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EU's trade standards and the export performance of small and medium-sized agri-food export firms in Egypt

RESEARCH ARTICLE

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Abstract

This paper examined the export performance of Egypt's small and medium-sized agri-food firms in relation to the proliferation and intensification of EU food safety and quality standards. The empirical work that was based on a survey and the estimation of ordered probit models revealed that certification is an indispensable market access instrument for Egypt's firms to penetrate EU markets for imported agri-food commodities. The experience of firms in the agri-food export business was associated with decreasing probabilities of border rejections and exiting export markets due to standards. Furthermore, the results implied that the surveyed firms turn to less demanding markets in terms of food safety and quality requirements as these requirements become more stringent in their traditional export markets. Finally, inconclusive findings were drawn from the role of permanent and skilled firms' labor on the export performance of the surveyed firms.

Keywords: food safety and quality standards, small and medium-sized firms, ordered probit model, Egypt, European Union
JEL code: F14, Q13, Q17, C36, C83

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1. Introduction

Over the past few decades, the liberalisation of agricultural trade and globalisation of agri-food value chains have markedly promoted the exchange of agricultural and food commodities between countries (Huang, 2010). In parallel with this, a multitude of food safety and quality standards (FSQSs) has been developed by public and private sectors to address various risks associated with the safety and quality of traded agri-food commodities (Tallontire *et al.*, 2011). In recent years in particular, the standards' landscape has substantially evolved internationally, nationally and within individual supply chains in response to shifts in consumer preferences, increased demand for high-quality and safer agricultural products, food safety scandals and disease outbreaks in many countries, and growing socioeconomic and environmental concerns (Pérez-Rodríguez *et al.*, 2018). Effectively, these developments in the agri-food value chain have made FSQSs the dominant mode of competition on international markets for agri-food commodities (Schuster and Maertens, 2013).

Accordingly, the proliferation and intensification of food safety measures and quality requirements are increasingly pressuring agri-food business operators, from farmers to retailers, to implement due diligence upstream and downstream in the agri-food supply chain to ensure that the safety and quality of agri-food commodities are fulfilled (Castka *et al.*, 2015). For instance, public bodies and private actors in the European Union (EU) have responded to consumers' increased focus on the quality, nutritional and safety characteristics of imported food products by imposing stricter regulations and requirements on FSQSs (Willems *et al*., 2005). In this regard, the EU General Food Law states: 'European citizens need to have access to safe and wholesome food of the highest standard, and that food businesses are obliged to provide safe foods, implement procedures to prevent unsafe foods, be able to trace food throughout the food chain, and withdraw and recall unsafe foods' (European Commission, 2017).

Existing studies provide inconclusive evidence regarding the impacts of FSQSs and their implications for developing countries' agri-food exports. One strand in this literature shows that stringent FSQSs in developed countries raise the bar to levels that developing countries in many cases have been unable to reach (Swinnen and Vandemoortele, 2011). While increasing agri-food exports is an important policy objective in many developing countries for rural income generation and poverty alleviation, such rigorous FSQSs regulations can hamper the expansion of developing countries' agri-food exports by excluding small farmers and small and medium-sized export firms (SMAEFs) from high-value food markets (Reardon *et al.*, 2009). However, another strand of this literature, meanwhile, suggests that meeting FSQSs is part of successfully developing export markets by catalysing necessary processes of upgrading and enhancing competitiveness and the export capability of small farmers and SMAEFs (Handschuch *et al.*, 2013). Elements in this literature suggest that small farmers who participate in global supply chains with higher FSQSs have greater welfare, more income stability and shorter lean periods. FSQSs could also have significant effects on improved technology adoption, better resource management and spillovers on productivity (Henson and Jaffee, 2008). In light of these conflicting views, a recent literature review by Fontes *et al.* (2015) concluded that the evidence is mixed on the impact of developed countries' FSQSs on the inclusion of developing countries' small farmers and SMAEFs in high-standard food export chains.

If, and to what extent, these ambivalent findings in the literature apply to Egyptian agri-food exporters and how EU FSQSs influence the export performance of SMAEFs were the main research questions that this study attempted to address. More specifically, the study surveyed Egyptian SMAEFs specialising in the export of fresh fruit and vegetables to the EU to analyse empirically the extent to which EU FSQSs influence their export performance.

The study focused exclusively on the EU market for two main reasons. First, the EU is the world's largest importer of fruit and vegetables, absorbing 50% of global imports, with figures estimated at around 13 million tonnes and worth 12.5 billion euros (CBI, 2015). Around 70% of the EU's total fruit and vegetable imports originate in developing countries. This presents sound opportunities for Egyptian agri-food exporters who can benefit from Egypt's geographic proximity to the EU, which may boost their competitiveness

compared to other global exporters. Second, the EU has always been one of the most important destinations for Egyptian agri-food commodities, absorbing about one third of the country's agri-food exports during the period 2000-2016 (WITS, 2017). Fresh fruit and vegetables in particular account for around 66% of Egypt's total agri-food exports to the EU. These exported commodities are predominantly grown by small farmers and exported by SMAEFs, representing at least 90% of both Egyptian farmers and export firms (Abu Hatab and Hess, 2013; El Nour, 2015).

Over the past decade, Egyptian agri-food exports to the EU have risen from 360 million US dollars in 2004 to slightly more than one billion US dollars in 2014, recording an average annual growth rate of 17% (Figure 1). This remarkable growth in the EU's agri-food imports from Egypt is credited to the 2004 EU-Egypt Association Agreement, which promoted agricultural trade liberalisation between the two sides and increased the quota levels for many Egyptian fruit and vegetable commodities. The slowdown in growth in the last few years is probably related to the political unrest and economic instability in Egypt following the 2011 Arab Spring, which resulted in several supply shocks that negatively affected all Egyptian exports.

Despite overall improvements in the performance of Egyptian exports of fresh fruit and vegetables to the EU, FSQSs continue to present a major market access barrier to SMAEFs (El-Enbaby *et al.*, 2015). Allam *et al.* (2005) showed that the stringency of FSQSs in high-income countries negatively affects the competitiveness of Egypt's SMAEFs and represents a major factor impeding their ability to penetrate EU markets. Abu Hatab and Hess (2013) showed that EU standards are one of the fundamental obstacles facing Egyptian SMAEFs, not only because of their strictness, but also due to the lower quality of Egyptian agri-food exports. Kareem (2016) showed that border rejections of Egyptian agri-food exports to the EU due to FSQSs issues represent about 16.5% of total EU border rejections imposed on agri-food commodities originating from African countries, with Egypt having the second highest number of rejections after Morocco.

Likewise, in other developing countries, existing studies on FSQSs and the export performance of Egyptian SMAEFs have primarily diagnosed and assessed these impacts at a producer level (Asfaw *et al.*, 2010). Comparatively few studies have empirically examined the influence of developed countries' FSQSs (such as those in the EU) on Egypt's SMAEFs. This represents a significant shortcoming in the literature, particularly recognising the significant contributions of SMAEFs to rural incomes and employment in Egypt (Abu Hatab and Hess, 2013). Another related shortcoming in the literature on foreign demand for Egyptian agri-food exports is related to the more limited attention paid to horticultural commodities in favour of other agri-food commodity groups, despite their progressively increasing share in total Egyptian agri-food exports (Abu Hatab, 2016).

The present paper attempts to fill these voids in the literature by providing empirical evidence based on the experiences of a sample of specialist Egyptian SMAEFs with EU FSQSs. A deeper understanding of how EU FSQSs influence the export performance of SMAEFs could help managers of Egyptian SMAEFs and

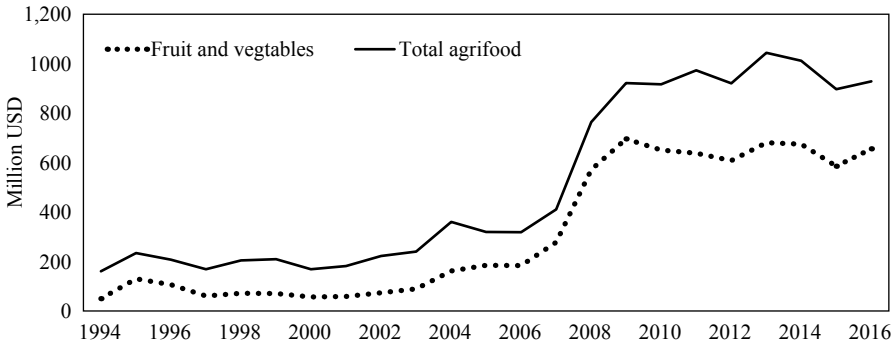

Figure 1. Evolution of Egyptian agri-food export values to the EU (WITS, 2017).

agri-food-export policymakers improve the competitiveness and export growth of these firms, which will enable them to participate in high-value food markets.

The remainder of this study is organised into four main sections. Section 2 describes the survey design, the data collection process and the empirical model. Section 3 reports the results of the descriptive survey analysis and discusses the results of the estimated ordered probit models. Finally, Section 4 summarises the findings and provides concluding remarks.

2. Survey design and empirical model

2.1 Survey design

Based on a comprehensive literature review, a paper-based questionnaire was designed to survey specialist SMAEFs, focusing on the export performance and the ability of these firms to comply with EU FSQSs. The first version of the questionnaire was translated into Arabic and submitted to two local experts in this field for review and comments. The revised version of the questionnaire was pre-tested to ensure that any misunderstandings or ambiguities in the questionnaire were clarified. The pre-test revealed the issue of respondents being unwilling to provide information on their firm's profitability and earnings. Finance-related questions were therefore reformulated using Likert-scale type of questions in order to allow respondents to select a choice from a range of sorted options. Other dependent variables were also recorded on multiple Likert scales (See Supplementary Table S1). This scaling method has been a preferred tool in similar studies because it is easy to construct and it does not force participants to take a stand on the topic in question but allows them to respond in a degree of agreement, making questions' answering easier for respondents (Kruger and Welman, 2001).

The final version of the questionnaire consisted of structured and open-ended questions, and contained eight sub-sections to obtain specific information on: (1) the firm's characteristics; (2) the firm's awareness of different FSQSs certifications; (3) the firm's perception and application of FSQSs, 4) the firm's experience of border rejections; (5) the firm's compliance strategy with agri-food standards; (6) the costs of compliance with quality and safety requirements; (7) the role of institutions and the assistance provided by Egyptian export authorities to SMAEFs; and (8) the firm's views on how to improve the ability of Egypt's agri-food exporters to meet EU food safety and quality requirements.

The sample consisted of small and medium-sized firms specialising in fresh fruit and vegetable exports to the EU. The authors were able to obtain an inventory of Egyptian SMAEFs from the General Organization for Export and Import Control in Egypt[1]. It included contact information for 216 SMAEFs that are actively involved in laboratory testing and consultancy with respect to FSQSs for export purposes. The 216 firms were contacted, the objectives of this work were explained, and they were invited to participate in the study. At the end of this communication process[2], it was possible to successfully conduct the data collection with 89 SMAEFs, corresponding to a response rate of 41.2%. Compared to the response rate of similar studies carried out with Egyptian agri-food exporting firms, this is among the highest achieved so far. For instance, Hassan (2016) and Abu Hatab and Hess (2013) investigated a sample of SMAEFs in Egypt and achieved a response rate of about 20.3% and 25% respectively.

In relation to SMAEFs that declined to participate in our survey, we could confidently argue that they share common characteristics with the 89 firms included in this study. Based on the information included in the SMAEFs' inventory obtained from the General Organisation for Export and Import Control (GOEIC) in Egypt as well as the respective websites of these firms, we found that they have more or less similar employment sizes, experiences in agri-food business and specialization in agri-food export to the EU. Thus, we believe

[1] This list is not freely accessible, but can be provided by the authors upon request.

[2] 117 firms agreed to participate. Of these, 16 firms cancelled their meeting due to unavailability and other business commitments. A further 12 firms that were interviewed did not respond to all the questions and thus were excluded.

that this study has captured a reasonably representative sample of Egypt's SMAEFs exporting agri-food commodities to the EU market.

Respondents to the questionnaire were key staff with knowledge of FSQSs and the practices within their firms, and included company owners, export managers, food safety officers, quality control managers and individuals within these firms who make decisions regarding FSQSs and agri-food exports. These groups were targeted because it was assumed that they would have the required knowledge and experience to provide practical information about the influence of FSQSs on their firm's agri-food exports.

2.2 The empirical model

The empirical analysis in this paper aimed to investigate how FSQSs set by the EU influence the export performance of Egyptian SMAEFs. Given that 'export performance' is unobservable *per se*, three proxies were identified – as shown in Supplementary Table S1 – to describe the export performance of Egypt's SMAEFs. Specifically, in light of recent studies that have examined the impact of FSQSs on agri-food exports from developing countries (e.g. Beestermöller *et al.,* 2018), the following three proxies were identified.

The first proxy, denoted 'export to total sales', is the share of agri-food exports to the EU of a firm's total sales. Responses related to this variable were coded on a Likert scale ranging from 1 (<30%) to 4 (>70%). The greater a firm's 'export to total sales', the higher its export performance. The second proxy, termed 'rejection frequency', captures the frequency and recurrence of border rejections of firms' agri-food exports by the EU. If a firm had experienced a border rejection, it was asked to rate the frequency of rejection on a Likert scale ranging from 1 (no rejection) to 6 (very frequent). It was hypothesised that the lower the 'rejection frequency', the better a firm's export performance. The third proxy, denoted 'export market shift', assesses a firm's capability to shift exports from one export market to another due to challenges associated with compliance with the required FSQSs. If a firm had experienced an export market shift process, it was asked to rate the easiness of the process on a Likert scale ranging from 1 (no market shift) to 6 (very difficult). The easier the export market shift process for a SMAEF, the higher its export performance.

Moreover, a set of independent variables (denoted by X) expected to have an influence on each of the export performance proxies are defined in Supplementary Table 1 and were included in the estimated econometric models. All these independent variables are categorical by nature and were coded on a Likert scale to capture the relevant answers of the surveyed SMAEFs.

Empirically, as the three export performance indicators (the dependent variables) defined as y_i, for i=1, 2, ..., N observations, are categorical, the use of an ordered probit model (OPM) is appropriate (Greene, 2012). As the OPM follows a standard normal probability distribution function and has a white noise error term, it is often used as a preferred discrete choice model since it constrains the resulting probabilities within the theoretically correct [0-1] probability range. Thus, in this econometric setting, the OPM for the observed and ordered y_i is derived from a latent variable y^* related to the above-mentioned set of explanatory variables through the following relationships:

$$P(y_i=j) = P(y_i^* \text{ falls within the } j^{th} \text{ category of } y_i) \quad (1)$$

and

$$y_i^* = \alpha_i + \beta X_i + e_i \quad (2)$$

where e_i is an error term following a standard normal distribution.

The above OPM model can be estimated using a maximum likelihood estimation procedure. However, the estimation of the parameter vector is complicated by the fact that some of the regressors contained in $\boldsymbol{X}$

are potentially endogenous and therefore correlated with the random error term *e*. In order to take this into account, an extended OPM model with endogenous regressors $\boldsymbol{W}$ was specified as follows:

$$y_i^* = \boldsymbol{X}_i\boldsymbol{\beta} + \boldsymbol{W}_{ci}\boldsymbol{\beta}_c + e_{ci} \quad (3a)$$

$$\boldsymbol{W}_{ci}^* = X_i\boldsymbol{A}_c + \varepsilon_{ci} \quad (3b)$$

where $\boldsymbol{A}_c$ is a vector of parameters, and (e_{ci}, ε_{ci}) are error terms independent from $\boldsymbol{X}_i$ and jointly normally distributed with mean 0 and covariance $\Sigma = \begin{bmatrix} 1 & \rho'_{e\varepsilon} \\ \rho_{e\varepsilon} & \Sigma_\varepsilon \end{bmatrix}$.

The matrix of endogenous regressors *W* must include instruments that do not belong to the set of independent variables *X*. This is necessary in order to ensure that the parameter vector β in the structural OPM model (Equation 3a) is identifiable (Wooldridge, 2010). Furthermore, since all regressors involved in Equation 3b are categorical and ordered, they are estimated simultaneously with Equation 3a by pseudo-maximum likelihood procedures using the extended ordered probit regression option of STATA 15 (StataCorp LLC, 2017).

In the OPM, it is well known that neither the sign nor the magnitude of the estimated parameter β can be directly interpreted, and thus the marginal responses of the regressors need to be calculated in order to understand and interpret the effects of each explanatory variable in OPMs (Greene, 2012). For this reason the marginal effects (*dy/dx*) of changes in the regressors were calculated on the dependent variable once the OPMs were estimated. These marginal effects for a given regressor, when added, should sum to zero by cancelling each other out across the response categories.

3. Results and discussion

3.1 Descriptive survey analysis

■ *Firm characteristics*

The survey results showed that SMAEFs in the sample had different levels of experience in the agri-food export business: 36% had been operating for over 20 years, 43% for 10 to 20 years, and 21% had less than ten years' experience in agri-food exports. Since the respondents did not reveal any financial data about their respective firms, the total number of employees in the firms served as a proxy for firm size. About three quarters of the surveyed firms employed fewer than 50 permanent workers. Moreover, almost all the surveyed firms employed temporary (seasonal) workers, with most of them having no more than 100 additional seasonal workers.

The firms were asked to evaluate the availability of skilled labour to cope with FSQSs using a six-point Likert scale ranging between 'very easily available' and 'very rarely available'. None of the surveyed firms responded that skilled workers were very easily available, and the category 'easily available' was chosen by just 3% of the respondents. In contrast, most firms agreed that qualified personnel were not available or were rarely available. Consequently, the majority of exporting firms encountered difficulties extending their export share.

In terms of annual sales to foreign markets, the results indicated that most firms had export sales ranging at between 30% and 70% of their total sales. However, 20% of the firms stated that they had less than 30% export sales as a proportion of total sales, while a similar number of firms recorded an export share of more than 70%. The major agri-food exports among the surveyed firms consisted of fresh vegetables (48%), fresh fruit (30%), frozen fruit and vegetables (13%), processed agri-food products (3%) and other agri-food commodities (6%). The prevalence of horticultural exports in Egyptian agri-food exports to the EU is a typical pattern in EU food trade with developing countries. In this respect, Okello (2011) points out that trade liberalisation

efforts between the EU and many developing countries over the past few decades have, together with low labour costs in developing countries and climatic differences between the two sides, made it possible for developing countries to meet year-round demand for horticultural commodities in EU member countries.

Respondents were asked to evaluate the share of their agri-food exports to the EU at two different points in time: 2008-2010 and 2011-2012. The objective was to assess whether there had been a change in the export share of the surveyed firms following the 2011 socio-political revolts (known as the Arab Spring) which generally had a significant negative effect on the Egyptian agricultural export sector. As shown in Figure 2, the proportion of firms generating less than 30% of their turnover from exports more than doubled from 13% to 28% between the two periods. As a follow-up question, firms were asked to assess how the agri-food sector's performance had changed since 2011. Around 11% of the firms described the situation as being better or much better than before 2011, whereas 72% indicated that the situation was worse or much worse.

Figure 3 summarises the firms' responses to a question on their perception of their greatest strengths in EU agri-food export markets (multiple responses were allowed). As can be seen from Figure 3, SMAEFs saw their greatest strengths in the seasonality and the extended seasonal availability of their agri-food commodities (70%). Around half of the surveyed firms (52%) referred to 'price competitiveness' which give Egyptian SMAEFs greater comparative advantage on EU markets. Interestingly, less than one-third of the surveyed firms referred to criteria related to FSQSs such as quality of the exported agri-food commodities (20%) and food safety control and traceability of exports (31%). Equally frequently cited were aspects related to marketing such as advertising and promotion plans, and R&D and market research (31%). Furthermore, a

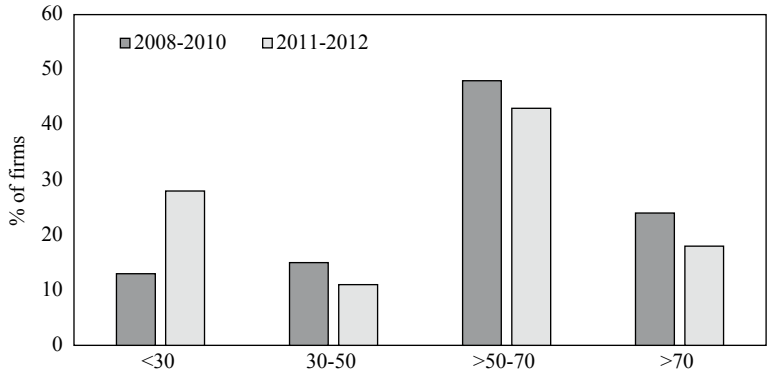

Figure 2. Firms' agri-food export sales to the EU as a percentage of their total sales.

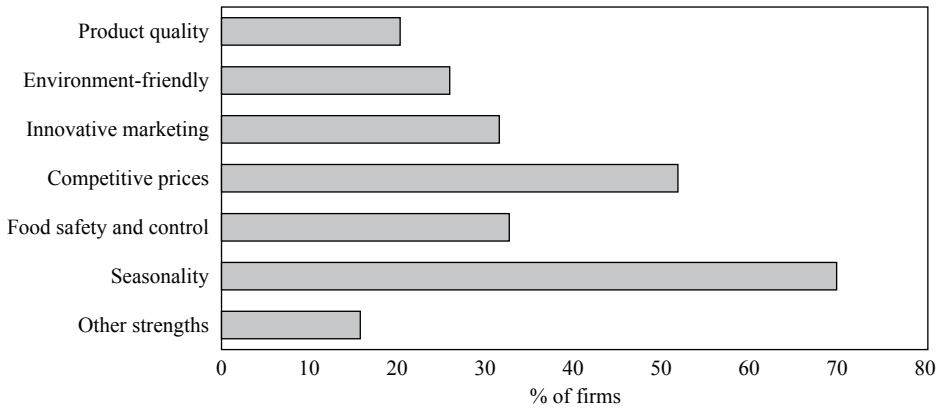

Figure 3. Firms' perception of their export strengths in the EU agri-food market.

quarter of the surveyed firms perceived their strengths in the adoption of environment-friendly and good agricultural production practices, such as organic farming. Finally, 16% of the firms saw their export strengths in other aspects such as proximity to export ports and agricultural production areas.

■ *Awareness and implementation of certification systems*

The questionnaire contained a list of 15 major FSQSs certification systems. The respondents were asked to tick a five-point Likert scale about their awareness of the various systems. Furthermore, they were asked whether these standards had already been implemented. Supplementary Table S2 shows that GlobalGAP followed by ISO 90001:2008 and ISO 14001 were the best known systems to the investigated firms. Although the adoption of GlobalGAP is voluntary, the surveyed firms pointed out that it is increasingly becoming *de facto* mandatory for the export of agri-food commodities to the EU. In this regard, Henson *et al.* (2011) found that compliance with GlobalGAP increases export revenues for fresh produce-exporting firms in African countries. With regard to other certification systems, around two thirds of respondents were fully aware or aware of the HACCP and ISO 22000 control systems. The SQF 2000/2001 system and the production safety standards GMP and BASC were comparatively less known.

Supplementary Table S2 provides a breakdown of the surveyed firms by the certification status of each of these FSQSs schemes. The results related to certification status point out that the standards of which most firms were aware are in line with the standards they had already implemented or were planning to implement. The most common reason given by the surveyed firms for certification was to reduce rejections (88% of respondents). The second most frequently given reason was that certification was required by their respective importer (81% of respondents). It was further indicated that more sales could be achieved if a particular system was implemented (64% of respondents) and that improvements in bargaining power with the importer were considered (70% of respondents). Enhancing their reputation and competitiveness (62% of respondents) was also given as a reason for implementing certification systems.

■ *Perception and application of FSQSs*

As noted by Henson and Humphrey (2010), cross-country differences among EU agri-food retailers regarding the development and enforcement of FSQSs schemes could impede exports from developing countries. To capture this effect for Egyptian SMAEFs, the surveyed firms were asked about the extent to which FSQSs influence their choice of export market. Almost all firms (96%) stated that it was very important or important. Only 6% indicated that the choice of export market was partly influenced by standards, and none agreed that FSQSs did not influence the choice of export market at all.

Figure 4 portrays export markets with the most stringent requirements for imports in the opinion of the surveyed SMAEFs. Specifically, Figure 4 presents the frequency with which an individual importing market was cited by the responding firms relative to the total number citations by the surveyed firms. It is noticeable that alongside many EU states, non-EU states such as Israel and Turkey also set high standards, while the USA and Canada are placed last. However, this can be explained by the fact that most agri-food products – particularly fruit and vegetables – are highly perishable, thus concentrating the exports of SMAEFs to neighbouring EU and other Middle Eastern countries (e.g. Turkey, Israel, and Saudi Arabia).

As to the question of whether the firms consider FSQSs and their requirements to be justified, nearly half of them believed that EU FSQSs are 'unjustified' or 'very unjustified'. Only 19% agreed that the FSQSs demands by the EU were 'very justified' or 'justified'. Such widespread perceptions regarding the justification of EU FSQSs could be a factor compounding firms' compliance with EU food standard requirements. According to Yapp and Fairman (2006), this may lead to more complex attitudinal issues within SMAEFs, including: (1) a lack of trust in the purposes behind FSQSs so that they start to be seen as discriminatory against non-EU exporters; (2) poor knowledge and understanding of FSQSs and their implementation; and (3) a lack of motivation in dealing and complying with FSQSs.

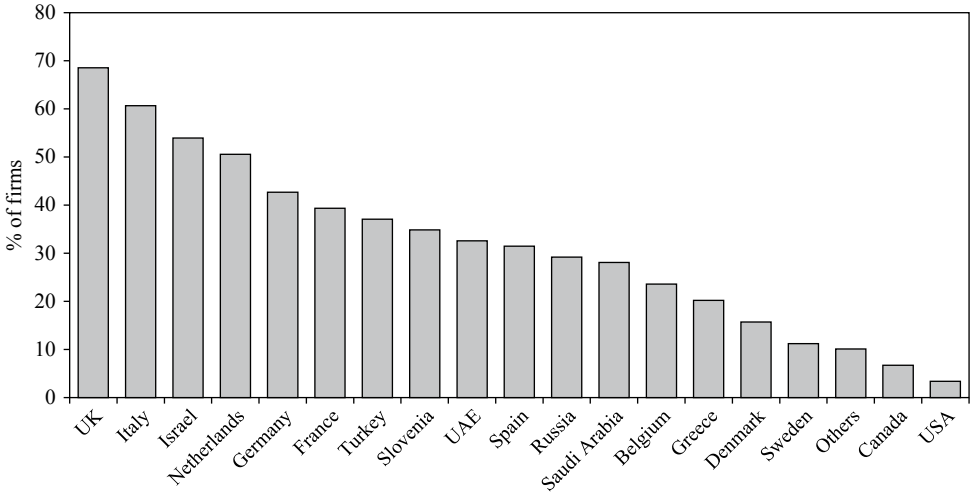

Figure 4. Export markets with the most stringent standard requirements as perceived by the surveyed firms.

■ *Companies' experience of agri-food shipment rejection due to food safety and quality standards*

Around 40% of the interviewed SMAEFs had had shipments returned due to non-compliance with FSQSs required by the EU. The main reasons for rejections included microbiological contamination, insects, chemical residues and damaged packaging. In more than 50% of cases, the reasons given for failure to meet FSQSs were a lack of information, insufficient technological equipment, and a lack of access to credit and financial services to invest in enhanced food quality and supply chain controls.

To avoid the rejection of shipments, the surveyed firms implemented different strategies, including: (1) sending product samples to certified laboratories for testing for chemical contamination; (2) performing internal tests before harvest, during processing and during packaging to check whether the agri-food products fulfilled requirements; (3) implementing internal quality control and traceability systems; (4) testing for pesticides; and (4) outsourcing product labelling and packaging to specialist firms.

■ *Strategy and benefits for companies' compliance with changes in food safety and quality standards*

Since new or additional FSQSs can be expected to come into force from time to time, firms were asked how they would cope with such changes. The majority replied that they would comply with changes in FSQSs, 25% said they would redirect their agri-food export to the domestic market as a way of bypassing compliance with standards, and fewer than 10% said that they would stop supplying to the export market. Overall, the respondents saw the greatest benefits of complying with FSQSs to be a significant reduction in returned shipments (74%), improved market access (65%), reduced product control and impoundments (54%), and an enhanced company reputation (52%).

In relation to the redirection of exports to the domestic market due to FSQSs, about two-thirds of the sample SMAEFs said that they had done so. The proportions that were redirected were remarkable: half of the firms redirected between 20% and 60% of their exports and about 40% sent up to 20% of their exports to the domestic market instead of exporting them to the EU. Furthermore, half of the firms indicated that these standards led them to switch from their traditional export markets to a different one (not the domestic market). Of these, about two-thirds stated that the process of shifting direction was difficult or very difficult to manage.

■ *Cost of compliance with food safety and quality standards*

Compliance with EU FSQSs incurred costs for the surveyed firms. As defined by the World Bank (2005), compliance costs include all additional expenses necessarily incurred in meeting the requirement to comply with a given standard in a given market. Examples of these costs include costs for physical upgrading, costs for human capital upgrading, management costs, the opportunity costs resulting from changes in firm's sales, and social costs (Kersting and Wollni, 2012). The results of the present survey show that almost half of the sample SMAEFs stated that these costs represented less than 20% of their total export costs, while the remaining firms estimated them to be between 20% and 40%. Most firms bore those costs themselves or took out a loan. Non-governmental export-promoting organisations supported about one-third of them and one quarter were backed by the government.

The extent to which efficient support for SMAEFs can be promoted by institutions is an interesting question. The firms were asked to evaluate different export support institutions with regard to the quality of their services provided to agri-food exporters. On average SMAEFs regarded these institutions as very efficient (16%), efficient (21%), less efficient (26%) and not efficient (37%). In this respect, several studies have documented that poor institutional capacity to foster the organisation of SMAEFs and the mismatch between the objectives of agricultural export strategies and their implementation in practice represent critical barriers to SMAEFs' export promotion (Tellioglu and Konandreas, 2017).

3.2 Ordered probit model results

The econometric results of the estimated OPMs explaining the export performance of Egyptian SMAEFs are presented in Table 1[3] and the marginal effects of each regressor on the three dependent variables are reported in Table 2. As indicated earlier, eight explanatory variables have been considered to be key factors in influencing the export performance of the surveyed SMAEs. Supplementary Table S2 provides relevant

[3] Cut-off estimates for the structural OPM (Equation 3a) and the endogenous regressor Equation 3b are not included in Table 1 due to the lack of space. They are available upon request from the authors.

Table 1. Regression results from three ordered probit models with endogenous covariates.[1,2]

Explanatory & instrumental variables	**Model 1 Export to total sales**	**Model 2 Rejection frequency**	**Model 3 Export market shift**
Structural ordered probit models (Equation 3a)			
Years of experience	0.6576 (0.0126)**	-1.2492 (0.0065)***	0.1367 (0.2688)
Permanent labour	1.0241 (0.2051)	0.2298 (0.4907)	0.3573 (0.0887)*
Seasonal labour	-0.2019 (0.0771)*	0.2147 (0.1520)*	-0.1032 (0.5857)
Skilled labour availability	-0.0405 (0.6573)	-0.1211 (0.6136)	-0.2356 (0.0186)**
Compliance cost	0.1178 (0.0891)*	0.0458 (0.7454)	0.0514 (0.4360)
Number of implemented FSQSs	0.1583 (0.1875)	0.1362 (0.0004)***	0.2239 (0.1860)
Response to changes in FSQSs	0.1520 (0.1076)	-0.3487 (0.0280)**	1.1122 (0.0038)***
Redirected exports	0.1357 (0.0506)*	0.4718 (0.1067)	0.2933 (0.0158)**
Auxiliary model for the endogenous regressors (Equation 3b)			
Reject reason (spoilage)	-1.7093 (0.1251)	-1.0487 (0.1190)	-0.444 (0.1286)
Reject reason (insects)	-0.2870 (0.2347)	-0.5068 (0.0725)	0.5110 (0.2842)
Reject reason (pesticides)	1.0351 (0.1061)	0.0992 (0.7518)	-0.0891 (0.8923)
Log pseudo-likelihood	-173.5	-171.7	-169.0
corr(e_{ci}, e_{ci})	0.3814 (0.0002)***	0.4141 (0.2080)	-0.8509 (0.0000)***

[1] *P*-values are in parentheses. Significance levels: 1%***, 5%** and 10%*.

[2] The endogenous regressor for the models are the variables 'permanent labor', 'years of experience' and 'response to changes in FSQs'.

Table 2. Calculated marginal effects based on the estimated ordered probit models for export performance.[1,2,3,4]

Determinants of export performance		Model 1 Export to total sales		Model 2 Rejection frequency		Model 3 Market shift	
Explanatory variables	**Level of dependent variables**	**dy/dx**	***P*>|z|**	**dy/dx**	***P*>|z|**	**dy/dx**	***P*>|z|**
Years of experience	1	-0.1372	0.1055	0.3121***	0.0016	-0.0490	0.2853
	2	-0.0802	0.4860	-0.0207**	0.0306	0.0012	0.4403
	3	0.0639	0.3504	-0.0626**	0.0418	0.0031	0.1602
	4	0.1535	0.1841	-0.0389***	0.0000	0.0069	0.2886
	5			-0.0792***	0.0000	0.0203	0.2247
	6			-0.1108	0.4152	0.0174	0.4180
Permanent labour	1	-0.2067	0.3547	-0.0760	0.4280	-0.1281*	0.0537
	2	-0.0810	0.3936	0.0118	0.5546	0.0031	0.4858
	3	0.0668	0.3859	0.0254	0.4687	0.0082	0.1324
	4	0.2210	0.2709	0.0111	0.3594	0.0181***	0.0031
	5			0.0160	0.4194	0.0531	0.1163
	6			0.0117	0.2483	0.0456	0.1270
Seasonal labour	1	0.0421	0.1093	-0.0711*	0.0775	0.0370	0.5932
	2	0.0246	0.5538	0.0111*	0.0794	-0.0009	0.5956
	3	-0.0196	0.5815	0.0238**	0.0267	-0.0024	0.5248
	4	-0.0471***	0.0012	0.0104	0.1032	-0.0052	0.5086
	5			0.0149	0.1501	-0.0153	0.5943
	6			0.0110	0.3071	-0.0132	0.6395
Available skilled labour	1	0.0085	0.6080	0.0401	0.5713	0.0844***	0.0036
	2	0.0049	0.7587	-0.0062	0.6191	-0.0021	0.4362
	3	-0.0039	0.7049	-0.0134	0.5879	-0.0054	0.1393
	4	-0.0095	0.6742	-0.0059	0.5605	-0.0119	0.1593
	5			-0.0084	0.5778	-0.0350**	0.0413
	6			-0.0062	0.5043	-0.0301***	0.0001
Compliance cost	1	-0.0246	0.3459	-0.0152	0.7316	-0.0184	0.4103
	2	-0.0144	0.4010	0.0024	0.7614	0.0004	0.6164
	3	0.0114	0.5552	0.0051	0.7460	0.0012	0.4801
	4	0.0275**	0.0176	0.0022	0.7231	0.0026	0.3460
	5			0.0032	0.7215	0.0076	0.4627
	6			0.0023	0.6816	0.0066	0.3837
Number of implemented FSQSs	1	-0.0330	0.3543	-0.0451**	0.0346	-0.0802	0.1470
	2	-0.0193	0.4712	0.0070**	0.0340	0.0020	0.5043
	3	0.0154	0.5734	0.0151**	0.0160	0.0051	0.3468
	4	0.0369*	0.0964	0.0066*	0.0732	0.0113	0.3973
	5			0.0095**	0.0379	0.0333	0.1847
	6			0.0070	0.2931	0.0286**	0.0171
Response to FSQSs changes	1	-0.0317	0.3051	0.1154**	0.0158	-0.2891***	0.0063
	2	-0.0185	0.4467	-0.0180**	0.0235	-0.0000	0.9990
	3	0.0148	0.2707	-0.0386**	0.0181	0.0030	0.7248
	4	0.0355	0.3259	-0.0169*	0.0696	0.0138	0.3451
	5			-0.0242**	0.0256	0.0858***	0.0000
	6			-0.0178	0.2072	0.1865	0.1410
Redirected exports	1	-0.0283	0.3207	-0.1562***	0.0083	-0.1051***	0.0045
	2	-0.0166	0.3384	0.0243	0.2169	0.0026	0.4126
	3	0.0132	0.2982	0.0522*	0.0601	0.0067	0.1667
	4	0.0317	0.2383	0.0228***	0.0003	0.0148	0.2785
	5			0.0328***	0.0061	0.0436***	0.0207
	6			0.0241***	0.0001	0.0374***	0.0000

[1] dy/dx: marginal changes. Marginal effects have been estimated using the Delta method.

[2] FAQSs: food safety and quality standards.

[3] Significance levels: 1%***, 5%** and 10%*

[4] The levels of the dependent variables refer to different Likert scales as defined in Supplementary Table S1. As stated earlier, note the sum of the marginal effects of the given explanatory variable on the levels of the dependent variable is being equal to zero.

statistical information on these eight explanatory variables. The following sub-sections highlight the econometric performance of the three estimated OPMs and then proceed with a presentation and discussion of the marginal effects that are deemed to be significant and/or meaningful.

■ *Econometric performance*

An inspection of the econometric results indicates that four regressors are statistically significant in each model for significance levels of 10%, 5% and 1%[4]. The variable 'years of experience' influenced two of the three export performance proxies in a significant manner. Also other regressors are statistically significant in two model specifications. This occurred for the variable 'redirect exports', 'seasonal labour' and 'response to changes in FSQS'. Multicollinearity among the eight explanatory variables entering the three structural OPMs did not seem to be a problem, as shown by the estimated Spearman rank correlation coefficients whose estimates were below |0.5|[5] (see Supplementary Table S3 for more details).

An important issue that needs to be addressed concerns the potential occurrence of endogeneity among the eight regressors in the three structural OPMs. From a statistical point of view, the explanatory variables in a regression and the residuals will be correlated, causing biased and inconsistent estimates of the regressors. In order to test each regressor for such a potential correlation with the residuals, the procedure proposed by Davidson and MacKinnon (1993) and for the case of the OPM by Wooldrige (2015) has been used: (1) each potentially endogenous right-hand side variable is regressed on all other exogenous variables of the regression plus a set of available external instruments; (2) the residuals from this regression are saved and added as a regressor to the main regression of interest; and (3) if these residuals appear significant, the corresponding variable is treated as an endogenous regressor. The instruments were selected on the basis of their statistical significance and lack of correlation with the error terms e_{ci} and ε_{ci}. Due to this process, Equation 3b included the three external instruments 'Rejection reason (spoilage)', 'Rejection reason (insects)' and 'Rejection reason (pesticides)' that are excluded from Equation 3a. The endogenous covariates in the three models are the variables 'Permanent labor' (P=0.087), 'Years of experience' (P=0.029) and 'Response to changes in FSQs' (P=0.014), respectively. The corresponding P-values refer to the level of significance at which exogeneity for each of these regressors was rejected based on the testing procedure described above.

In two out of the three models (Models 1 and 3), the estimated correlation coefficients ρ between error terms were significantly different from zero, thus confirming the endogeneity of the selected regressors. Concerning Model 2, although the correlation coefficient ρ was not statistically different from zero, the two-equation specification was estimated simultaneously because endogeneity could not be rejected according to the Davidson and MacKinnon (1993) endogeneity test.

■ *Marginal effects: presentation and discussion*

Among the explanatory variables influencing the export performance of Egyptian agri-food SMAEFs, 'years of experience', 'Number of implemented FSQSs', 'Response to FSQSs changes' and 'redirected exports' showed the most significant and consistent marginal effects among the three OPM models. Looking at the results pertaining to Model 2, the marginal effects of 'years of experience' on almost all the categories of the dependent variable (rejection frequency) were statistically significant. In particular, the negative marginal effects for the dependent variable's categories between 2 (very infrequent rejections) and 6 (very frequent rejections) implied that the probability of export rejection falls with the number of years a SMAEF has been involved in the agri-food export business. By contrast the opposite effect occurred when SMAEFs have a low probability of no rejection.

[4] A robust estimation procedure has been adopted to compute the standard errors of the estimated coefficients.

[5] This pattern in the lack of multicollinearity among the eight regressors is confirmed by the value of the condition number, which is equal to 2.45. Concerning Equation 3b, multicollinearity is not a problem as the majority of selected instruments have associated coefficients that are significantly different from zero.

The total number of permanent and temporary (seasonal) workers was used as proxies for firm size. It is expected that the higher the number of permanent and seasonal workers, the greater the probability that a firm's export share would be and likely exceed 50% of its total sales (Beestermöller *et al.*, 2018). However, this pattern, which occurs for the marginal effects related to the variable 'permanent labour' in Model 1, was statistically insignificant. Meanwhile, the same marginal effect estimated for Model 3 indicated that there is a monotonic' relationship between the dependent variable and the numbers of permanent workers employed by the surveyed firms. Thus, larger SMAEFs that have a larger pool of permanent workers have a greater capacity to shift to other export markets as FSQSs in their initial export markets become stricter.

Regarding seasonal labour, it is worth mentioning that a higher seasonal labour force induces increases in exports when the export-to-sales ratio is less than 50%. In this latter case, the associated marginal effect estimates were positive but statistically insignificant. On the other hand the same marginal effect becomes negative when the export-to-sales ratio is greater than 50%, and even statistically significant when it exceeds 70%. In such circumstances, as their food exports may decline, these SMAEFs have an interest in hiring less temporary seasonal labour and rely more on their permanent staff. Looking at the marginal response results of seasonal labour on rejection frequency, it would seem that a larger pool of seasonal labour would result in the likelihood of more rejections. This finding would support the idea that Egyptian agri-food SMAEFs exporters may need to use more skilled labour if they want to reduce the frequency of rejections.

Turning now to the regressor 'available skilled labour', the examination of its estimated marginal effects revealed that only those obtained for Model 3 were statistically significant for half of the six estimated marginal effects. Furthermore, the estimated marginal effect is positive when export firms experienced no need for a market shift due to more stringent FSQS (level 1 of the dependent variable) while it becomes negative for all the remaining levels (i.e. levels 2 to 6) when export firms find it more and more difficult to shift to other export markets. These findings lead us to draw the following conclusion: if SMAEFs were able to acquire skilled labour to ensure compliance with importing markets FSQSs, the less likely they would be to exit their traditional export markets and seek other ones. This latter finding is in contrast to that obtained for the impact of permanent labour, which tends to favour SMAEF strategies to promote agri-food exports to new foreign markets away from the EU. This 'opposition' between these two results was unexpected and difficult to interpret. This state of affairs was made even harder to analyse by the fact that both categories of permanent and available skilled labour have statistically insignificant impact on improving the export performance of SMAEFs to the EU market. However, a tentative interpretation could be that surveyed export firms would develop a division of tasks to be performed by permanent and available skilled staff. While the former, which are not likely to specialise in technical matters dealing with FSQSs, would tend to look after or monitor new foreign markets in order to 'bypass' stricter FSQSs, the latter, because of their technical knowledge on FSQS, would be involved in tasks aimed at maintaining and expanding SMAEF export shares of agri-food products to the EU. It could also be argued that all of the above findings may possibly reveal firms' inability to attract 'skilled' workers, viewed as employees with a high degree of formal education, to undertake agri-food export handling operations and manage food quality and safety matters with the aim of increasing the probability of achieving larger export shares. These questions concerning the above findings, which are counterintuitive and difficult to interpret, should also be related to the relatively poor quality of higher agricultural education in Egypt that fails to produce agricultural graduates with relevant skills and training to meet the needs of agri-food export labour markets (Swanson *et al.*, 2007).

The estimated marginal effects for Model 1 seemed to reveal another interesting pattern. Indeed, the more standards are implemented, the higher the probability a firm increases its exports when its export-to-total sales ratio is above 70%. When this is high, compliance costs also tend to be high. Such findings are in line with other studies that have concluded that compliance with FSQSs is associated with significant costs for export firms, in particular for small firms (e.g. Asfaw *et al.*, 2010). Concerning Models 2 and 3, the cost of compliance with the EU FSQSs did not yield significant marginal responses.

In relation to the regressor 'response to changes in standards', the calculated marginal effects associated with all ordered categories of the dependent variable in Model 2 had the expected signs. Looking at the marginal effect results of Model 3, it seems that the more responsive a firm is to changes in FSQSs, the higher the probability of it shifting from one export market to another. Indeed, it could be argued that firms' responses to changes in FSQSs reflect the fact that Egyptian SMAEFs turn to markets with less strict FSQSs or lower compliance costs. This finding concurs with the findings of Abu Hatab and Hess (2013) who show that the strictness of FSQSs and firms' ability to meet them represent a major criterion based on which Egyptian SMAEFs rely to identify their foreign target markets[6]. This pattern is furthermore confirmed by Barrientos (2012) who highlights the fact that agri-food export firms in developing countries are increasingly looking to alternative markets that are less demanding in terms of FSQSs compliance and certification requirements.

Regarding the possibility of redirecting exports towards the domestic market, a very significant relationship occurred between this explanatory variable and the frequency of shipment rejection (Model 2). Redirecting exports to the domestic market by SMAEFs was associated with a higher probability of facing more frequent rejections by the importing markets. The marginal effects of this explanatory variable for Model 3 revealed that the higher the redirection rate of agri-food commodities intended for export towards the domestic market due to FSQSs, the more likely that a firm would shift its agri-food sales from one export market to others. This finding is unsurprising since it could be assumed that exports would shift towards other export markets that are characterised by less stringent FSQSs than those in the domestic Egyptian market. Moreover, it could be expected that exporters who redirect their commodities towards the domestic markets also have a strategy to seek other export markets to avoid stringent FSQSs in their importing markets. It should be highlighted that three out of six estimated marginal changes were statistically significant.

4. Summary and concluding remarks

Based on a survey of specialist SMAEFs in Egypt, this paper examined the export performance of Egypt's SMAEFs, focusing on their ability to comply with the EU food quality and safety standards. The empirical results revealed that firms' experience in the agri-food export business significantly improves their performance by reducing the probability of border rejections by the EU and decreasing the probability of exiting a current export market due to FSQSs. Moreover, the results pointed out that larger SMAEFs, which have a greater pool of permanent workers, were found to have a higher capacity to shift to other export markets as FSQSs requirements in their traditional export markets become stricter.

Furthermore, the results illustrated that certification is increasingly becoming an indispensable instrument for SMAEFs' entry to the EU agri-food market. The higher the number of adopted certification schemes, the greater the probability that a firm's agri-food exports would exceed 70% of its total sales. In the same context, the results implied that Egyptian SMAEFs tend to respond to changes in food quality and safety standards with the objective of reducing the frequency of rejections by EU authorities. In this process, they also tend to turn to less demanding markets in terms of FSQSs compliance and certification requirements as FSQSs requirements in their traditional export markets become more stringent.

Unexpectedly, the empirical results revealed some contradictory effects of the various categories of labour on the export performance of Egyptian SMAEFs. Thus, permanent and available skilled labour do not seem to promote the strategies aimed at expanding exports of agri-food products to the EU. In addition, the two categories of labour have opposite effects on exporters' policies to diversify their foreign markets to places other than the EU. The permanent labour force would tend to have a positive impact on SMAEFs willing to shift to export markets other than the EU, while the pool of available skilled labour would rather focus on tasks aimed at strengthening and expanding the exports of agri-food products to EU markets. This lack of convergence on the impacts of the categories of permanent and skilled labour on the export performance

[6] As also noted by El-Miniawy and Gouell (1994), Egyptian agri-food exporters seem to focus mainly on profit maximisation and pay less attention to maintaining their position and the stability of their exports on the import markets.

of Egyptian SMAEFs leads to the development of uncertain explanations and conclusions on SMAEFs' strategies to hire permanent, skilled and temporary staff.

The findings of this paper have several implications for policy formulation and implementation. First, they indicate that it might be necessary to rethink the established paradigm regarding the role of compliance costs as a fixed-cost investment for SMAEFs. Agricultural export policies should more carefully address other factors and non-monetary constraints along the agri-food export supply chains that may have an influential impact on SMAEFs' export performance.

Second, human capital upgrading should be at the core of strategies aimed at promoting agri-food exports and enhancing SMAEF access to EU markets. Jevšnik *et al.* (2008) and Handschuch *et al.* (2013) point out that on top of the direct costs of compliance with FSQSs, meeting the standards' requirements entails significant managerial effort and organisational quality improvement. A lack of skilled human resources can be a decisive market access factor for small export firms. Therefore, efforts by Egyptian agri-food export-promoting organisations aimed at enhancing the participation of SMAEFs in export value chains should address human capital shortfalls and skills gaps, managerial skills, and the organisational quality of SMAEFs. In this context, there is a need for the higher agricultural education system in Egypt to transform educational programmes and introduce specific institutional changes in order to strengthen the link between these institutions and private sector organisations, and connect academic programmes to the human resource needs of the agricultural sector. To this end, developing FSQSs networks, local benchmarking activities, vocational training and trade fairs involving SMAEFs could also be important mechanisms for building human capital within agri-food export firms. Moreover, supporting farmers and exporter organisations could enhance SMAEFs' compliance with FSQSs because membership of these organisations helps them identify the best prospective agri-food suppliers, provides technical support and lowers transaction costs.

Finally, as public and private FSQSs in the EU are likely to intensify in future and may increasingly embrace additional issues of sustainability, the environment and labour standards, the role of the physical and intuitional infrastructure will become increasingly crucial for improving SMAEFs' compliance with FSQSs and enhancing their competitiveness in the EU market. In this context, this paper shows that around two thirds of the surveyed firms evaluated different export institutions with regard to their efficiency as less efficient or inefficient. It is therefore glaringly obvious that targeted long-term agricultural export strategies should focus on ensuring the provision of infrastructure and improving both logistics and connectivity, consolidating Egypt's national food safety system, strengthening coordination among export organisations and actors in the export supply chain, and improving trade-facilitating procedures at the border to ensure market access.

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Supplementary material

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Table S1. Export performance proxies and explanatory variables used in the estimations of ordered probit models.
Table S2. Awareness and status of implementation of major FSQS certification systems (% of respondents).
Table S3. Descriptive statistics.
Table S4. Matrix of Spearman rank coefficients between explanatory variables included in the three estimated ordered probit models.

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