

# Quality assurance programs and access to international markets: the case of horticultural processors in Vietnam

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### Abstract

**Purpose** – The purpose of this paper is to seek to show how the implementation of different quality assurance programs (QAPs) affects international market access for horticultural processing firms in developing countries.

**Design/methodology/approach** – A representative survey of 50 registered firms processing horticultural produce in Vietnam was conducted. Logistic regression models are used to analyze the effects of QAPs and other firm level factors on participation in different export supply chains.

**Findings** – QAPs influence firms' participation in export supply chains significantly. While the implementation of internationally recognized QAPs improves access to OECD markets, national QAPs are more important for exports to non-OECD countries.

**Practical implications** – Horticultural processing firms in developing countries can improve their access to export markets when they implement formal QAPs. There is segmentation between non-OECD supply chains, for which national QAPs suffice, and OECD supply chains with higher food safety and quality requirements, for which international QAPs are important. Depending on the intended target markets, firms can adjust their strategies accordingly.

**Originality/value** – This study contributes empirically to the literature on private sector food regulations and developing country exports by using a unique set of firm level data from Vietnam. While analyzing the impact of QAPs on export market access, it is differentiated between national and international QAPs. Policy implications are discussed.

**Keywords** Agriculture, Exports, Fruits, Quality assurance, Vegetables, Vietnam

**Paper type** Research paper

### Introduction

Food scares have triggered higher awareness of food safety problems among consumers in rich countries, but also among more affluent buyers in urban centers of developing and transition countries (Buzby, 2001; Mergenthaler *et al.*, 2009a, b). The importance of consumer orientation in fruit supply chains has been described by Mowat and Collins (2000), and the implications for supplier regimes in the supermarket sector have been analyzed by Ruben *et al.* (2007) for Thailand and China. Josling *et al.* (2004) describe how the trends

towards food quality and food safety have led to a growing demand for more stringent food safety regulations. These requirements can have profound implications for the different actors in food supply chains, including food processing firms' and primary producers' access to export markets (Swinnen, 2007; Stanton and Burkink, 2008). Often, it is assumed that developing country exporters would suffer from tighter regulations in import markets. In this context, an emerging question that we address in this article is whether implementation of quality assurance programs (QAPs) can facilitate international supply chain participation for firms in developing countries.

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Given the increasing amounts of traded high-value agricultural products, and the growing number of supply chains that surpass national and regional boundaries, collaboration between supply chain actors has been increasingly on the agenda (Matopoulos *et al.*, 2007). Along with this, food regulations have become an issue in international trade (Jaffee and Henson, 2005). Henson and Loader (1999) argued that sanitary and phytosanitary measures required by developed countries would be increasingly challenged by developing country exporters due to their potential trade impeding effects. They mostly referred to public sector standards. In addition, however, there is a growing number of regulations emerging from the private sector. Starting in the 1990s, major food retailers have been driving the trend towards private standards (Fearne and Hughes, 1999). Private measures spread, partly because public regulatory approaches have not kept pace with rapidly changing consumer preferences for food safety and food quality (Henson and Reardon, 2005). Martinez *et al.* (2007) highlighted how private regulations can add, complement, or substitute public regulations to different degrees and in different set-ups. As these private regulations and requirements might hamper access to export supply chains in a similar way as public standards, Martinez and Poole (2004) coined the term of “commercial barriers to trade”. Though private standards are voluntary, they become *de facto* mandatory once importers require them. This situation is further aggravated by the fact that private standards are not within the regulatory scope of the World Trade Organization.

Reardon *et al.* (1999) described the different venues food exporters in developing countries can take to deal with such non-tariff import restrictions in high-income countries. Turner *et al.* (2000) illustrated how the implementation of QAPs at the firm level is considered as a strategic management decision to meet the more stringent private requirements. Overall, however, there is relatively little empirical evidence on how firms in the food industry of developing countries respond to increasing demands for food safety and food quality in export supply chains (Henson, 2006; Stagiaire, 2006). In particular, it is not well understood whether and, if so, how QAPs can facilitate participation in export supply chains. Nor is there clear evidence on how different types of QAPs might affect export market access. This research gap is addressed in the present article. Building on a survey of fruit and vegetable processing firms in Vietnam, we analyze whether the implementation of different QAPs has an effect on participation in different downstream supply chains. Potential issues of reverse causality are tested for.

The article is organized as follows: the next section introduces the survey data and methodology employed. Then, we present and discuss how QAPs and other factors affect horticultural firms’ participation in different supply chains. The last section concludes and outlines several implications for policy makers and horticultural processing firms in developing countries.

## Data and methodology

We use the fruit and vegetable processing sector in Vietnam to test the hypotheses of the facilitating role of QAPs for participation in export supply chains. Horticultural processing in general, and in Vietnam in particular, is an interesting example for several reasons. First, the structure of

developing country agricultural exports is changing: while traditional export crops – like tea, coffee, and cocoa – are losing relative weight in commodity baskets, non-traditional exports are gaining market shares (Aksoy, 2005). Fruits and vegetables in particular are gaining in importance; their volume of exports has increased fivefold between 1961 and 2001 (Weinberger and Lumpkin, 2007). Second, at cultivation, post-harvest, and processing levels, fruits and vegetables are characterized by limited economies of scale. Hence, they have the potential to play an important role as employment generator in rural development and poverty reduction strategies (Cadilhon *et al.*, 2003). Third, after a period of isolation from international markets, Vietnam is opening up its economy and is making increasing efforts to diversify and enhance revenues from agricultural exports. The promotion of fruits and vegetables in national and international markets is an integral part of this strategy (Cadilhon *et al.*, 2005; Son and Anh, 2005).

## Data

For the empirical analysis, a dataset of 50 Vietnamese fruit and vegetable processing firms is employed, which is based on a survey that we conducted between August and October 2005. We define fruit and vegetable processors as enterprises that transform fruits and vegetables into a different state – often but not necessarily in order to preserve them. This processing can involve freezing, canning, pickling, drying, or converting into jams, but also value adding of fresh products like grading, washing, and packaging. This definition goes along with Diop and Jaffee (2005), who included all SITC (Standard International Trade Classification) items of Revision 1, Chapter 5, except for nuts, roots, and tubers.

The sample was randomly drawn from a list of 96 fruit and vegetable processing firms in Vietnam. This list, which contained most of the registered companies at the national level in 2005, was compiled based on data from different agencies[1]. Complete and up-to-date lists of all processing firms in the horticultural sector, including those that are only registered at provincial levels, are not available. However, based on national statistics of sales volumes, the total number is estimated to be between 120 and 140. Different local experts that we consulted confirmed that our sample can be considered representative of the horticultural processing industry in Vietnam. In terms of their headquarters, half of the sample firms are located in Vietnam’s two major cities, Hanoi (12 percent) and Ho Chi Minh City (38 percent). The other half are located in the major vegetable growing area in the central highlands (14 percent), important fruit growing areas in the Mekong river delta (8 percent), and other provinces of the country.

Firm managers were interviewed face to face in order to improve data reliability. Though anonymity and confidentiality were assured to respondents, it should be mentioned that information given by managers might be biased, due to strategic considerations and unwillingness to disclose information regarded as sensitive – problems that are well known in agribusiness and supply chain research. The structured questionnaire specifically developed for this survey captured information about firm attributes and characteristics of upstream and downstream supply chains. A particular focus was on food quality related issues.

### Econometric model specification

First insights into how firms' QAPs facilitate participation in different supply chains can be gained by using descriptive statistical analyses. Comparing mean values, however, is not sufficient in order to attribute a firm's participation in a certain supply chain to the implementation of QAPs. Therefore, we specify econometric models that try to explain participation in different downstream supply chains through QAPs, while controlling for other covariates possibly affecting supply chain participation.

Introduction of QAPs and getting access to export supply chains has not necessarily to be thought of as a clear temporal sequence. QAPs can facilitate access to international supply chains, but existing participation in export supply chains can also trigger firms to implement QAPs, in order to remain competitive. From a dynamic perspective, causal chains can be elusive, and a detailed analysis would require panel data. We only have cross section data, so that our analysis is static in nature. Yet, from a static perspective, QAPs can be interpreted as a determinant of participation (as opposed to gaining access) to export supply chains at a given point in time. This access may be newly gained or maintained from previous periods.

In a basic model specification (model (1a)), we explain the export status of a processing firm by the following equation, which will be estimated through a bivariate logistic regression approach:

$$EX1 = d + \alpha_1 QAP + \gamma_1 D + \beta_1 S + \beta_2 H + \beta_3 C + \beta_4 T + \varepsilon \quad (1a)$$

The dependent variable (EX1) is a dummy, which takes a value of one if the firm participates in an export supply chain, regardless of the destination country, and zero otherwise. As treatment variable (QAP), we use a dummy, which is one when a formal QAP of any kind is implemented, and zero when no formal program is used. Our hypothesis is that firms with QAPs have a higher probability of participating in export supply chains, which would result in a positive estimation coefficient  $\alpha_1$ . In addition, we test for the influence of domestic sales (D), measured in million US\$ per year. The sign of the estimated coefficient  $\gamma_1$  could be positive, if there are complementarities between selling in domestic and export markets, but it could also be negative, if firms specialize on certain market segments[2].

Other covariates control for additional firm characteristics.  $S$  is a measure of firm size expressed in terms of the workforce.  $H$  denotes human capital, which is hard to measure; we use a dummy, which is one if management considers university education among the top three sources of employee qualification, and zero otherwise.  $C$  indicates access to commercial credit: this is a dummy that is one if the most important source of credit for a particular firm is the commercial banking sector, and zero otherwise.  $T$  is a quality measure of the processing technology used. In Vietnam, technology from abroad is considered superior to technology produced domestically or in neighboring countries. Therefore,  $T$  is as a dummy that is one if the firm uses processing equipment imported from non-neighboring countries, and zero otherwise. To some extent,  $T$  can also be considered an indicator of the firm's financial capital endowment.

In a different model specification, we take account of the fact that export supply chains are differentiated and might

have different requirements in terms of food quality and food safety. For instance, markets in the rich countries belonging to the Organization of Economic Cooperation and Development (OECD) might be more demanding in terms of food quality and food safety than markets in other countries. Therefore, in model (2a) the dependent variable is disaggregated by the destination of the main downstream supply chain, with domestic, OECD, and non-OECD supply chains as distinct categories (EX2).

$$EX2 = \delta + \alpha_1 QAP_{nat} + \alpha_2 QAP_{int} + \gamma_1 D + \beta_1 S + \beta_2 H + \beta_3 C + \beta_4 T + \varepsilon \quad (2a)$$

National and international QAPs ( $QAP_{nat}$  and  $QAP_{int}$ ) are considered as two separate treatment variables. As above, our hypothesis is that firms with QAPs have a higher probability of exports, which would result in positive estimation coefficients for both treatment variables. The other independent variables are defined as in equation (1a). This model will be estimated with a multinomial logistic regression approach.

There are potential endogeneity problems associated with the treatment variables described. First, there might be a selection issue, because implementation of QAPs at the firm level is not random and might be influenced by unobservables that we cannot control for. Second, there might be reverse causality, namely that QAPs are not only facilitating access to export markets, but are a prerequisite, or that export participation facilitates implementation of QAPs through knowledge spillovers and technical advice. These endogeneity problems would lead to correlation between the QAP variables and the error term, which would bias the estimated treatment effect. To avoid a selection bias, a two-step Heckman procedure could be used. However, in our context we prefer a propensity score approach (Wooldridge, 2002, pp. 617ff), because this can take care of both types of endogeneity problems.

## Results and discussion

### Patterns and basic determinants of export supply chain participation

Over the last 15 years, the number of firms in Vietnam's horticultural industry has risen significantly, and integration in export supply chains has grown constantly. Economic liberalization policies and state support have created a trade facilitating environment (World Bank, 2005), with an increasing share of horticultural processing firms exploiting opportunities in export supply chains. Of the total of 50 firms we had sampled in 2005, 33 were exporters, while the other 17 only supplied the domestic market (Table I). Of the exporting firms, 19 exported to OECD countries, especially Japan, Germany, and the USA, but also a few others. The remaining 14 exporters were part of supply chains to non-OECD countries, including Taiwan, Russia, and China[3]. Exported fruits most often mentioned by managers were pineapple, rambutan, guava, and litchi, while the most important vegetables for exports are chilies and cucumbers. Overall, in our sample vegetables play a less prominent role in export supply chains than fruits.

Summary statistics for the variables used in the regression models, which were described in the previous section, are shown in Table I for the whole sample and also disaggregated

Table I Summary statistics for the whole sample and by firms' supply chain participation

	All (n = 50)	Domestic (n = 17)	Supply chain Non-OECD (n = 14)	OECD (n = 19)
All QAPs (dummy)	0.66	0.47	0.78	0.73
National QAPs (dummy)	0.38	0.35	0.57	0.26
International QAPs (dummy)	0.28	0.12	0.21	0.47
Workforce (full time equivalents)	193.60 (260.65)	98.49 (149.36)	272.16 (290.44)	220.82 (300.10)
University educated workforce (dummy)	0.62	0.35	0.86	0.68
Access to commercial credit (dummy)	0.62	0.53	0.64	0.68
Imported technology (dummy)	0.72	0.65	0.71	0.79
Domestic sales (million US\$)	0.82 (1.78)	0.48 (0.85)	1.69 (2.97)	0.48 (0.90)

Notes: Table reports mean values. For continuous variables standard deviations are shown in parentheses

by supply chain. Estimation results are shown in Table II. The coefficients can be interpreted as marginal effects on the probability to export. We first discuss the influence of the control variables, before we analyze the treatment effects of QAPs in the next sub-section.

In model (1a), among the covariates only firm size and human capital endowment have significant impacts on participation in international trade. An increase in firm size by 100 employees raises the probability to export by 7.5 percentage points. A positive impact of firm size on exports was also found in other empirical studies (Naude and Serumaga-Zake, 2003). In firms where management considers university education among the most important sources of employee qualification, the predicted probability of being an exporter is 27 percentage points higher than in other firms. This is similar to Fischer (2004), who also found that education and training of staff are major determinants of a firm's success in international food supply chains. Interestingly, when export supply chains are further disaggregated (model (2a)), firm size and human capital endowment lose their statistical significance, both for non-OECD and OECD exports. However, this should not be over-interpreted. As the sample size is small, standard errors are relatively large. The signs of the coefficients are as in model (1a).

### Impact of QAPs on participation in export supply chains

Quality related measures, including technology upgrades and changes in the supplier base, were considered as pre-conditions for the initial access to export markets by the majority of firm managers in our survey. Most exporters stated that they had temporarily lost international market access at some point in the past. In one-third of the cases, lost international market access was linked to quality problems, like spoiled produce due to a non-continuous cold-chain. This highlights that the position of Vietnamese firms in international high-value markets is vulnerable and can easily be lost to competitors in other countries (see also World Bank, 2005). Most of Vietnam's trade competitors in Southeast Asia are already more integrated in international markets. For instance, countries like Thailand and Malaysia are considered more experienced and efficient in adhering to food safety and

quality requirements in fruit and vegetable processing (IFPRI, 2002).

The management of processing firms has to find appropriate strategies to deal with rising customer demand for food safety and quality in export supply chains. An important question is how to communicate relevant information to buyers in a credible way, since this can have important implications for the firm's economic success. QAPs can facilitate communication with supply chain partners. Different QAPs have become prominent in the horticultural industry in recent years. International QAPs implemented by the horticultural processing firms in Vietnam include standards of the International Organization for Standardization (e.g. ISO 9000), Hazard Analysis and Critical Control Points (HACCP), and protocols of the Euro Retailer Group for Good Agricultural Practices (then EurepGAP, now GLOBALGAP). Though these programs are different in scope, they all focus on the process of production within firms and supply chains through record keeping and controls. ISO 9000 is a general program applied in many industries to improve business performance with respect to quality; HACCP has been developed in the food sector and aims to identify and control critical points in the production process, while GLOBALGAP focuses on the level of primary production most prominently in the horticultural sector. Processing firms being part of less demanding supply chains in non-OECD countries often employ QAPs that are not internationally recognized. These refer mainly to national guidelines for safe food production, often with a similar approach as HACCP, but requirements, enforcement, and certification are generally less strict.

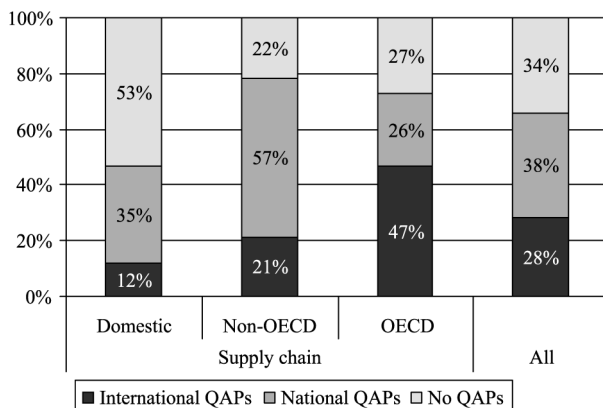
As Table II and Figure 1 show, formal QAPs are implemented by 66 percent of the fruit and vegetable processing firms in our sample (33 out of the 50). The share is considerably higher among exporters (76 percent, or 25 of 33 firms) than among non-exporters (47 percent, or 8 of 17 firms), which is a first indication that QAPs improve participation in export supply chains. Further disaggregation shows that OECD exporters implement more internationally known programs (47 percent, or 9 of 19 firms) than non-OECD exporters (21 percent, or 3 of 14 firms). However, a considerable share of the exporting firms (24 percent, or 8 of 33) has not implemented a QAP (22 percent of non-OECD

Table II Logit regressions for export market participation

	Binary logit models <sup>a</sup>		Multinomial logit models <sup>b</sup>			
	Model (1a) Export	Model (1b) Export	Model (2a) Non-OECD OECD		Model (2b) Non-OECD OECD	
<b>Treatment</b>						
All programs	0.333 *** (0.115)	0.297 ** (0.142)				
National QAPs			0.332 *** (0.096)	-0.038 (0.193)	0.223 ** (0.088)	0.039 (0.185)
International QAPs			0.022 (0.271)	0.387 ** (0.170)	-0.011 (0.270)	0.378 ** (0.157)
<b>Covariates</b>						
Workforce (hundreds)	0.075 * (0.042)		0.041 (0.031)	0.038 (0.036)		
University educated workforce	0.272 *** (0.102)		0.166 (0.197)	0.123 (0.128)		
Access to commercial credit	-0.070 (0.167)		-0.073 (0.193)	-0.005 (0.185)		
Imported technology	0.230 (0.161)		0.080 (0.189)	0.143 (0.220)		
Domestic sales (million US\$)	-0.018 (0.039)		0.099 ** (0.043)	-0.151 ** (0.060)		
<b>Propensity scores (PS)</b>						
PS all QAPs		-0.083 (0.225)				
PS national QAPs					-0.005 (0.328)	-0.497 (0.339)
PS international QAPs					0.435 (0.452)	-0.054 (0.380)
Constant	-0.400 * (0.234)	-0.023 (0.107)	-0.405 * (0.238)	-0.129 (0.173)	-0.098 (0.122)	-0.023 (0.103)
<b>Summary statistics</b>						
Observations	50	50	50		50	
Log likelihood:	-25.57	-30.00	-43.92		-48.01	
Chi <sup>2</sup> :	38.67 ***	4.36	335.97 ***		112.06 ***	

Notes: Table reports marginal effects at sample means and standard errors in parentheses; \* significant at 10 percent; \*\* significant at 5 percent; \*\*\* significant at 1%; <sup>a</sup> the dependent variable is a dummy that is one for exporting firms (33 out of 50) and zero for non-exporting firms (17 out of 50); <sup>b</sup> the dependent variable has three options: non-exporting firms (17 out of 50), exporters to OECD countries (19 out of 50), and exporters to non-OECD countries (14 out of 50)

Figure 1 Share of firms implementing different QAPs by firms' supply chain participation



Source: Based on own survey data

exporters and 27 percent of OECD exporters). It therefore seems that QAPs are not a prerequisite for accessing export markets in general. They rather have a facilitating role, which supports the validity of our econometric model specifications.

This was also confirmed by survey respondents: QAPs facilitate participation in higher value supply chains, where higher prices can be obtained. But why do some firms hesitate to adopt formal QAPs? According to the survey responses, the main reasons are higher costs and management requirements. The total cost increase through QAPs is estimated to be 9 percent on average[4]. Strikingly, estimated cost increases are highest for domestic supply chain participants, somewhat declining for non-OECD exporters and OECD exporters. It is likely that some of the exporters had already met higher standards before the implementation of formal QAPs, which explains their lower relative cost increases. This phenomenon is what Martinez and Poole (2004) referred to as a “decreasing depths of the compliance gap”. Higher costs

due to QAPs are associated with investments in more sophisticated equipment and increased labor requirements. Moreover, management time is estimated to be 22 percent higher on average, mainly related to worker supervision, dealing with external audits, and identifying suitable suppliers. Yet, there are also individual firms where managers indicated that quality programs are not associated with higher costs or even allowed cost reductions. This might potentially be attributed to improved operational processes and efficiency gains (see Holleran *et al.*, 1999).

In our regression approach, significant positive impacts of QAPs on export supply chain participation are detected in model 1a (Table II). *Ceteris paribus*, the predicted probability of being part of an export supply chain is 33 percentage points higher for firms with a QAP than for those without. The results in model (2a) show that the type of QAP differentiates between export supply chains. The predicted probability of being part of a supply chain to a non-OECD country is 33 percentage points higher for firms with national QAPs than for firms without any certified program. For OECD supply chains, in contrast, international QAPs are of crucial importance. Implementing an international QAP increases the probability of being part of a supply chain to an OECD country by 39 percentage points; national QAPs have no significant effect for participation in these higher-value supply chains.

Models (1b) and (2b) are used to test whether there is an endogeneity bias in the QAP treatment effect. As mentioned above, we use a propensity score approach for this purpose. Table II shows that the coefficients of the propensity scores in export models (1b) and (2b) are not significant (see Table III for the first stage regression results that are used to calculate the propensity scores). This indicates that the initially estimated treatment effects for QAPs in models (1a) and (2a) are unbiased. That is, there is no correlation between the treatment variables and the error term[5].

### Domestic sales and export supply chain participation

Domestic markets can have a decisive impact on export supply chain participation of firms in developed countries, as shown by Porter (1990). We expect this to be similar in developing countries. On the one hand, competitive experience in domestic markets can facilitate export participation, as it might help firms to prepare for even higher levels of competition in export supply chains (Porter, 1990). On the other hand, domestic market thinness can also be a push factor for exports. Looking at our data, we find that participants in non-OECD supply chains have much higher domestic sales than firms participating in OECD supply chains, both in absolute and relative terms (Figure 2). This suggests a synergetic relationship between domestic and non-OECD export supply chains, due to similar competitive requirements. However, supply chains of OECD exporters, with higher food safety and quality requirements, seem to be somewhat segmented from the rest.

Looking at our regression results, we find that – when export supply chains are not distinguished (model (1a)) – the value of domestic sales is not a significant factor influencing a firms' export supply chain participation. However, domestic sales are a highly significant and distinguishing factor once export supply chains are differentiated (model (2a)). Domestic sales have a positive impact on the probability of exports to non-OECD countries: with every additional million US\$ in domestic sales, the probability to be part of a non-OECD export supply chain increases by almost 10 percentage points (at sample means). In contrast, an additional million of domestic sales decreases the probability to be part of an OECD export supply chain by 15 percentage points (Table II).

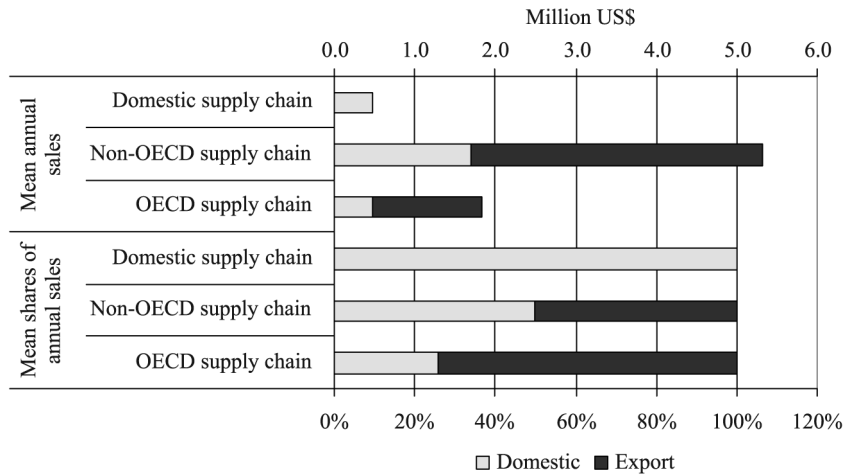
We analyze the relationship between domestic sales and the different export supply chains more explicitly. By using the estimated coefficients of model 2a, we predict probabilities for participation in export supply chains for firms with different levels of domestic sales, at the same time accounting for the

Table III Logit regressions for the implementation of QAPs (first stage of propensity score approach)

	Binary logit model	Multinomial logit model	
	All QAPs	National QAPs	International QAPs
Workforce (hundreds)	0.044 (0.043)	0.021 (0.042)	0.021 (0.022)
University educated workforce	-0.098 (0.166)	-0.312* (0.182)	0.201** (0.101)
Access to commercial credit	0.265** (0.127)	0.039 (0.136)	0.244* (0.128)
Imported technology	-0.323 (0.218)	-0.285* (0.158)	-0.047 (0.149)
Domestic sales (million US\$)	0.021 (0.040)	0.026 (0.033)	0.002 (0.029)
Constant	0.196 (0.191)	0.353** (0.151)	-0.319* (0.167)
<i>Summary statistics</i>			
Observations	50	50	
Log likelihood:	-26.70	-45.89	
Chi <sup>2</sup> :	16.25***	23.01**	

Notes: Table reports marginal effects at sample means and standard errors in parentheses; \* significant at 10 percent; \*\* significant at 5 percent; \*\*\* significant at 1 percent

Figure 2 Magnitude and composition of mean annual sales by firms' supply chain participation



Source: Based on own survey data

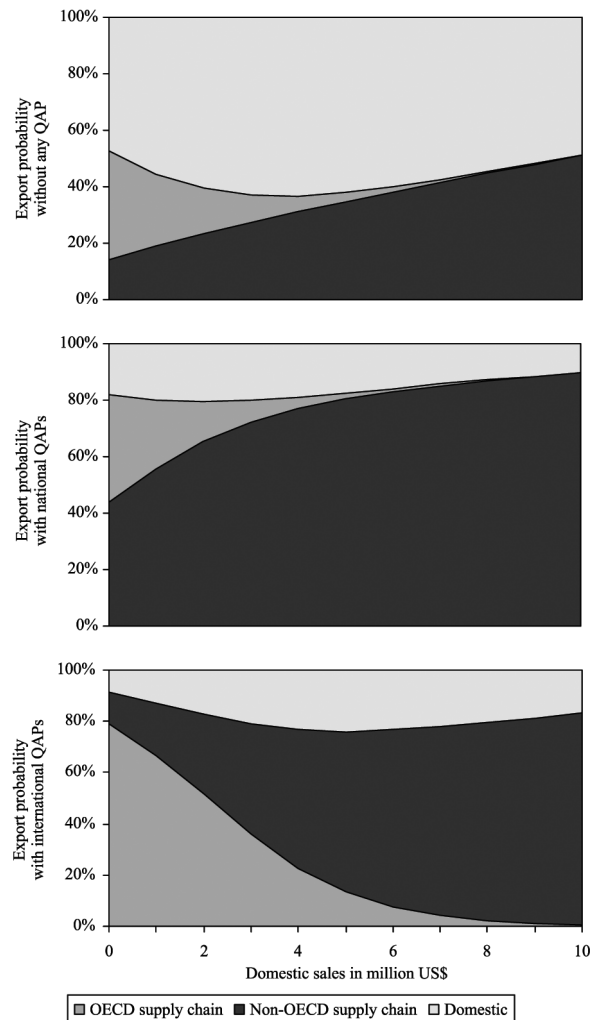
influence of different types of QAPs. The results are displayed in Figure 3. When firms do not have any QAP (upper panel in Figure 3), the probability of being part of an OECD export supply chain decreases sharply, from around 40 percent with no domestic sales to zero as domestic sales increase. Implementation of national QAPs (middle panel) hardly changes the picture for OECD supply chain participation. However, with implementation of international QAPs (lower panel), the probability of participating in OECD export supply chains increases to almost 80 percent when domestic sales are low. This probability decreases with increasing domestic sales – although less rapidly than for firms with national or no QAPs. At high levels of domestic sales, the probability to participate in OECD supply chains converges to zero, whereas the probability of being part of an export supply chain to non-OECD countries increases.

While the overall probability of exporting at a given QAP status does not vary much at different levels of domestic sales, the relative probability of exporting to OECD countries versus non-OECD countries decreases exponentially, particularly for firms with international QAPs. Therefore, domestic sales are a highly distinguishing factor for participation in export supply chains, especially when firms have international QAPs and to a lesser degree when they do not have any QAP. This confirms that there are synergies between domestic and non-OECD supply chains, whereas such synergies do not occur to the same extent with OECD supply chains. These supply chains are more demanding and therefore require a higher degree of specialization. Obviously, a complete specialization by processing firms towards OECD markets is not likely to occur, as under-quality produce, not meeting the highest standards, has to be sold at domestic or non-OECD markets. Nonetheless, the results generally support the supply chain segmentation hypothesis discussed above.

**Conclusions**

Rising consumer concerns about food safety and food quality issues have led to a growing importance of private food

Figure 3 Predicted export probabilities by domestic sales and QAPs



Source: Based on own survey data

regulations at national and international levels. Consequently, food processing firms in developing countries might face entry barriers to international supply chains. In this article, a sample of fruit and vegetable processing firms from Vietnam has been used to analyze whether the implementation of QAPs helps to improve access to export supply chains. Descriptive statistics and econometric analyses show that such programs are not a general prerequisite for exports, but that they definitely facilitate participation in international supply chains. However, the effect is supply chain specific and depends on the type of program implemented. While international QAPs – like HACCP, GLOBALGAP, or ISO 9000 – notably improve participation in export supply chains to OECD countries, national QAPs seem to be sufficient for participation in export supply chains to non-OECD countries. This suggests segmentation between domestic and non-OECD supply chains on the one hand, and OECD supply chains with higher food safety and quality requirements on the other. Supply chain segmentation is further indicated by a positive relationship between domestic sales and non-OECD exports, and a negative relationship between domestic sales and OECD exports.

Hence, horticultural processing firms in developing countries aiming to participate in export supply chains are well advised to have a QAP. The choice of QAP differentiates between supply chains. For OECD supply chains, internationally recognized QAPs facilitate supply chain participation. Nevertheless, depending on the target market, also national QAPs can be a suitable strategy for processing firms to participate in export supply chains. While national QAPs do not facilitate access to OECD markets, they improve the competitive position in non-OECD supply chains. Firms in our sample that opted for this strategy have considerably higher annual sales than both OECD exporters and processing firms in purely domestic supply chains. As non-OECD exporters are part of supply chains that have similar food safety and quality requirements as in the home country, they can exploit possible economies of scale in production and avoid possible diseconomies of scale in monitoring and coordination. This points in the direction of increasingly lucrative South-South supply chains, as also discussed by Reardon *et al.* (2007).

Our results also have implications for rural development and therefore for policy makers and development practitioners. Since the horticultural sector in Vietnam and other developing countries provides livelihoods for many of the rural poor, either as farmers or as wage laborers in primary production and processing, these people directly depend on the industry's success in export supply chains. Increasing consumer demand for high-value products offers new income earning opportunities, when food supply chains manage to adapt properly to the new conditions, as shown by Stanton and Burkink (2008). This is not only a challenge for processing firms, but also for upstream stages of the supply chain. It also confirms Matopoulos *et al.* (2007), who called for improved collaboration among supply chain actors. For instance, many managers of the exporting firms in Vietnam stated in the interviews that they have problems identifying suitable primary producers, who can supply required qualities. Therefore, comprehensive adjustments are required at different levels. This goes along with Ruben *et al.* (2007) who concluded for supermarkets in Thailand and China that with preferred supplier regimes considerable

investments are required. Adjustments in supply chains include awareness creation, training, as well as appropriate institutional and technological innovation. Policy makers are challenged to provide support that facilitates such developments, considering the wider framework conditions (Cadilhon *et al.*, 2003). In the past, development programs have often primarily targeted production issues. Our results indicate that such programs should be designed with a wider scope to include investments in human and institutional capital throughout the supply chain.

## Notes

- 1 In Vietnam, firms have to register formally, in order to start a legal business. Registration is also the basis for firm taxation. Most of the firms are registered at the federal level, although some with a limited geographical scope are only registered at the provincial level.
- 2 Alternatively, D could be expressed as the share of domestic sales in total sales. However, as this share also directly depends on the success in export markets, it might be associated with an endogeneity problem.
- 3 In official export statistics, China is the most important export destination (see Hung *et al.*, 2007), while in our sample exports to China play a smaller role. The reason is probably that exports to neighboring China are sometimes conducted by non-registered firms, or by traders of fresh, unprocessed products without further value-adding activities. Our survey explicitly focused on registered processing firms.
- 4 Exact cost calculations for QAPs are not a straightforward task; there is no general agreement on how to exactly categorize and capture different costs (Antle, 1999). Most firms in our sample did not keep detailed records of costs related to QAPs, so that we asked the managers to give a percentage estimate, taking total costs without QAPs as the reference. A similar approach has also been used in other studies (e.g. Mezher, 1999).
- 5 Beyond the QAP treatment variables, some of the covariates, such as the access to commercial credit and imported technology dummies, might potentially be endogenous. Due to the lack of suitable instruments, we could not use an instrumental variable approach. However, removing these covariates from the regressions does not much influence the other coefficients, so we conclude that there is no systematic bias concerning the treatment effects.

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