worker visits the farm to assess the quality of the product, (ii) the broccoli that qualifies for the export sector is delivered to the collection center, where it undergoes a first grading process in the presence of the farmer, (iii) the broccoli meeting the quality criteria at the collection center is further sent to the exporter, where a second grading process takes place, this time in the absence of the farmer,[4] and finally, (iv) the product meeting the exporting firm's quality requirements is accepted

[1] Detailed information on export prices and volumes are depicted in Fig. A1 in the Appendix.

[2] Defined as farmers owning less than 20 hectares (Gall, 2009).

[3] The farmers' organization under study is the only organized group of smallholders producing broccoli for the export sector in the country.

[4] The rejection data in our data set refer to the rejections at the exporter level, and do not take into account rejections at the collection center where the farmer can assist and verify the process.



Source: Farmers' collection center records.

Fig. 1. Number of suppliers and quantity delivered per year to the collection center.

and the payment scheduled for two weeks later according to the terms of the contract. Due to the fact that broccoli for the export market is harvested differently than that for the local market and, due to its high perishability, the broccoli rejected at the exporter level can no longer be sold in the local market and thus represents a monetary loss to the farmer.[5]

In 2009, the exporting firm sourcing from the collection center went bankrupt and left the scene without paying for the product delivered over several months. As a consequence, the collection center faced a liquidity crisis, and payments to farmers were delayed for extended time periods. After their original buyer went out of business, the collection center established a new marketing contact. The contract scheme outlined above still applies in this new marketing relationship, and is renegotiated on an annual basis. Nevertheless, 12 years after the inclusion process started, a large percentage of small-scale suppliers have abandoned the scheme and the collection center faces a shortage of broccoli supplies.

Figure 1 shows the dynamics of broccoli supplies to the collection center during the last decade. The amount of broccoli delivered to the export sector drastically declined in 2009 and since then has been further decreasing. Suppliers have joined and abandoned the supply chain at different points in time. The total number of farmers who have ever participated in the export sector is around 630 from 8 villages located in the province of Chimborazo. The largest number of suppliers (403 farmers) was registered in 2005. Nowadays, there are only 108 active suppliers of which only 47 are members of the producer organization.

While broccoli was initially introduced as an export crop, local demand has also grown. Nowadays, the local wholesale market in Riobamba (capital city of Chimborazo), represents an alternative market outlet for broccoli producers. As the harvesting process differs between local and export market, the market decision needs to be made prior to harvesting. While prices in the export market are fixed throughout the year, the local wholesale market is characterized by extremely volatile prices. In 2011, for instance, when the export market price was fixed at 0.25 US$/kg, the wholesale market price fluctuated between a minimum of 0.09 US$/kg and a maximum of 0.50 US$/kg resulting in high levels of price uncertainty for producers selling in this market.[6] In particular, given high day-to-day fluctuations, planning the harvest such as to target high prices is nearly impossible. Therefore, while the average local market price of 0.27 US$/kg was slightly higher than the export market price in 2011, the export market offers the advantage of a secure market outlet at fixed prices.[7]

3. Conceptual framework

As outlined in the previous section, broccoli producers in Ecuador can choose between two alternative market channels to sell their produce: (1) The spot market: coordinated by price and characterized by nonrecurring transactions with no prior arrangements and no promise of repeating the transaction in the future. It takes place at the local wholesale market where there are multiple buyers and sellers and payment is usually made at the moment of the transaction. (2) The export market: characterized by vertical coordination between the parties to supply a fixed quantity of broccoli with certain characteristics, during a certain time period, and at a constant price. The payment is made 15 days after delivery and the closer relationship between the parties can facilitate the flow of information. While large-scale farmers are offered individual contracts directly with the exporting firm, small-scale farmers can only access the export market through verbal agreements with the collection center managed by the farmers' group under study.

To participate in the export market channel, farmers have to fulfill stringent requirements related to the quality, quantity, and timing of deliveries. The farmer's ability to meet these conditions determines her probability of participation. Farmers are assumed to maximize their expected utility at the time of harvest. They will decide to participate in the export market if their expected utility of participation is higher than their opportunity costs of participation (Barrett et al., 2012), i.e., in this case, their expected utility of selling in the local market. The farmer's expected utility associated with participation in the export chain is influenced by several factors including expected revenues and production costs, the transaction risks associated with selling broccoli, and possibly intangible factors like the social relations involved in the transaction. The farmer will update her beliefs regarding expected prices, costs, transaction risks, and uncertainties of delivering to each market outlet based on previous experiences (e.g., payment delays, product rejections) and based on current information (e.g., differences in prices and

[5] When harvested for the export market, only the head of the broccoli is cut and the rest of the plant is left in the field, while for the intermediaries and local market the head has to be covered by several plant leafs.

[6] Wholesale market price fluctuations are depicted in Fig. A2 in the Appendix.

[7] The following prices were fixed between the exporter and the producer organization: 2002–2007: 0.22 US$/kg, 2008: 0.21 US$/kg, 2009–2010: 0.22 US$/kg, 2011–2012: 0.25 US$/kg.

Table 1
Transaction risks associated with export market participation

Transaction risks related to:	Risk exposure in export market compared to local market
Price uncertainty	Lower–due to annually fixed price
Timing of payment uncertainty	Higher–due to longer payment periods
Buyer uncertainty	Lower–there is a secure buyer
Quality uncertainty	Higher–due to stringent quality requirements
Relationship-specific investments (and related exposure to opportunistic behavior)	Higher–e.g., due to specific harvesting techniques

costs). Based on the framework proposed by Williamson (1979) and extended by Hobbs and Young (2000), Table 1 summarizes the transaction risks associated with the commercialization of broccoli in the export chain compared to the alternative, i.e., the local market.

While certain types of risks are typically reduced through contract farming arrangements that link smallholders to export markets similar to the one studied here, other types of risks can be exacerbated (Barrett et al., 2012). Uncertainty related to the price and to finding a suitable buyer is usually lower compared to the local market, given that a purchase agreement exists with the exporter and the price is negotiated *ex ante*. However, new uncertainties may be introduced, e.g., related to the farmer's ability to meet stringent quality requirements. Furthermore, even though an *ex ante* agreement exists, the exporter may renege on the agreement, e.g., by rejecting produce inappropriately or by delaying or defaulting on the final payment (Barrett et al., 2012; Gow et al., 2000). Transaction risks are also exacerbated by relationship-specific investments incurred by farmers producing for the export market (Gow et al., 2000). In the broccoli sector, these become especially relevant after harvest, due to distinct harvesting technologies between the two markets. Thus, once the product has been harvested for the export market, the farmer is locked into the marketing relationship with the exporter, given that his second best option of selling the broccoli elsewhere now tends toward zero. We expect that the realization of these transaction risks, i.e., to what extent the exporter takes advantage of holdup opportunities, determines the gains accruing to farmers, and, thus, in the long term the dynamics of smallholder export participation. In particular, past holdups experienced by the farmer threaten the sustainability of the chain by reducing the farmer's willingness to invest, and thus the quantity and quality of produce delivered, and—if transaction risks become too high—can even induce a farmer to drop out of the export market entirely.

4. Data collection

To gain an in-depth understanding of the structure and organization of the broccoli sector, we conducted semistructured interviews with members of the farmers' group, exporting firms, and government institutions. Subsequently, from November 2012 to February 2013, we conducted a household survey with small-scale broccoli producers in the province of Chimborazo. We covered all eight villages where former and active suppliers of the collection center live. In addition, we interviewed farmers who never participated in the export market living in the same eight villages and in a ninth village (with similar infrastructure and climatic characteristics).

Three categories of farmers were identified for the survey: Active suppliers of the export market (*current participants*, $n = 108$), former participants who stopped supplying the export market (*former participants*, $n = 522$), and farmers who have always supplied exclusively the local market (*nonparticipants*, $n =$ approx. 1,500). A stratified random sample was used to select farmers for the interviews. Given their comparatively small number, we decided to oversample current suppliers in order to ensure sufficient observations for analysis. Current and former participants were randomly chosen from a complete list of active and former producers provided by the producer organization. Nonparticipants were selected using a random walk sampling approach. In order to obtain a comparable control group, households were eligible only if they have been producing broccoli during the last 12 months.

The final sample is composed of 401 farmers: 88 current participants, 195 former participants, and 118 nonparticipants. A structured questionnaire was used to collect information on socioeconomic and farm characteristics, agricultural production and marketing decisions, group memberships, and household assets for 2012. Information on farm size and on family members who have worked in the collection center was obtained for the past 11 years using recall data. The respondent's attitude toward risk was measured using an experimental risk lottery designed by Binswanger (1980) offering real pay-offs. Enumerators visited each household and conducted a face-to-face interview of approximately 1.5 hours with a household member involved in the cultivation and commercialization of broccoli. The data collected for the current and former suppliers of the export chain were merged with longitudinal records provided by the producer organization containing data on the quantity of broccoli delivered, the days to payment, and the quantity rejected by the exporter per delivery from 2002 to 2012.

5. Econometric analysis

5.1. Duration model to analyze market exit decisions

Time duration models estimate the probability that an individual switches from one stage to another given that he has not done so in the previous period (Cleves et al., 2008; Dadi et al., 2004). We model the farmer's decision to withdraw from the export market, by estimating the probability that the farmer changes his position from participation to nonparticipation at the beginning of time period t, given that he has not done so

before t. We organize our data in a discrete time fashion, where each farmer has 11 observations, one for each year of the time period under study (2002–2012). Given that the withdrawal from the export sector is conditional on previous participation, those farmers who have never participated in the export sector do not enter the analysis. The event of withdrawal is called failure, and we denote the discrete time to failure with T. The dependent variable is a dummy variable that equals zero in every year that the farmer supplies the export sector and one in the year he stops supplying (failure). Multiple spells are allowed, which means that farmers can decide to participate a second or third time after withdrawing. A vector of time variant covariates (X_{it}) is included, which is fixed within the interval t and speeds up or delays the failure time of the individual. A vector of time invariant covariates ($\mathbf{Z}_i$) is also observed, which is constant over the whole period under study.

The hazard function (α_i), which characterizes T, is given by the conditional probability for the risk of failure in interval t, given that the individual has not failed before t, and is expressed by:

$$\alpha_i(t|TR_{i(t-1)}, X_{it},\ Z_t) = \Pr(T_i = t|T_i \geq t, TR_{i(t-1)}, X_{it},\ Z_i),$$
$$t\ =\ 1, \ldots, q, \tag{1}$$

where $T_i = t$ denotes failure within interval t, $T_i \geq t$ denotes survival up to time t for individual i, $TR_{i(t-1)}$ represents the transaction risks experienced by the household in the previous period, X_{it} is a vector of other time-varying covariates, and Z_i is a vector of time invariant covariates.

The hazard function can also be expressed as a function of time (baseline hazard) combined with a vector of covariates acting multiplicatively on the baseline hazard and shifting it proportionally (Burton et al., 2003). Semiparametric approaches in duration analysis, such as the Cox model, do not require any assumption on the distribution of the errors, and thus on the baseline hazard (Cleves et al., 2008). The Cox proportional hazards model is specified as:

$$\alpha_{ij}(t) = \alpha_0(t) \exp(\beta TR_{i(t-1)} + \gamma X_{ij} + \delta Z_i + v_j), \tag{2}$$

where $\alpha_0(t)$ is the unspecified baseline hazard, v_j corresponds to the error term (frailty) of the model, i.e., a latent random effect within groups that enters multiplicatively on the hazard function.

Given that in our data we have multiple observations per individual (multiple spells), we can expect that the failing times for each farmer are not independent from each other and thus the standard errors should be adjusted to account for this possible correlation. The option of shared frailty is used to account for this potential correlation, which is measured by θ and is assumed to have a gamma distribution (Cleves et al., 2008). As we consider time discrete (yearly data), it is likely that more than one observation fails at the same time (tied failures) and the order of failures within this year cannot be established as required for the simple Cox model. Cleves et al. (2008) mention three ways of handling such tied failures, of which we use Efron's method.[8]

5.2. Potential determinants of market exit

Among the variables potentially explaining the decision to drop out of the export sector, we are particularly interested in the effect of transaction risks. In particular, holdups experienced in previous periods might increase the perceived risk of the transaction and thus accelerate the withdrawal from the export chain. Transaction risks are captured by the variables: (i) *payment delay*$_{(t-1)}$ which is the average number of days the farmer had to wait for payment from the exporter in the previous year, and (ii) *% rejection*$_{(t-1)}$ which represents the percentage of produce rejected by the exporter in the previous year.

Regarding other transaction characteristics, the price per kilogram paid by the exporter to the collection center at time t (*price export market*) represents the fixed price that is negotiated between the farmers' group and the exporter on an annual basis. In addition, we include a dummy as a proxy for *low bargaining power in the local market.* This equals one if during 2012 the average price obtained by the farmer in the local market was below the fixed export market price of 2012.[9] We also include the *number of crops* grown by the farmer, as a measure for better marketing opportunities in the local market. Hence, farmers who obtain higher relative prices in the local market and have a larger variety of crops and thus more attractive outside options are expected to drop out faster from the export chain.

We consider two distinct proxies for social networks and information access: a dummy variable that equals one if the farmer has *family ties with workers of the collection center* at time t and a dummy variable for *membership in the farmers' group* operating the collection center. We also include as a potential determinant the farmer's attitude toward risk (*risk aversion*), which is likely to influence farmers' subjective perception and evaluation of transaction risks.

To capture poverty and dependence on government support, we use a dummy variable that equals one if the household received a governmental cash transfer in 2012 targeted to the poorest households in the country (*cash transfer*).[10] Other variables capturing household and farm characteristics are included as controls, such as *age*, *gender*, and *education of the household*

[8] Efron's method is an approximation to the exact marginal calculation method for tied failures, where all the possible orders of failures within a group failing at the same t are taken into account for the final probability of failure at that specific time t. In Efron's method, the risk set used as denominator contains all the observations failing at time t, but is corrected using probability weights (Cleves et al., 2008).

[9] As we have farmer-specific local market prices only for 2012 and not for the full study period, we implicitly assume that individual bargaining power remained invariable throughout the analyzed time period. Please note that low prices in the local market may not be entirely due to low bargaining power, but also a result of, e.g., supply or demand shocks in the local market.

[10] The allocation mechanism is likely to be imperfect, and thus, our measure of government support is only a rough proxy for poverty and should be interpreted with care.

head, *number of household members over 15 years*, *farm size*$_{t-1}$, and *distance to the collection center*. We also include interaction terms between a dummy variable for the *period 2009–2012* and our main variables of interest in order to identify heterogeneous effects after the negative external shock caused by the bankruptcy of the buyer. Long payment delays and payment defaults during this time may have jeopardized the trust of smallholder suppliers, negatively affecting their participation. Year and village dummies are also included to control for year-specific macroeconomic shocks as well as village-specific characteristics. An overview of the variables included in the time duration model (including data type and source) as well as detailed variable definitions are provided in the Appendix (Tables A1 and A2).

5.3. Evaluating impacts of export market participation

The primary motivation for linking smallholder farmers to high-value export chains is to improve their income opportunities and thus their welfare. In our study, the question arises whether participation in the export sector indeed makes farmers better off. To address this question, we specify a linear regression model estimating the incremental welfare effect of an additional year of participating in the export sector. We construct an asset index[11] as proposed by Sahn and Stifel (2003) to measure accumulated wealth. Due to potential self-selection, simple Ordinary Least Squares (OLS) estimates would result in biased treatment effects. We therefore include the *predicted length of participation* derived from the duration model instead of the observed years of participation (see Carletto et al., 2010). Thus, we estimate the following model:

$$W_i = \rho\widehat{L_i} + \lambda Z_i + \varepsilon_i, \tag{3}$$

where W_i is wealth of farmer i measured by the asset index, $\widehat{L_i}$ is the predicted length of participation measured in years, and ρ is the average treatment effect of an additional year of participation in the export chain. Z_i is a vector of socioeconomic and demographic characteristics likely to influence wealth levels. We report bootstrapped standard errors due to the inclusion of an estimated regressor in the equation.

In order to obtain the predicted length of participation, we need to assign a parametric distribution to the baseline hazard of the duration model, for which we choose the exponential distribution. To estimate $\widehat{L_i}$ (*predicted length of participation*) in a duration model with time-varying covariates, we follow three steps: (1) the yearly hazard of withdrawal ($\widehat{\alpha_{ij}(t)}$) is estimated for each individual, (2) the cumulative hazard ($\widehat{H(t)}$) is obtained by integrating the estimated yearly hazards for each individual, and (3) the mean time to withdrawal is estimated by integrating the function $dT = \exp\{H(t)\}dt$.

[11] The asset index was calculated using rotated principal component analysis. Further details are reported in Table A3 in the Appendix.

Table 2
Number of participation spells and average length of participation

Spell	Number of farmers (%)	Length of participation (years)		
		Min	Max	Mean (Std. dev.)
1st spell	283	1	11	6.75
	(100)			(3.21)
2nd spell	65	1	6	2.75
	(23)			(1.49)
3rd spell	5	1	4	2.42
	(2)			(1.05)

Note: Based on subsample of 283 farmers who are current or former suppliers of the export market.

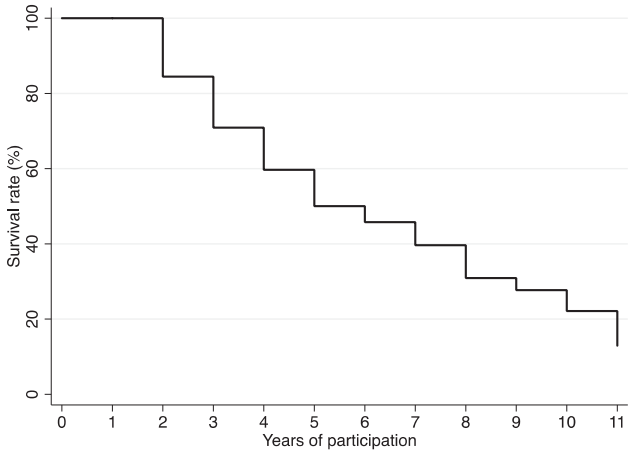
6. Descriptive results

The cross-sectional survey data reveals that transaction risks vary substantially between the two market channels. In the export market, farmers had to wait on average 38 days for their payment in 2012, whereas in the local market payment was made on average within two to four days after delivery. Similarly, stringent quality requirements result in relatively high rejection rates in the export sector. On the average, 11.5% of produce delivered by export market participants in 2012 was rejected by the exporter, while in the local market produce rejections were not an issue.[12]

The longitudinal data on export market transactions reveals that during our study period some farmers entered and exited the export sector more than once. Table 2 presents statistics on the number of participation spells and the average length of participation per spell. Many farmers only experience one participation spell—either because they drop out completely or because they continue supplying the export market without interruption. The average length of participation during the first spell is 6.75 years, ranging between a minimum of one and a maximum of 11 years. For some farmers in our sample, however, multiple participation spells are recorded. Twenty-three percent of the farmers entered the export sector for a second spell after they had dropped out, participating for another 2.75 years on the average. For a small number of farmers even three participation spells were recorded indicating that they exited and reentered the export market twice.

Figure 2 presents a graphical illustration of the survival probabilities, i.e., the probabilities to remain in the export market, based on the nonparametric Kaplan–Meier estimator. The Kaplan–Meier curve measures the length of time farmers remain in the export sector before they drop out and is thus the complement of the empirical distribution function. The graph shows that during the first five years of participation in the export market, the survival probability decreases rapidly and overall 50% of the farmers drop out at some stage during their first five years of participation. During year 6 and 7, drop-out rates are lower, but increase again in year 8—which for those

[12] Detailed descriptive results are presented in Appendix B.



Note: Based on subsample of 283 surveyed farmers who ever delivered broccoli to the export sector.

Fig. 2. Kaplan–Meier estimated survival rate.

farmers in our sample who started supplying the export market in year one coincides with the bankruptcy of the main buyer. After year 8, drop-out rates are again lower. After 10 years of participation, less than 25% of the farmers continue to supply the export sector.

7. Econometric results

7.1. Dropping out of a high-value export chain

Table 3 shows estimation results from the Cox model analyzing the decision of current and former participants to exit the export market. The coefficients represent the change in the log odds of the outcome variable for a one-unit increase in the independent covariate, holding all other covariates constant. For easier interpretation, the hazard ratios are also reported, which were calculated by exponentiating the coefficients. To check the proportional hazard assumption, we applied a test based on Schoenfeld residuals (Cleves et al., 2008). Results obtained for each covariate and for the general model indicate no deviation from the proportional hazards assumption and thus confirm the specification of the model (Table A4 in the Appendix). The empirical hazard function is visualized in Fig. A3. in the Appendix.

Column (1) in Table 3 provides full results from the Cox model, including interaction effects, and thus allowing for changes in magnitude and sign of the coefficients after the structural break potentially induced by the bankruptcy of the main buyer. For several variables we observe substantial changes in the effects, both in terms of effect size and direction, after the negative external shock. For comparison, we also report results without interaction terms in column (2).

The results of the full model (column (1)) show that the coefficients of the transaction risks variables regarding payment delays and rejections are positive and significant. Both a larger number of days to payment and a higher percentage of rejection in the previous period increase the speed of withdrawal from the export chain.[13] Specifically, for each additional day the farmer had to wait for payment, the individual hazard rate increases by 0.5 percentage points. This can become an important risk factor considering that for the period 2004–2009 farmers had to wait for more than 60 days on the average for their payment (see Table A5 in the Appendix). Moreover, for each additional percentage point of rejection (in relation to the quantity delivered), the hazard rate of withdrawal increases by 6.5 percentage points. These effects remain unchanged after the supply chain shock.

We further find that having a family member who works at the collection center speeds up the process of withdrawal from the export chain, increasing the hazard rate by 220 percentage points. While this is unlike expected, it is likely that the enforcement of the existing agreement is hampered by family ties to the extent that farmers do not fear strong punishment when diverting their product to the local market. This is in line with the findings of Fafchamps and Minten (2001), who show for the case of Madagascar that agreements are handled more flexibly, when actors are related through kinship. However, after the external shock (2009–2012) the effect of family ties reverses, decreasing the overall hazard rate of withdrawal by 29 percentage points.[14] Thus, farmers with family ties, while often pursuing short-term benefits in the period before the shock, tended to support the collection center during difficult times.

Membership in the farmers' group has a negative effect on the log odds of dropping out of the export chain, decreasing the hazard rate of withdrawal by 91 percentage points, when compared to nonmembers in normal times. This result can be explained by the fact that group members are also the owners of the collection center and thus hold shares of the enterprise. Nonetheless, the negative external shock also significantly affected the members of the association. Overall, after the crisis (2009–2012) the effect of being a member on the speed of withdrawal is still negative, but to a lesser extent. In this period, membership decreases the total hazard rate by only 41 percentage points.

Furthermore, the speed of dropping out of the export sector is correlated with household-specific characteristics. We find that poor (as proxied by *cash transfer*) and female-headed households drop out faster from the export chain. For poor households, the hazard rate of withdrawal is 59 percentage points higher compared to nonpoor households. Similarly, for female-headed households the hazard rate is 120 percentage points higher compared to male-headed households. Interestingly, after the external shock the effect reverses for female-headed households, who now tend to remain longer in the export chain compared to their male counterparts.

[13] Alternative model specifications (including longer lags and accumulated bad experience) are provided in Appendix C.

[14] To calculate the effect of a variable in the period 2009—2012, the coefficients before and after this period are added and then exponentiated.

Table 3
Results on the hazard of dropping out of the export sector

Variables	(1)		(2)	
	Coefficient	Hazard ratio	Coefficient	Hazard ratio
Transaction characteristics				
Payment delay$_{(t-1)}$	0.005*	1.005*	0.003***	1.003***
	(0.002)	(0.002)	(0.001)	(0.001)
% rejection$_{(t-1)}$	0.063**	1.065**	0.021	1.021
	(0.031)	(0.033)	(0.015)	(0.016)
Price export market	−0.545	0.580	−0.423	1.041
	(0.470)	(0.272)	(0.467)	(0.038)
Low bargaining local market	−0.177	0.838	0.064	1.066
	(0.247)	(0.207)	(0.157)	(0.168)
Number of crops	0.038	2.038	0.040	1.041
	(0.054)	(0.056)	(0.037)	(0.038)
Social networks				
Family ties	1.162**	3.196**	−0.021	0.979
	(0.518)	(1.655)	(0.231)	(0.226)
Membership farmers' group	−2.390***	0.092**	−1.054***	0.349***
	(0.431)	(0.040)	(0.219)	(0.076)
Other control variables				
Risk aversion	−0.464	0.629	−0.303	0.738
	(0.361)	(0.227)	(0.211)	(0.156)
HH members over 15	−0.015	0.985	−0.005	0.995
	(0.096)	(0.094)	(0.098)	(0.097)
HH head age	−0.010	0.990	−0.008	0.992
	(0.007)	(0.007)	(0.007)	(0.006)
HH head secondary education	−0.056	0.946	−0.005	0.995
	(0.196)	(0.186)	(0.193)	(0.192)
HH head female	0.787***	2.197**	0.328	1.388
	(0.286)	(0.628)	(0.212)	(0.294)
Distance to collection center	−0.0181	0.982	−0.015	0.985
	(0.054)	(0.053)	(0.055)	(0.054)
Own area$_{(t-1)}$	−0.008	0.992	−0.014	0.987
	(0.021)	(0.021)	(0.018)	(0.017)
Cash transfer	0.460**	1.585**	0.194	1.214
	(0.223)	(0.354)	(0.146)	(0.177)
Period 2009–2012				
d2009-2012 × Payment delay$_{(t-1)}$	−0.002	0.998		
	(0.003)	(0.003)		
d2009-2012 × % rejection$_{(t-1)}$	−0.053	0.948		
	(0.036)	(0.034)		
d2009-2012 × Low bargaining local market	0.450	1.569		
	(0.311)	(0.487)		
d2009-2012 × number of crops grown	0.0127	1.013		
	(0.074)	(0.075)		
d2009-2012 × Family ties	−1.509***	0.221***		
	(0.571)	(0.126)		
d2009-2012 × Membership farmers' group	1.859***	6.418***		
	(0.465)	(2.987)		
d2009-2012 × Risk aversion	0.154	1.167		
	(0.442)	(0.515)		
d2009-2012 × HH head female	−0.964**	0.381**		
	(0.442)	(0.168)		
d2009-2012 × Own area$_{(t-1)}$	−0.0196	0.981		
	(0.034)	(0.033)		
d2009-2012 × Cash transfer	−0.440	0.644		
	(0.273)	(0.176)		
Θ	1.13×10^{-7}		1.13×10^{-7}	
Observations	1539		1539	
Number of groups	278		278	
Log-likelihood	−1177.32		−1192.88	

Notes: Standard errors in parenthesis: $^{***}P < 0.01$, $^{**}P < 0.05$, $^{*}P < 0.1$. Dummies for years and villages included. Likelihood-ratio test of θ: $P = 0.498$ for both models.

Table 4
Linear regression on asset index (with predicted length of participation as regressor)

Variables	(1)	(2)
Length of participation (predicted)	−0.012	0.019
	(0.007)	(0.023)
Length of participation (predicted) squared		−0.003
		(0.002)
HH head female	−0.038	−0.038
	(0.029)	(0.035)
HH head age	0.012***	0.010*
	(0.006)	(0.006)
HH head age squared	−9.79e-05*	−8.43e-05
	(5.53e-05)	(5.55e-05)
HH head secondary education	0.127***	0.127***
	(0.032)	(0.031)
HH members over 15	0.023***	0.024***
	(0.008)	(0.008)
Membership in any group/ organization	0.053**	0.058**
	(0.025)	(0.028)
Risk aversion	−0.019	−0.022
	(0.028)	(0.027)
Constant	−0.016	−0.014
	(0.136)	(0.145)
Observations	246	246
R-squared	0.353	0.345

Notes: Standard errors in parenthesis: $^{***}P < 0.01$, $^{**}P < 0.05$, $^{*}P < 0.1$. Dummies for villages included. Standard errors have been bootstrapped using 200 repetitions.

Compared to male-headed households, the total hazard rate of withdrawal is 16 percentage points lower for female-headed households in the period 2009–2012. This marked difference between the two periods is likely to be related to the different transaction costs associated with the two market channels and the perceptions thereof of vulnerable population groups, such as female-headed households. For example, the bankruptcy of the main buyer led to large outstanding debts of the collection center toward farmers. More vulnerable households may be more inclined to stay in the export chain hoping to recover at least some of their outstanding payments.

7.2. Impact of export market participation

In this section, we present results on the impact of participation in the export chain to identify whether it has indeed been associated with positive welfare effects. Table 4 reports results of the OLS model on accumulated wealth using the predicted length of participation as regressor. In both model specifications, the effect of an additional year of participating in the export chain on accumulated wealth is insignificant. We also conducted several tests based on propensity score matching using different welfare indicators and comparison groups (current versus former versus nonparticipants; long-term versus short-term versus nonparticipants). The results from the propensity score matching approach confirm the regression results presented here (for details see Appendix D).

The lack of a clear treatment effect of export market participation found in our study stands in contrast to some of the previous literature that has reported positive income effects of participation in contract schemes that link farmers to export markets (Bellemare, 2012; Maertens and Swinnen, 2009; Minten et al., 2009). The fact that much of that literature has analyzed immediate income effects at a specific point in time may explain these divergent results to a certain extent. Our results are in line with Carletto et al. (2010, 2011) who report no significant income effects in the long run and conclude that those who drop out of a particular high-value chain may indeed have better income opportunities elsewhere. Similarly, Narayanan (2014) finds that the financial benefits obtained through contract farming in the context of high-value and export markets are heterogeneous and can be nonsignificant and even negative in particular cases. From a policy perspective, this implies that whether nonparticipation constitutes an exclusion of disadvantaged farmers or whether it reflects a deliberate choice among alternative income options based on competitive advantage needs to be considered carefully on a case-by-case basis.

Last but not least, an interesting finding from a policy perspective is that membership in organizations is associated with positive welfare effects. Irrespective of export market participation, the social networks that are built and maintained through these organizations can help rural households to realize their full income potential—whether in the export sector or through alternative income activities—and thus improve their livelihoods.

8. Conclusions

This study combines cross-sectional and longitudinal data to analyze the dynamics of smallholder participation in the broccoli export market. We focus on the effects of transaction risks on the timing of withdrawal from this high-value chain. While previous studies have investigated the factors influencing participation in high-value markets, we add to the existing literature by using longitudinal data, which allows us to take multiple entries and exits into account and thus identify the threats to the long-term sustainability of smallholder inclusion in high-value export chains. We also provide evidence on the welfare effects of export market participation. Given that linking smallholder farmers to high-value markets is considered a promising tool for lifting rural households out of poverty, the identification of potential threats is of paramount importance for designing and promoting sustainable value chains for rural development.

Results of our analysis reveal that holdups experienced in the export chain substantially increase the uncertainty associated with market transactions in the chain and thus have a negative influence on farmers' participation. Both product rejections and long payment delays significantly increase the risk of dropping out of the export chain. Our results further show that social network variables, such as family ties and membership in the farmers' group, play an important role in the market choice. Finally, while we find no particular evidence for the exclu-

sion of small-scale farmers from the export sector, we do find that poorer households and female-headed households tend to drop out faster, especially as long as the sector is still prospering. After the external negative shock, however, female-headed households drop out more slowly suggesting that they may get trapped more easily in a crisis-stricken sector.

Before discussing policy measures to increase and maintain participation levels of smallholder farmers in high-value export chains, it is important to consider the associated welfare impacts. In our study, we find that participation does not translate into tangible benefits for smallholder farmers, neither when we consider the length of participation on accumulated wealth, nor the effects of current participation status on current income (propensity score matching results provided in Appendix D). Thus, drop-outs from the export chain are not necessarily a matter of exclusion, but may represent a rational decision based on considerations of costs and (lack of) benefits.

From a policy perspective, it is of course not satisfactory to leave everybody equally worse-off—provocatively put. Just because we find no positive welfare effects of export chain participation, does not mean that value chains could not be designed to provide attractive business models and income opportunities that are superior to local market conditions. The main question therefore remains how value chains can more sustainably integrate and benefit smallholder farmers. Our case study provides important insights into this issue. In particular, the Ecuadorian broccoli export chain is characterized by high transaction risks that were further exacerbated by the bankruptcy of the main buyer and the subsequent liquidity crisis. For instance, while a payment period of 15 days is stipulated in the contract, farmers had to wait on the average between 27 days in 2003 and 200 days in the aftermath of the crisis in 2009. Thus, if policy makers aim to link smallholders to high-value chains with a welfare objective in mind, they should first and foremost consider the conditions under which smallholders participate.

In this regard, we derive some policy recommendations aiming to improve the long-term sustainability in high-value chains. As high rejection rates in the export sector have strong economic implications for farmers, it is important to increase transparency regarding the reasons for rejections. Saenger et al. (2014), e.g., propose the implementation of a third-party control mechanism to increase transparency in the grading process. This could also be useful in the Ecuadorian broccoli sector, where nontransparent product rejections at the factory level provoke farmers' mistrust in downstream actors of the value chain.

Furthermore, it should be a priority to reduce the risk of external shocks caused by the sudden retirement of an export firm and the consequent default in payment borne by farmers. There is an urgent necessity for a stronger legal framework regulating the finances in contract farming and the participation of small farmers' businesses in such schemes. In particular, adequate safeguards could be demanded from export firms to reduce opportunistic behavior and protect small-scale farmers and their organizations from bearing the consequences of downstream actors' financial problems.

Finally, farmers' businesses and organizations should be placed in a real network environment. Policy attention needs to shift from supporting and regulating particular organizations toward a whole value chain perspective. The debate about smallholder participation in high-value markets needs to graduate from the initial focus on facilitating access to a focus on how to make these business relationships viable and beneficial in the long term. For donors and practitioners, this means, for example, that it is not sufficient to provide incentives for participation, but that more long-term business assistance is needed, for example, improving bargaining skills and providing support to conduct legal actions when farmer organizations are affected by opportunistic behavior of downstream actors of the value chain.

Acknowledgment

The financial support of the German Research Foundation (DFG) is gratefully acknowledged.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Table A1: Definition of variables
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Table D1: Estimated average treatment effects using propensity score matching
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Fig. A1: Prices and quantities exported by Ecuador during the past decade.
Source: National Central Bank, 2013.
Fig. A2: Daily wholesale market prices of broccoli in 2011 (Riobamba, Ecuador).
Source: Original price data collected in the local wholesale market in Riobamba, Ecuador.
Fig. A3: Smoothed hazard estimate for farmer's withdrawal from the export chain.
Note: The hazard function is the derivative of the Nelson–Aalen cumulative hazard, which is the number of expected failures in the period $(0, t)$ for a subject, if failure is a repeatable event. As the cumulative hazard cannot be directly differentiated, the hazard is estimated by smoothing the steps of the cumulative hazard with a kernel smoother. This requires averaging values over a moving window of data. Near the endpoints, these windows contain insufficient data for accurate estimation, so the estimators contain boundary bias and are not plotted in the graph (Cleves et al., 2008).
Fig. B1: Problems experienced by farmers in the export sector.
Note: Based on subsample of 283 surveyed farmers who ever delivered broccoli to the export sector.
Fig. D1: Propensity score matching: Common support areas.