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Food Standards, Heterogeneous Firms and Developing Countries' Export Performance

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Abstract

While recent studies emphasize the importance of firm heterogeneous effects in understanding international trade and its gains, these insights have largely been ignored in the literature on standards. In this paper we analyze how the adoption of private food standards by individual firms affects their export performance at the intensive and extensive margins of trade. We use unique 18-year panel data from 95 asparagus export firms in Peru and apply fixed effects and system GMM models. Results indicate that, when export persistence, unobserved heterogeneity and reversed causality are controlled for, certification to private standard schemes does not improve firms' propensity to export, nor their export volumes and values. This insight puts doubt on the effectiveness of development programs to support developing country exporters to comply with private food standards in order to maintain or improve international market access.

Key Words: Food standards, Private standards, Firm heterogeneity, New new trade theory, Export performance, Developing countries

JEL classification: C23, F14, Q17

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I. Introduction

Tariffs have decreased considerably over the past two decades but at the same time standards on a variety of issues related to production, processing and distribution procedures have increased tremendously (Henson and Jaffee, 2008). While there is a large number of studies on how countries and firms are affected by reduced tariffs[2], there is much less evidence on how standards affect trade. The trade effect of standards is an important issue, especially in the agri-food sector and especially for developing countries (Orden et al., 2012). Food trade has experienced the most impressive switch from being regulated by tariffs towards being governed by public and private standards[3] (Hoekman and Nicita, 2011). Developing countries have experienced the most impressive reduction in tariffs through preferential market access policies, followed by an increase in standards set by public authorities and private companies in the main export destination countries. Understanding the impact of food standards on developing countries is imperative, as agricultural and food exports are a fundamental component of developing countries' growth (Jaud and Kukenova, 2011).

There is a debate on whether food standards act as non-tariff barriers to trade or as catalysts to trade for developing countries (Jaffee and Henson, 2004; Maertens and Swinnen, 2007). On the one hand, compliance with standards requires one-time investments, e.g. to update facilities, and recurrent fixed costs, e.g. for certification procedures (Maskus et al., 2005). For exporters and farmers in developing countries these costs may be high relative to their operational size and financial means. By increasing the cost of trade, standards may act as barriers to trade and especially limit exports from developing countries. On the other hand, standards can solve information asymmetries between trading partners and reduce transaction costs, and act as catalysts to trade (Jaffee and Masakure, 2005; Hudson and Jones, 2003). This

[2] See e.g. Winters et al. (2004), Heckelei and Swinnen (2012) for a review of this literature.
[3] Standards can be set by public authorities, i.e., public standards, or by private firms and other non-state actors, i.e., private standards. Compliance to public standards is usually mandatory while compliance to private standards is voluntary (Henson and Humphrey, 2010).

might be true especially for exports from developing to industrialized countries, as this is where information asymmetries are largest. This debate needs to be underpinned with convincing empirical evidence on how standards affect developing countries' export performance. As we will discuss in the next section, empirical evidence on this issue is still weak, mainly because studies are plagued by methodological shortcomings.

In this paper, we analyze the trade effects of standards in the fresh asparagus export sector in Peru. Given the emphasis on firm heterogeneity in the recent trade literature, we look at individual firm-level effects for one country and one sector. We analyze the impact of certification to private standards on firms' export performance. We believe this approach creates insights that are complementary to macro-economic gravity models, which have mostly been used in empirical studies on the trade effects of standards. We look at firms' propensity to export and at the exported volumes and values, and thereby distinguish between effects at the extensive and intensive margin, and between volume and price effects. We account for heterogeneity in food standards and analyze the effect of standards in general and of particular individual standards.

Peru is the largest exporter of fresh asparagus worldwide and the sector represents 25% of the countries' total agricultural exports. The sector has a long history, involves yearly more than 100 companies, and experienced an increase in certification to private standards in recent years; which makes it an ideal case to estimate firm-level trade effects of standards. We use firm-level panel data for the period 1993-2011, compiled from customs data and an own firm survey. With our data we are able to control for export persistence over time and reduce the bias created by observed and unobserved heterogeneity and company self-selection into private standards compliance. We do so using OLS, fixed effects and system GMM models. Our approach represents an important methodological improvement in comparison with previous firm-level research on the trade effects of private standards.

The paper is organized as follows. Section 2 motivates our research based on the literature. Section 3 describes the database, the Peruvian asparagus export sector and heterogeneity across export firms. Section 4 presents the econometric approach. Section 5 discusses the results and section 6 concludes with policy and research implications.

II. Motivation

There is a growing body of empirical literature that analyzes the relationship between standards, both public and private standards, and trade flows, both imports and exports, and feeds the debate on "standards-as-barrier" versus "standards-as-catalyst" to trade. Most empirical studies use macro-economic trade models and focus on public standards, i.e. standards set by public authorities to which compliance is usually mandatory. Some studies quantify standards in tariff-equivalents and estimate trade effects in cross-country and cross-industry gravity models (e.g. Hoekman and Nicita, 2011; Wilson et al., 2003b). Other studies focus on particular food standards; e.g. on aflatoxin standards in grains and nuts (Wilson and Otsuki, 2003), on tretracycline standards in beef (Wilson et al., 2003a), and on HACCP standards in seafood (Anders and Caswell, 2009). All these studies find that standards limit trade. Some studies distinguish between different sectors; e.g. Moenius (2004) finds that standards in importing countries reduce imports of non-manufacturing goods, but promote imports in the manufacturing sector. Others distinguish between public and private standards; e.g. Mangelsdorf et al. (2012) find that public food standards in exporting countries positively affect exports while the effect of private standards is less clear. Some of these studies specifically analyze effects for developing countries and find that standards limit their exports (e.g. Hoekman and Nicita, 2011; Mangelsdorf et al., 2012; Wilson et al, 2003b).

Gravity models result in very useful findings on the macro-economic effects of standards but do not capture micro-economic effects. Recent theoretical and empirical studies have argued that micro-economic effects are essential in understanding international trade and

its gains. The international trade literature has extensively dealt with firm heterogeneity and the characteristics of exporting firms. The early literature highlighted the role of sunk costs in firms' export participation (e.g. Dixit, 1989; Krugman, 1989), and documented significant differences in firm characteristics between exporters and non-exporters[4] (Bernard and Jensen, 1997 & 1999). An important insight from this literature is that sunk costs are large and a significant source of export persistence. Melitz (2003) introduced the concept of firm heterogeneity and self-selection of firms in exporting. The key insight of his seminal work is that heterogeneity of firms creates gains from trade by shifting resources from less productive to more productive firms. More recent empirical studies build on this 'new new trade theory' and confirm that observed as well as unobserved heterogeneity in firm characteristics matter to explain trade (e.g., Bernard and Jensen, 2004; Bernard et al., 2007; Breinlich and Criscuolo, 2011; Jiangyuong et al., 2010). As a consequence, firms' self-selection into exporting needs to be accounted for when explaining the performance difference between exporters and non-exporters (e.g., Alvarez and Lopez, 2005; Das et al, 2007; Eaton et al., 2008). An important prediction of the new new trade models is that only the most productive firms will continue to export after an increase of fixed export cost (Tybout, 2004).

These insights from the recent trade literature have largely been ignored in the literature on the impact of standards[5]. Yet, firm heterogeneity is important in the discussion. First, it has been shown that compliance with standards, whether public or private standards, involves fixed and variable costs that are borne by exporters and that vary considerably by individual firm (Maskus et al., 2005). By increasing the cost of exporting, standards may lead to less productive firms exiting the market and export growth of more productive firms. In line with the insights from Melitz (2003), standards may lead to additional productivity gains

[4] For example Roberts and Tybout (1995, 1997), and Aitken et al. (1997) highlight that plant size, age, wages and firms' ownership structure are positively related to the propensity to export.

[5] To our knowledge only Rau and Van Tongeren (2009) explicitly take firm heterogeneities into account when developing a partial equilibrium model, that is applied to the issue of compliance with the EU food standards in Polish meat production. Due to the lack of real data, they however have recourse to a simulation analysis.

by shifting resources away from less productive to more productive firms. In case of private standards, to which compliance is not mandatory, more productive firms may self-select into compliance and certification. However, this will only lead to a reallocation of resources between firms and additional productivity gains if certification increases firms' export performance.

Second, the recent trade literature stresses the importance of export persistence and firm observable and unobservable characteristics in explaining trade. As a consequence, export dynamics and unobserved heterogeneity have to be taken into account when estimating the impact of standards on firms' export performance. Only a handful of empirical studies take into account firm heterogeneity and estimate the effect of standards on the export performance of individual firms. Chen et al. (2008) looks at how public standards in different destination markets affect the stated ability of export firms in developing countries to export to that destination. He finds that standards limit firms' export ability, especially for firms in the agricultural sector. More recent studies deal with private standards and point to positive effects of compliance with private standards on individual firms' export performance. Some studies analyze the effect of a specific standard that applies to different sectors; e.g. Volpe-Martincus et al. (2010) and Otsuki (2011) find that ISO certification improves the export performance of firms in Argentina, respectively in Central and Eastern Europe and Central Asia. Henson et al. (2011) empirically investigate the impact of GlobalGAP certification on the export revenue of fresh produce exporters in ten African countries and conclude that certification improves firms' export performance. These findings from micro-economic firm-level models that standards set by importing countries enhance developing countries' exports contradict those from macro-economic gravity models that standards limit developing countries' exports.

Firm-level empirical studies on the impact of standards are plagued by methodological weaknesses, likely due to the limited availability of data. Studies use cross-sectional data from different industries and/or different countries, which makes it difficult to attribute differences in export performance between firms to the impact of private standards. With such data it is impossible to take into account export dynamics and to control for unobserved heterogeneity. Firms' self-selection into certification and export persistence likely leads to an overestimation of the effect of certification to private standards on firms' export performance. In the debate on the firm level trade effects of private food standards, there is a need for panel data and better methods to reduce unobserved heterogeneity bias and control for dynamic effects.

III. Data and Descriptive Statistics

Data

We use a unique firm level dataset on Peruvian fresh asparagus exports constructed from secondary sources and own original data collection. Secondary data include transaction-level custom data and tax administration data on 567 asparagus export firms for the period 1993 - 2011. Primary data include survey data from a stratified random sample of 95 export firms. This includes recall information on certification to private food standards, production and processing procedures, management structure, ownership, etc. The sample includes both firms that are operative in 2011, the survey year, as well as firms that ceased operations by then, which ensures its representativeness not only for the current situation but for the whole period. In subsequent analysis we use a total number of 87 export firms, which are not only exceptionally exporting[6] and for which we have non-missing information on certification behavior and other firm characteristics over 18 years. This represents 66.5% of the overall

[6] Firms with less than five shipments over entire period, declaring to only extraordinary export fresh asparagus or that sent batches were export trials

fresh asparagus export volume during that period. The dataset is described in more detail in Schuster and Maertens (2013a).

Export performance

Peru is the largest exporter of fresh asparagus worldwide. The sector currently accounts for about 25% of the country's total agricultural exports. More than 220,000 ton of asparagus are produced yearly. There is no domestic market for asparagus and 99% of the whole production is exported, of which 70% as fresh produce (SUNAT, 2011).

Figure 1 shows the evolution of the total exported volume and value (figure 1a), and the number of firms exporting each year (figure 2b). Asparagus exports increased tremendously in the period 1993-2011, from 4,590 metric tons (mt) and 6,413 thousand US $ in 1993 to 134,992 mt and 286,534 thousand US $ in 2011 (figure 1a). Export growth was steady during the 1990s, accelerated in the late 1990's, and slowed down again from 2009 onwards. The accelerated growth in the late 1990's might be due to the introduction of several new neo-liberal land policies and laws promoting private investment in agriculture at the end of the 90s and year 2000 (Shimizu, 2006; Diaz, 2007). The growth slowdown in 2009 is likely related to increasing USD/Peruvian Nuevo Sol exchange rate fluctuations[7] and to overall international demand shocks, e.g., the global economic crisis that badly hit all Peruvian exports. The number of firms exporting each year shows a similar trend (figure 1b). The number has tripled from around 40 firms at the end of the 1990s to almost 120 firms in 2006, and stabilized at around 100 firms per year since 2006. Given a total number of 567 firms that ever exported fresh asparagus since 1993, these figures point to an absence of consolidation and a large transition in and out of exporting[8].

[7] The USD was historically weak as compared to the Peruvian Nuevo Sol at the end of the year 2007/ beginning of 2008.
[8] This is in line with observations from other studies, e.g., Freund and Pierola (2010), Eaton et al. (2008).

[Take in Figure 1]

Table 1 describes the average export performance at the firm level for 2001 and 2011. Out of all firms that had ever been exporting fresh asparagus, 25% were actively exporting in 2001 and 18% were actively exporting in 2011. These figures confirm the large export entry and exit transitions. The average export volume of actively exporting firms doubled over the past decade, from 673 mt in 2001 to 1,405 mt in 2011, and the average export value tripled, from 973 thousand US $ to 2,984 thousand US $ (table 1). When using unconditional export performance indicators, i.e. when including firms that are not actively exporting in specific years, the total export volumes and values per firm are lower, but still increase considerably over time. This indicates that Peruvian asparagus export firms are growing on average and in terms of total exported goods. Standard deviations of export volumes and values are large, indicating a large variability in firms' exports.

[Take in Table 1]

Certification to private standards

Figure 1 also describes, for our sample, the evolution of export volumes and values for certified and non-certified firms (figure 1c) and the evolution of the number of certified and non-certified firms (figure 1d). The spread of certification was most rapid in the early years 2000. Until 2001 only one firm was certified. The number of certified firms surpassed the number of non-certified firms by 2006 but remained stable from the year 2007/2008 onwards. Similarly, also the certified export volume and value increased rapidly from 2000 onwards. Almost no produce was certified until the year 2000 but by 2003 the export volume of certified firms already exceeded that of non-certified firms. The volume of non-certified asparagus decreased sharply between 2000 and 2005, but increased slightly again after 2005.

At the firm level, this translates into an increased likelihood of certification, from 7% in 2001 to 37% in 2011 (table 2). GlobalGAP is the most important private standard in the sector, with slightly more than one third of the export firms being GlobalGAP certified by 2011. Other important private standards, for which about 15% of the firms are certified, include HACCP, BRC and BASC. Other standards, such as TESCO, LEAF, IFS, GMP, SQF2000 and SQF1000, are taken up by less than 10% of firms.

[Take in Table 2]

Firm heterogeneity

Table 3 reports summary statistics for export performance and observable firm characteristics and compares certified and non-certified companies in 2011. Out of the 96 companies that were exporting fresh asparagus in 2011, 56 were included in our survey, of which 34 companies are certified to at least one private standards, while 22 don't adhere to any certification scheme. It is striking how the firm characteristics and, in particular, firms' export performance differ substantially by certification[9]. The 2011 export volumes and values of certified firms are on average almost three times higher than those of non-certified firms. Yet, already in 2003[10] and 2006 before becoming certified, these companies had significantly larger exports. This indicates that certified firms perform better in the export market but that they already did so before being certified. The export volumes of currently certified firms grew faster during the past decade than the exports of non-certified firms, with a yearly average relative growth of around 23% compared to around 6% for non-certified firms; this difference is statistically significant. Yet, differences are less pronounced for the relative percentage growth of export values and differences are not statistically significant. Certified

[10] We report export figure for 2003 instead of for 2001 as no company in our sample that is not certified in 2011 was already exporting in 2001.

firms grew faster than non-certified firms in terms of the quantity exported, but this is not necessarily reflected in the values they get for the exported volumes.

[Take in Table 3]

Certified and non-certified firms differ substantially in terms of observable characteristics. Out of all firms, 53% own agricultural land and 49% own a processing plant, but certified firms are more likely to own both agricultural land (96%) and a processing plant (85%) than non-certified firms (32% and 28% respectively). The average landholdings are substantially larger for certified firms (52 ha) than for non-certified firms (3,6 ha). On average in 2011, asparagus export firms existed for more than 8 years and had almost 7 years of export experience. Certified firms are significantly older (13 years) and have significantly more years of export experience (~10 years) than non-certified firms (~5 and 4 years), which could indicate that there is less entry and exit among certified firms. Indeed, 59% of the currently certified firms are pioneers who were already in the market before 2003 while this is barely 5% for non-certified firms. 40% of all firms rely on foreign capital; this is slightly but not significantly larger among certified firms (44%) than among non-certified firms (38%). The large majority of all firms grows green asparagus (94% of all firms) and the cultivation of white asparagus is concentrated in the hands of few large –mostly certified - export companies in northern Peru. The difference with non-certified companies is however not statistically significant. During their lifespan companies experience administrative and organizational changes, but these are relatively rare (respectively around 7% and 3% of all companies) and are not more frequent in certified or non certified companies. Exports under two different tax identifiers, the classification as being a good taxpayer and the location of certified and non-certified firms differs a slightly, but differences are not significant. Significant differences are observed in the company's number of production quarters,

administrative offices and origin of the starting capital, which are all variables related to the size of a company.

IV. Econometric Approach

To assess whether the observed differences in export performance between certified and non-certified firms are due to the causal impact of certification we estimate the following regression model:

$$Export_{it} = \beta_0 + \beta_1 C_{it} + \beta_2 X_{it} + D_t + v_{it} \quad (1)$$

To estimate effects at the intensive and extensive margin of trade, the dependent variable $Export_{it}$ is specified in five different ways: 1/ as a dummy variable equaling one if firm *i* is exporting in year *t*; 2 and 3/ as the logarithm of the export volume (2) or the export value (3) of firm *i* in year *t*, being positive when the firm exports or zero when the firm does not export in year *t*; 4 and 5/ as the logarithm of the export volume (4) or the export value (5) of firm *i* in year *t*, conditional on exporting in that year.

The key variable of interest in the model is the dummy variable for certification of firm *i* in year *t*, C_{it}. This is a dummy variable equaling one if firm *i* is certified to any type of standards or to a particular individual standard. The vector X_{it} is a large set of observable firm characteristics related to the type and size of the firm, experience, access to foreign capital, tax pay regime, management changes and location – these variables are described in Table 3[11]. Year dummies D_t are included to control for common macro-economic effects and v_{it} is the error term.

A main difficulty in estimating equation (1) and identifying the causal impact of certification to private standards C_{it} on firms' export performance $Export_{it}$ is that the voluntary certification decision of firms is potentially endogenous. The endogeneity could be

[11] The number of variables slightly varies over the models, as time constant variables are only included in the cross-sectional model specification (simple OLS)

due to 1/ potential reversed causality, i.e., certification decisions might be determined by current export performance; 2/ certification being predetermined, i.e., certification might depend on past export performance, which also affects current exports; or 3/ unobserved heterogeneity, i.e., unobserved factors being contemporaneously correlated with exports and certification. The recent empirical trade literature has shown that export persistence and unobserved firm heterogeneity are important in explaining export performance. Failing to control for past export behavior and unobservable characteristics would likely lead to an overestimation of the impact of certification on export performance. We use several estimation techniques to control for dynamic and unobserved effects.

First, we ignore firm-specific unobserved effects and the dynamic export pattern and estimate equation (1) using OLS[12]. We expect that, due to past exports and unobserved factors being positively (negatively) correlated with certification and with current exports, OLS is leading to an upward bias in estimating the effect of certification on export performance. Second, we account for export persistence over time by including a one-year lag of the respective dependent variable $Export_{i,t-1}$ in the model, as specified in equation (2). Since past export performance is likely positively correlated with the current certification decision and with current export performance, we expect the bias on the certification variable to decrease.

$$Export_{it} = \beta_0 + \beta_1 C_{it} + \beta_2 X_{it} + \beta_3 Export_{i,t-1} + D_t + v_{it} \qquad (2)$$

Third, we explicitly consider the role of unobserved firm heterogeneity and re-specify the equation by decomposing the error term v_{it} in a time-constant ε_i and a time-varying component u_{it}. Equation (3) specifies a fixed effects model in which time-constant unobserved

[12] Although the dependent variable can be binary (when considering the export dummy) or exhibit a probability mass at zero (when considering unconditional export volumes or values), we use a linear method. We do so in order to compare results with alternative estimations. Moreover, it has been shown that linear models perform as well as more complex non-linear estimation strategies with unobservable characteristics (Chay and Hyslop, 1998; Bernard and Jensen, 2004). Results from probit and tobit estimations are not reported but are very similar to the reported OLS results.

heterogeneity ε_i can be eliminated. We estimate the model using the standard within (fixed effects) estimator.

$$Export_{it} = \beta_0 + \beta_1 C_{it} + \beta_2 X_{it} + \beta_3 Export_{i,t-1} + D_t + u_{it} + \varepsilon_i \qquad (3)$$

With this strategy we can control for time-constant unobserved heterogeneity but a problem remains (Nickell, 1981). Lagged export performance $Export_{i,t-1}$ is not strictly exogenous, which could lead to a downward bias in the estimated coefficient β_3 (Bond, 2002). Also certification C_{it} is likely not strictly exogenous and if a positive (negative) shock to past export performance positively (negatively) affects the likelihood of certification, the standard fixed effects estimator would lead to a downward (upward) bias in the estimated certification coefficient β_1 (Bond, 2002). Therefore, we expect the fixed effects estimator to result in a downward bias of the estimated effect of certification on export performance.

Fourth, to deal with this remaining problem we estimate the model using the System General Method of Moments (System GMM) approach (Arellano and Bond, 1991; Blundell and Bond, 1999). This method combines first difference transformation to eliminate time-constant unobserved heterogeneity ε_i with an instrumental variable estimation to further reduce remaining endogeneity bias. Lagged levels of the explanatory variables and further lags of the dependent variable are used as instruments in the first-difference equation while lagged first-differences of these variables[13] are used as instruments in the levels equations, and the moment conditions of the first difference and the levels equations are combined in the System GMM (Arellano and Bond, 1991; Arellano and Bover, 1995; Bond, 2002; Blundell and Bond, 1998 & 1999). For the choice of the instruments it is important to ascertain whether the explanatory variables are strictly exogenous (independent), predetermined

[13] As proposed by Arellano and Bover (1995) and Blundell and Bond (1999) the two moment conditions are combined and the lagged first-differences of the explanatory and the dependent variable are used as additional instruments to circumvent the problem that with persistent time series, the lagged levels of the explanatory and dependent variable might be weak predictors of endogenous changes (Blundell and Bond, 1998).

(depending on past exports) or simultaneously endogenous (depending on current exports). We treat the time dummies D_t as exogenous, certification C_{it} as endogeneous[14] and all but one firm characteristics X_{it} as predetermined. The variable 'Asparagus land' is also treated as endogenous because land can be purchased or sold rather quickly in response to export shocks, while adaptation of other firm characteristics to changes in the export performance is not immediate. Predetermined variables are instrumented with three lags in the difference equation and with their difference lagged once in the levels equation. For the endogenous variables the number of instruments is reduced by one, as only lags two and up are valid. All instruments are collapsed in order to limit the instrument count (Roodman, 2009). The validity of all instruments and the additional moment conditions from the equation in levels are tested respectively with the Hansen test of over-identification restrictions and the Hansen difference test. We believe that the System GMM estimator gives the most correct estimates with the smallest bias.

Fifth, we use the same System GMM estimator as above but extend the lagged instruments by one level in the difference equation. This comes down to instrumenting all first differenced predetermined variables with their levels from one to four inclusive and the endogenous variables from two to four inclusive; in the levels equation the number of instruments does not change. To the extent that this specification of the system GMM estimator introduces more information, it should improve efficiency, and at the same time test the robustness of the results to an alternative set of instruments (Roodman, 2007 and 2009).

An additional problem arises when considering the conditional export volumes and values as dependent variables. If unobservable firm characteristics affect both firms' decision to export and the quantity exported, there is an additional selection bias problem. This would

[14] We also estimated the System GMM model with certification as predetermined variable. These results are not reported but are very similar to the reported System GMM results with certification as endogenous variable.

lead to additional bias especially in the OLS estimation but is (partially) controlled for in the fixed effects and System GMM estimation.

V. Results and Discussion

Impact of certification on export performance

Table 4 reports regression results for the main variable of interest, certification to private standards. Results are reported for the different export performance indicators – an export dummy variable and conditional and unconditional export volumes and values – and for different estimation methods – OLS without lagged exports (model 1), OLS with lagged exports (model 2), fixed effects (model 3), system GMM with up to three period lags as instruments (model 4), and system GMM with up to four period lags as instruments (model 5). In all regressions we control for observable covariates, time and location dummies.

Our main result is that, when controlling for export persistence, unobserved heterogeneity and reversed causality, certification to private standards has no impact on companies export performance, neither at the extensive margin nor at the intensive margin, and neither on export volumes nor on export values. We find a significant positive effect of certification on the export dummy and the unconditional export volumes and values when using an OLS estimation without controlling for export persistence (model 1). The effect reduces sharply but remains significant when time trends are controlled for (model 2) and becomes completely insignificant in the fixed effects (model 3) and System GMM (model 4 & 5) estimation. The estimated effects from the OLS regression without time trends are two to four times larger than the estimated effects in the other models. This is in line with our expectations that OLS without lagged dependent variable overestimates the effect because of a positive correlation between past export performance and certification, because of unobserved firm characteristics being contemporaneously correlated with certification and

export performance, and because of reversed causality. We believe the System GMM estimations are the most correct ones with the smallest bias in the estimated coefficients.

When estimating the effect of certification on export volumes and values conditional on exporting in year *t*, we find no significant effect at all in any of the models. The estimated coefficients for the certification variable are substantially lower when considering conditional export volumes and values than when considering unconditional export volumes and values. This is most apparent in the OLS models where we do find a significant effect on the probability of exporting and on unconditional export volumes and values but not on conditional export volumes and values. This implies that certification is more correlated with the likelihood of exporting, i.e. the extensive margin than with the intensity of exporting, i.e. the intensive margin. Also the reduced sample size – stemming from the fact that companies do not export in all years – may result in larger standard errors of the estimates and a lack of significant effects in the OLS models.

Table 5 reports the regression results of the effect of certification on export performance for specific individual standards, including GlobalGAP, HACCP, BRC, BASC, GMP and SQF2000. Again different export performance indicators are used and observable covariates, time and location dummies are controlled for. Only results from the System GMM model are reported, as this gives the most credible estimates with the smallest bias. These results largely corroborate the findings above that, when controlling for export persistence, unobserved effects and reversed causality, none of the individual private standards has an impact on firms' export performance, neither at the extensive margin nor at the intensive margin, and neither on export volumes nor on export values.

Our result that certification to private standards does not improve firms' export performance challenges the point of view that standards can act as catalyst to trade and contradicts previous empirical findings. Our results disagree with the findings by Henson et

al. (2011) that certification to GlobalGAP positively affects the export performance of African fresh produce exporters. Part of the explanation for these diverging findings might relate to the nature of the specific cases that are studied. It might well be that in less established horticultural export sectors, such as in Africa where fresh horticultural exports developed more recently (Maertens et al., 2012), private standards have a more important impact and could indeed stimulate the development of a sector. Peru already had a long tradition of asparagus exports before private standards started to become important in international markets, and private standards might have less impact in this case. In addition, methodological differences likely also contribute to explaining the contradicting findings. We find large differences between OLS estimates and estimates from FE and system GMM methods, which indicates that failure to control for export persistence and for unobserved heterogeneity, as was the case in previous studies, might lead to an overestimation of the impact of private standards.

Full regression results

We report the full regression results for the preferred System GMM estimation in table 6[15]. First, we find that the null hypotheses of no second order autocorrelation of residuals, of the joint validity of all instruments (Hansen test) and of the joint validity of the additional instruments used in the System GMM estimation (Difference Hansen test) cannot be rejected at the 5% or 10% significance level. This confirms the validity of the instruments used.

Second, we find that other firm characteristics have an impact on export performance as well. Lagged exports has a significant and large positive effect on current exports, which is an indication of the expected export persistence. This effect is consistent for the different export performance indicators and the magnitude of the effect is similar to that reported by other

[15] The full regression results for the OLS and fixed effects models are very similar but are not reported in order to avoid lengthy tables.

authors (e.g., Bernard and Jensen, 2004). Further, we find that ownership of a processing plant and of more agricultural land do not significantly affect firms' propensity to export but do have a significant positive – and for land a decreasing – effect on the export volume and value. This implies that larger and established processing and production firms perform better in the export market but are not necessarily more likely to be in the market in specific years. This might indicate that fixed investment costs affect firms' export performance, but cannot avoid entry and exit behavior. The age of a firm has a u-shaped effect and export experience an inverse u-shaped effect on export performance, with turning points around 13 and 9 years respectively. The negative and decreasing effect of age could be related to issues such as idleness or lower adaptability. Finally, having multiple tax identifiers and a status as good taxpayer positively affect firms' total export volume and value and the likelihood of exporting but not the conditional export volume and value. Facing a lower tax burden – either artificially because firms split up and pay taxes on two small, instead of one large firm or because they are classified as reliable entities by the national tax authority – has a positive effect on firms' exports at the extensive margin.

VI. Conclusion and implications

In this paper we have analyzed the firm-level trade effects of certification to private standards in the fresh asparagus export sector in Peru. We find that, when controlling for export persistence, unobserved heterogeneity and reversed causality, certification to private standards in general and to specific individual private standards, has no effect on firms' export performance, neither at the extensive margin nor at the intensive margin, and neither on export volumes nor on export values. Our results indicate that exports are sticky and that unobserved firm characteristics (e.g. entrepreneurial ability, openness towards innovations, personal links with importers) play an essential role in determining both export performance and certification to private standards. These results are in line with the recent trade literature

but contradict earlier empirical findings on the firm-level trade effect of private food standards.

We believe to have made methodological improvements that resulted in more correct estimates of the impact of private standards on firms' export performance, while previous studies likely overestimated effects. This was possible due to the availability of panel data, including a large number of firms in many years. However, our case-study and approach has limitations as well. First, we need to be careful to generalize results. Peru is a middle-income country that had a well-established asparagus export sector before private standards started to spread. The effects of private standards might be different in this case than in the case of low-income countries and emerging export sectors. It might well be that export persistence plays a less important role in the latter case. Second, in our analysis on the impact of certification on firms' export performance we only look at direct effects of private standards. Yet, spillover effects might be important as well and need to be addressed with a different approach. Certification might, especially in emerging export sectors, be a market signaling tool and affect not only certified firms' own exports but also those of other non-certified firms. Third, we distinguished between effects at the intensive and extensive margin in a rather rough way. We only looked at whether certification changes firms' propensity to export but there might be diverging effects on exports to different markets as the adoption of private standards likely differs across destination markets. We urge for more research to tackle these issues and come to more generally valid findings, and for the use of panel data and appropriate methods to correctly assess the trade impact of private standards.

Based on our results, we need to refute the view that private standards act as a catalyst to trade and that certification leads to a price premium in the export market. This has implications for ongoing investments of NGOs and development agencies to support developing country exporters to comply with private standards and seek certification.

Initiatives such as the *Pesticide Initiative Program* in ACP countries (Jaud and Cadot, 2012) and MCA or BAMEX in Madagascar (Bignebat and Vagneron, 2011; Supervie and Vagneron, 2012) assist private firms to comply with the requirements of overseas buyers, based on the assumption that this will benefit trade and development in the country. Our results imply that the return to such development programs, especially in middle-income countries and in well-established export sectors, is questionable. Studies that measure the impact of such programs and find positive effects on firms' export performance (e.g. Jaud and Cadot, 2012) are also plagued by a lack of panel data and methodological shortcoming. In previous research, for the same case-study and with the same data (Schuster and Maertens, 2013b) as well as for other case-studies (Maertens and Swinnen, 2009), we have shown that private standards lead to changes in the sourcing strategy of export firms and ultimately result in the exclusion of smallholder suppliers and family farms from export chains. Given that development agencies are often concerned specifically with the inclusion of smallholder farmers in export chains, development programs to assist export firms with standards compliance might even defeat agencies' development goals.

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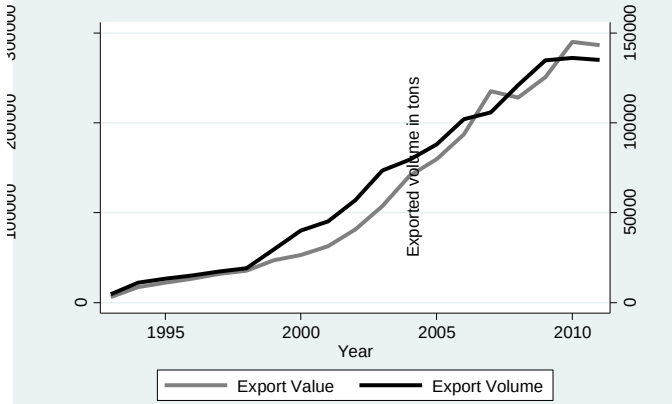
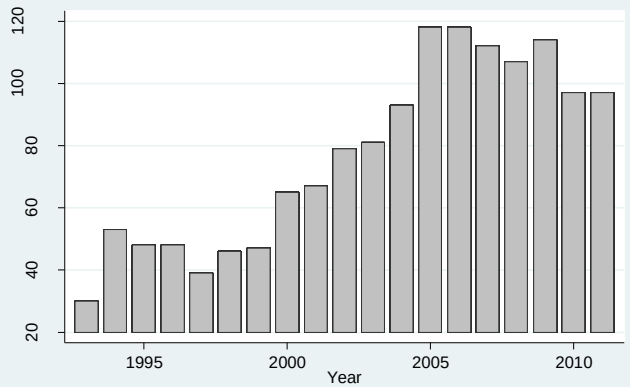
Figure 1: Evolution of fresh asparagus exports and export firms, 1993 – 2011

a) Total export volume and value



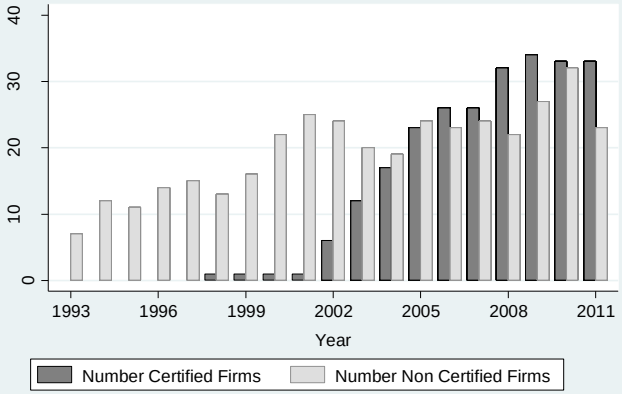
Note: Population of 567 export firms over 1993-2011
Source: Author's calculation based on SUNAT Custom data, Peru

b) Total number of export firms



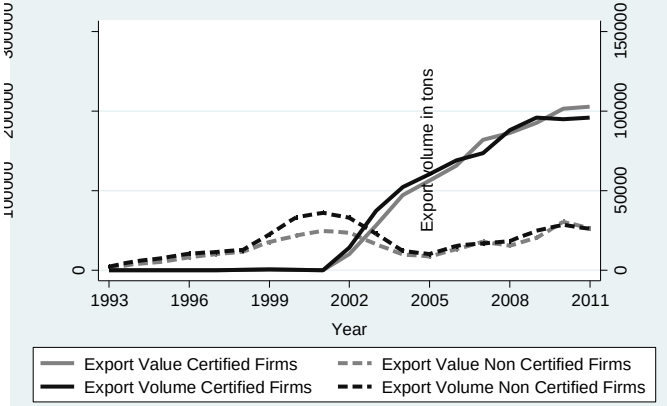
Note: Population of 567 export firms over 1993-2011
Source: Author's calculation based on SUNAT Custom data, Peru

c) Export volume and value – by certification



Note: Sample of 87 export firms over 1993-2011
Source: Author's calculation based on SUNAT and survey data

d) Number of export firms – by certification



Note: Sample of 87 export firms over 1993-2011
Source: Author's calculation based on SUNAT and survey data

Tables

Table 1: Export performance of firms, 2001 versus 2011

Variables	2001			2011		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Propensity to export (dummy)	0.25	0.43	269	0.18	0.39	525
Export Volume (in mt)	167.80	659.07	269	257.03	1215.25	525
Export Volume (in mt) - conditional on exporting	673.72	1190.71	67	1405.63	2552.32	96
Export Value (in th. $)	233.49	911.08	269	545.78	2572.01	525
Export Value (in th. $) - conditional on exporting	937.45	1643.36	67	2984.73	5397.42	96

Source: own elaboration from SUNAT Data

Table 2: Certification to private food standards, 2001 versus 2011

Certification variables (=1 if certified)	2001 (N=26)		2011 (N=56)	
	Mean	Std. Dev.	Mean	Std. Dev.
Certification	0.071	0.262	0.378	0.489
Global Gap	0.000	0.000	0.346	0.480
HACCP	0.036	0.189	0.141	0.351
BRC	0.000	0.000	0.154	0.364
BASC	0.000	0.000	0.152	0.362
GMP	0.036	0.189	0.075	0.265
SQF2000	0.000	0.000	0.077	0.269
SQF1000	0.000	0.000	0.011	0.104
TESCO	0.000	0.000	0.064	0.247
LEAF	0.000	0.000	0.043	0.204
GAP	0.000	0.000	0.021	0.146
IFS	0.000	0.000	0.024	0.154

Data from survey on stratified random sample; All sample means are weighted for the population average to control for the oversampling of consolidated and intermediate companies

Table 3: Export performance and firm characteristics, by certification, 2011

Variables	All firms, exporting in 2011			Certified firms, exporting in 2011 (N=34)		Non certified firms exporting in 2011 (N=22)		Comparison of means [a]
	Mean	Std. Dev.	N	Mean	Std. Dev.	Mean	Std. Dev.	
Firm export performance								
Export volume								
2001 (^) - mt	565.70	1481.41	96	1386.96	2345.31	191.19	677.70	*
2006 (^^) - mt	910.63	1777.79	96	1663.44	4327.08	46.45	227.76	*
2011 - mt	1405.63	2552.32	96	2664.22	4032.29	828.12	1221.64	**
% growth 2001-2011	9.23	214.21	521	22.85	355.26	6.09	21.33	*
Export value								
2003 (^) - in th. $	835.74	2223.34	96	3450.85	3312.95	1275.97	1205.00	*
2006 (^^) - in th. $	1688.07	3745.31	96	4749.80	5718.42	1531.54	1705.20	*
2011 - in th. $	2984.73	5397.42	96	5721.92	8407.95	1671.77	2507.28	**
% growth 2001-2011	4.99	85.57	521	8.86	135.27	3.39	17.81	
Firm characteristics								
Asparagus Land (Dummy)	0.534	0.504	50	0.964	0.245	0.320	0.384	**
Asparagus Land (Ha)	20.235	45.313	50	52.860	86.337	3.633	6.574	***
Processing Plant	0.486	0.504	57	0.846	0.462	0.282	0.361	**
Years Exist	8.021	6.374	96	13.105	6.056	4.991	3.051	**
Years Exporting	6.583	5.653	96	10.520	6.471	3.626	2.756	*
Pioneer[b]	0.244	0.433	62	0.593	0.629	0.051	0.177	*
Foreign Capital	0.401	0.494	57	0.443	0.636	0.381	0.389	
Green Asparagus	94.463	20.485	59	86.313	39.723	99.038	5.222	
Administrative staff change	0.083	0.278	96	0.028	0.212	0.116	0.256	
Organizational change	0.032	0.177	56	0.028	0.212	0.034	0.146	
Double Tax ID	0.021	0.144	96	0.028	0.212	0.000	0.000	
Taxpayer "Good"	0.031	0.175	96	0.057	0.295	0.116	0.256	
Production quarters[b]	1.490	2.559	96	2.882	4.259	0.299	0.500	***
Administrative quarters[b]	0.208	0.631	96	0.493	1.204	0.000	0.000	***
Non-agricultural capital[b]	0.233	0.427	96	0.330	0.602	0.175	0.305	**
Ancash[b]	0.021	0.144	56	0.057	0.295	0.000	0.000	
Ica[b]	0.588	0.496	56	0.641	0.614	0.556	0.398	
La Libertad[b]	0.301	0.463	56	0.246	0.551	0.329	0.377	
Lima[b]	0.080	0.273	58	0.028	0.212	0.115	0.255	

Note: [a] t-tests *, ** and *** denote 10, 5 and 1% significance level, respectively. [b] Time constant variables. All sample means are weighted for the population average to control for the oversampling of consolidated and intermediate companies; (^) Number of companies that are exporting in 2011 and in 2003: N=25, of which 'certified comp'.: N=20, 'Non certified comp'.:N=5; (^^) Number of companies that were exporting in 2011 and in 2006:N=37, of which 'certified comp'.:N=28, 'Non certified comp'.:N=9

Table 4: Certification to any private standard and firms' export performance

Coefficients for certification (=1 if certified; =0 not certified)

Model / Dep Var	OLS (1)	OLS (2)	FE (3)	Sys-GMM (4)	Sys-GMM (5)
Export dummy	0.209***	0.101**	0.113	0.089	0.093
	(0.071)	(0.044)	(0.071)	(0.079)	(0.073)
	N=785	N=713	N=713	N=713	N=713
Export Volumes (mt)	2.871***	0.953*	0.693	0.706	0.688
	(1.024)	(0.510)	(0.723)	(0.759)	(0.692)
	N=785	N=713	N=713	N=713	N=713
Export Values (th $)	3.046***	1.030*	0.785	0.735	0.694
	(1.072)	(0.534)	(0.757)	(0.793)	(0.727)
	N=785	N=713	N=713	N=713	N=713
Export Volumes (mt), conditional on exporting	0.407	0.109	-0.701	0.404	0.451
	(0.475)	(0.382)	(0.428)	(0.788)	(0.752)
	N=499	N=468	N=468	N=468	N=468
Export Values (th $), conditional on exporting	0.424	0.131	-0.66	0.364	0.41
	(0.460)	(0.374)	(0.403)	(0.815)	(0.780)
	N=499	N=468	N=468	N=468	N=468
Time trend	no	yes	yes	yes	yes
Year and Location Dummies	yes	yes	yes	yes	yes
Covariates	yes	yes	yes	yes	yes

Company cluster robust standard errors in parenthesis for the OLS and FE estimations. Robust finite samples corrected standard errors (Windmeijer, 2005) in parenthesis for the System GMM; *** p<0.01, ** p<0.05, * p<0.1; Column 4 show SYS-GMM results with up to three lags of instruments; Column 5 show SYS-GMM results with up to four lags of instruments;. The tests for second order autocorrelation, Hansen-test for overidentification restrictions and Difference Hanson test are not reported in columns 4 and 5 but all accepted at above the 10% significance level

Table 5: Certification to specific private standards and export performance

Independent variable - Main certification schemes (=1 if certified; =0 not certified)

Certification / Dep Var	Global Gap (1)	HACCP (2)	BRC (3)	BASC (4)	GMP (5)	SQF2000 (6)
Export dummy	0.008	0.057	0.108	-0.002	0.115	0.128
	(0.083)	(0.087)	(0.085)	(0.084)	(0.100)	(0.098)
	N=695	N=696	N=696	N=696	N=696	N=696
Export Volumes (mt)	0.002	0.071	1.154	-0.358	1.33	1.48
	(0.963)	(0.876)	(0.893)	(0.891)	(1.122)	(1.060)
	N=695	N=696	N=696	N=696	N=696	N=696
Export Values (th $)	-0.009	0.056	1.24	-0.338	1.321	1.53
	(1.006)	(0.913)	(0.939)	(0.915)	(1.161)	(1.064)
	N=695	N=696	N=696	N=696	N=696	N=696
Export Volumes (mt), conditional on exporting	0.159	0.592	-1.347	-1.126	-0.536	0.861
	(0.826)	(1.151)	(1.221)	(0.908)	(0.766)	(0.610)
	N=457	N=457	N=457	N=457	N=457	N=457
Export Values (th $), conditional on exporting	0.103	0.388	-1.217	-1.068	-0.739	0.976
	(0.863)	(1.234)	(1.418)	(0.980)	(0.801)	(0.655)
	N=457	N=457	N=457	N=457	N=457	N=457
Year Dummies	yes	yes	yes	yes	yes	yes
Covariates	yes	yes	yes	yes	yes	yes

Columns show SYS-GMM results with up to three lags of instruments. Robust finite samples corrected standard errors (Windmeijer, 2005) in parenthesis for the System GMM; *** p<0.01, ** p<0.05, * p<0.1. The tests for second order autocorrelation, Hansen-test for overidentification restrictions and Difference Hanson test are not reported but all accepted at above the 10% significance level

Table 6: Regressions on firms' export performance – Results from System GMM

Dep Var / Ind Var	Export Dummy	Export Volume	Export Value	Export Volume, conditional on exporting	Export Value, conditional on exporting
	(1)	(2)	(3)	(4)	(5)
Certification dummy	0.093	0.688	0.694	0.451	0.41
	(0.073)	(0.692)	(0.727)	(0.752)	(0.780)
Export dummy(t-1)	0.406***				
	(0.077)				
Export volumes(t-1)		0.576***		0.075***	
		(0.062)		(0.029)	
Export values(t-1)			0.583***		0.066**
			(0.062)		(0.030)
Processing plant	0.126	2.298***	2.398***	0.795*	0.887*
	(0.077)	(0.875)	(0.899)	(0.399)	(0.486)
Asparagus land[(a)]	0.004	0.066***	0.067**	0.052***	0.049***
	(0.003)	(0.026)	(0.027)	(0.016)	(0.017)
Asparagus land2[(a)]	-0.000*	-0.000**	-0.000**	-0.000***	-0.000**
	0.000	0.000	0.000	0.000	0.000
Years exist	-0.132***	-1.376***	-1.427***	-0.890***	-0.911***
	(0.026)	(0.269)	(0.281)	(0.262)	(0.263)
Years exist2	0.005***	0.053***	0.055***	0.033***	0.035***
	(0.001)	(0.014)	(0.015)	(0.012)	(0.012)
Years exporting	0.077***	0.596***	0.608***	0.730***	0.748***
	(0.022)	(0.203)	(0.213)	(0.236)	(0.245)
Years exporting2	-0.004***	-0.031***	-0.032***	-0.029***	-0.031***
	(0.001)	(0.012)	(0.012)	(0.011)	(0.012)
Green Asparagus (%)	-0.005	-0.015	-0.02	-0.015	-0.025
	(0.004)	(0.034)	(0.036)	(0.021)	(0.022)
Double Tax ID	0.126**	1.224**	1.281**	-0.02	-0.029
	(0.057)	(0.593)	(0.620)	(0.281)	(0.278)
Organizational Change	0.084	1.559	1.618	0.521	0.608
	(0.087)	(1.043)	(1.060)	(0.385)	(0.382)
Admin staff change	-0.016	0.26	0.244	0.055	0.054
	(0.058)	(0.714)	(0.759)	(0.244)	(0.241)
Foreign capital	0.109	1.047	1.141	0.038	0.05
	(0.192)	(1.694)	(1.801)	(1.038)	(1.018)
Taxpayer "good"	0.281***	2.700**	2.889**	0.59	0.756
	(0.108)	(1.150)	(1.238)	(0.669)	(0.631)
Constant	0.990***	6.387*	7.047**	13.252***	15.001***
	(0.361)	(3.288)	(3.419)	(2.173)	(2.235)
Year and Location Dummies	yes	yes	yes	yes	yes
N	713	713	713	468	468
Number of collapsed IV's	76	76	76	76	76
2nd order autocorrelation	0.095	0.17	0.217	0.158	0.149
Hansen test: overid restrictions (p-value)	0.32	0.425	0.394	0.567	0.652
Diff Hansen test (p-value)	0.785	0.604	0.633	0.524	0.459

SYS-GMM results with up to three lags of instruments; Robust finite samples corrected standard errors (Windmeijer, 2005) in parenthesis; *** p<0.01, ** p<0.05, * p<0.1; (a) divided by 10 hectares