UNITED NATIONS UNIVERSITY
UNU-WIDER

WIDER Working Paper 2016/163

Private standards and labour productivity in the food sector in Viet Nam

Neda Trifkovic*

December 2016

United Nations University World Institute for Development Economics Research
wider.unu.edu

Abstract: A rising number of firms from developing countries have adopted voluntary private standards in the last decade. This has become an area of active research, especially in terms of the impact of private standards on trade, organizational performance, and employee outcomes. This paper analyses how standards affect labour productivity of small and medium firms from the food sector in Viet Nam. The results based on a 3-year panel show that the application of private standards improves labour productivity. These gains primarily occur to firms operating above a threshold labour-intensity level. Firms with low labour intensity are not likely to experience gains in labour productivity from standards. This implies that employee compensation increase due to standards is a likely mechanism for labour productivity gains. The results are robust to several specification changes and instrumental variable estimation.

Keywords: standards, labour productivity, food, small- and medium-sized enterprises, Viet Nam
JEL classification: L66, D22, J4, J81, O12

Acknowledgements: The author would like to thank John Rand for helpful comments and constructive feedback, as well as the participants of the Nordic Conference in Development Economics (NCDE), Oslo, Norway, 13–14 June 2016. The author is also grateful to Finn Tarp and the research teams from the Vietnamese Institute of Labour Science and Social Affairs (ILSSA) and the Central Institute for Economic Management (CIEM) for productive and stimulating collaboration. Support from Danish International Development Agency (DANIDA) and United Nations University World Institute for Development Economics Research (UNU-WIDER) is greatly appreciated.

* UNU-WIDER, Helsinki, Finland, neda.trifkovic@econ.ku.dk.

This study has been prepared within the UNU-WIDER project on 'Structural transformation and inclusive growth in Viet Nam'.

Information and requests: publications@wider.unu.edu

ISSN 1798-7237 ISBN 978-92-9256-207-6

Typescript prepared by Ayesha Chari.

The United Nations University World Institute for Development Economics Research provides economic analysis and policy advice with the aim of promoting sustainable and equitable development. The Institute began operations in 1985 in Helsinki, Finland, as the first research and training centre of the United Nations University. Today it is a unique blend of think tank, research institute, and UN agency—providing a range of services from policy advice to governments as well as freely available original research.

The Institute is funded through income from an endowment fund with additional contributions to its work programme from Denmark, Finland, Sweden, and the United Kingdom.

Katajanokanlaituri 6 B, 00160 Helsinki, Finland

1 Introduction

Food production and trade have become inseparable from requirements for certification of standards that regulate quality, safety, social, or environmental impact of products and production processes. Standards have emerged as a way of improving consumer's information about product characteristics, affecting consumer loyalty and trust (Raynolds 2002). This is especially relevant for food trade from developing to developed countries (Beghin et al. 2015). Private standards are applied voluntarily and, per occasion, independently from national regulation. The issues they address may or may not overlap with the official regulation. Standards are found to substitute for missing public regulation, a process described as 'a shift from public to private governance' (Hatanaka et al. 2005).

Firms in the food sector put a lot of effort into ensuring compliance with private standards, which can potentially improve access to higher-value markets (Masakure et al. 2009), firm's reputation (Fulponi 2006), financial performance (Alpay et al. 2002; Corbett et al. 2005; Foster and Gutierrez 2013), and competitiveness (Delmas 2001), but only if firms can overcome the costs of implementation (Maskus et al. 2013). The inability to finance compliance with standards has been identified as one of the main obstacles for participation of small-scale producers from developing countries in global trade (Henson and Humphrey 2010).

A growing body of literature is focusing on the impact of standards on firm performance, covering both developed and developing countries. Corbett et al. (2005) found improvements in financial performance for ISO 9000 certified firms in the United States, and Terlaak and King (2006) discovered that certified facilities grow faster after certification. Fontagné et al. (2015) analysed the impact of standards on export performance of French firms, whereas Martincus et al. (2010) and Otsuki (2011) investigated the effect of ISO certification on export performance of firms in Argentina, in Europe, and Central Asia. Schuster and Maertens (2015) analysed the effect of various types of private standards on export performance of firms in Peru using fixed effects and generalized method of moments (GMM) models. Henson et al. (2011) and Masakure et al. (2009) analysed the returns to certification in terms of export sales revenue for Sub-Saharan African countries and Pakistan. Apart from the study in Peru, all studies report positive effects of standards on export performance and revenue. Goedhuys and Sleuwaegen (2013) studied how international standards certification affects productivity and sales performance in various countries. They found that certification raises productivity and sales, with the effects being larger in countries where market-supporting institutions are weak.

The growth of high-standards food exports from developing countries has been associated with positive welfare outcomes and extended employment opportunities (Beghin et al. 2015; Maertens and Swinnen 2009). Especially in high-value export sectors, private standards can lead to better employment conditions. Colen et al. (2012) have associated GlobalGAP certification with higher employee daily wages and longer employment periods in exporter–producer companies in Senegal. Blunch and Castro (2005) have found that ISO 9000 and ISO 14000 certification affects a firm's training decisions. Schuster and Maertens (2016) show mixed evidence of labour standards in Peru, such as the Ethical Trading Initiative and Social Accountability 8000 (SA8000): although food export firms with labour standards appear more likely to pay minimum wage, they are not likely to offer higher wages or longer employment. How these benefits relate to labour productivity is fairly underexplored in the existing literature.

This paper examines labour productivity in order to understand whether private standards introduce differences in the efficiency of labour input use between certified and non-certified

firms. Labour productivity can change because of the adjustments in a firm's work system after the implementation of standards. For example, international standard ISO 9001 optimizes processes whereas ISO 22000 can cut operational costs by managing food safety risks. If standards entail employee skill-building and streamlining operating procedures, cutting waste, and increasing sales, the changes will be registered as improved labour productivity. In contrast, if the costs of implementation of standards are too high, additional employee effort and skills may be under-rewarded and thus stall productivity. In competitive markets, the differences in productivity resulting from investments in standards would be entirely reflected in wage differentials. In practice, however, the relationship between gains in productivity and wages can vary according to the origin of financing, job type, as well as wage and fringe benefits structure. In the case of standards, it is probable that there is a considerable divergence between wages and productivity gains as it is the employers who bear the costs of implementation of standards. Thus, the wage premium attributed to standards in earlier studies is likely to constitute a lower bound of productivity gains resulting from this investment.

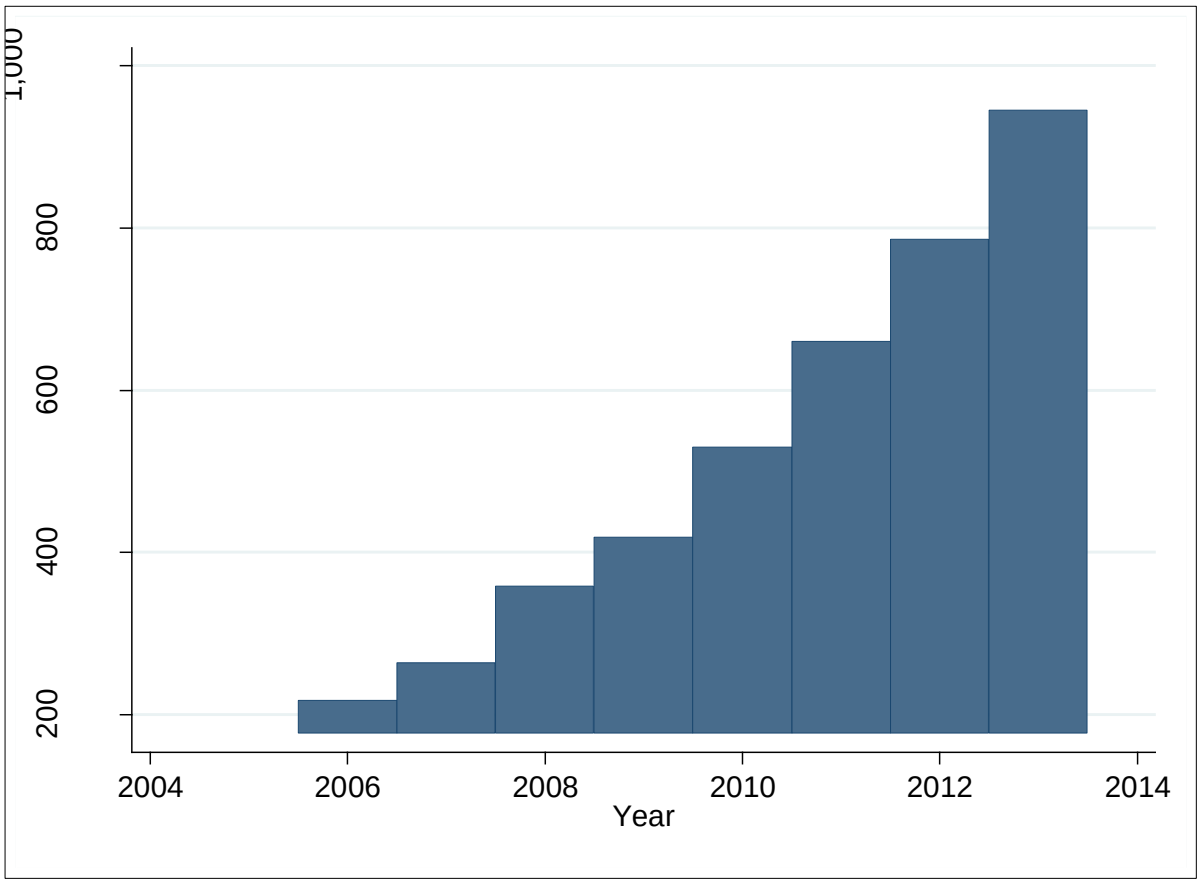
The paper estimates the effect of standards on labour productivity, where labour productivity is measured as value added per worker. This paper uses a panel dataset from three rounds of surveys of small- and medium-sized enterprises (SMEs) in Viet Nam, conducted in 2011, 2013, and 2015, covering 1,837 observations (988 firms) in the unbalanced and 1,425 observations (475 firms) in the balanced panel. The estimation uses ordinary least squares (OLS), fixed effects, and difference GMM to estimate effects and control for reverse causality and unobserved heterogeneity. The results show that the application of private standards improves labour productivity among the SMEs from the food sector in Viet Nam. Firms that have adopted private standards enjoy 20–37 per cent higher labour productivity than firms that have not adopted such standards. This paper also suggests that the benefits from standards are higher for firms with higher labour compensation, implying that employee wage increase due to standards is a likely mechanism for labour productivity gains. The results are robust to several specification changes and instrumental variable (IV) estimation. They supplement earlier findings of a positive impact of standards on employee outcomes (Colen et al. 2012; Delmas and Pekovic 2013; Levine and Toffel 2010; Schuster and Maertens 2016). Slowing income and economic growth in many developing countries have been attributed to the inefficient use of labour and a lack of productivity growth (Rodrik 2011). By linking standards and labour productivity, this paper brings a policy-relevant perspective on the performance of the SME sector, which, as Beck et al. (2005) argue, is the foundation of the employment and economic growth for developing countries.

2 The Vietnamese food sector

Food processing is one of the most important manufacturing sectors in Viet Nam as it employs around 10 per cent of all manufacturing workforce.[1] The sector has grown four times in value at current prices since 2005, as illustrated in Figure 1. The growth has been around 5 per cent in recent years: the industry has expanded by 5.1 per cent in 2014 and by 6 per cent in 2013 (at 2010 prices). The number of firms in the food sector was around 5,000 in 2005 and it has increased to 5,820 in 2013, showing a 16 per cent overall increase or annual growth of 3.1 per cent.

[1] The Statistical Yearbook of Vietnam 2014 reports 518,520 employees in food manufacturing and 5,333,912 employees in all manufacturing sectors in 2013 (GSO 2014).

Figure 1: Gross output of food manufacturing (at current prices)

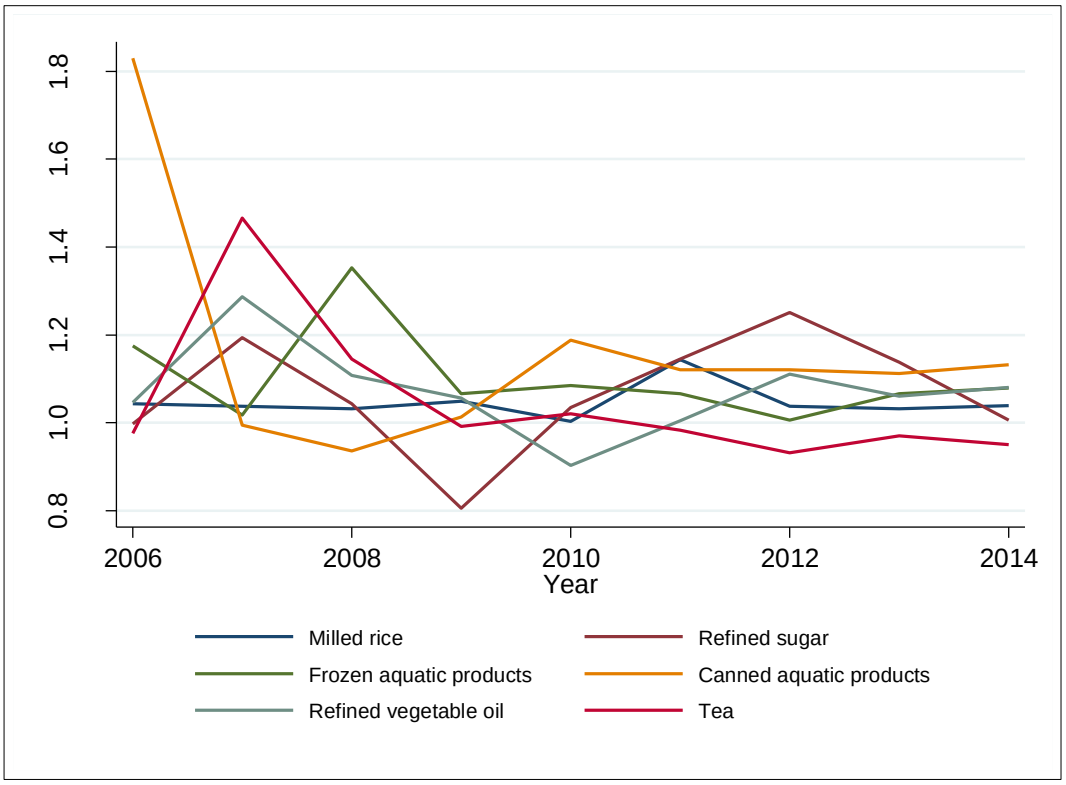


Source: Author's calculations based on GSO (2015a).

Data from Viet Nam's General Statistics Office (GSO) show that the food types processed in the largest volumes are: milled rice (45 million tons), refined sugar (1.8 million tons), and frozen aquatic products (1.6 million tons) (GSO 2015a) (see also Figure 2). Processing increased sharply between 2005 and 2014: production of refined sugar increased by 70 per cent, milled rice by 50 per cent, and frozen aquatic products by 132 per cent. The highest annual growth rate of 13 per cent was observed for fresh milk, produced at 840 million litres.

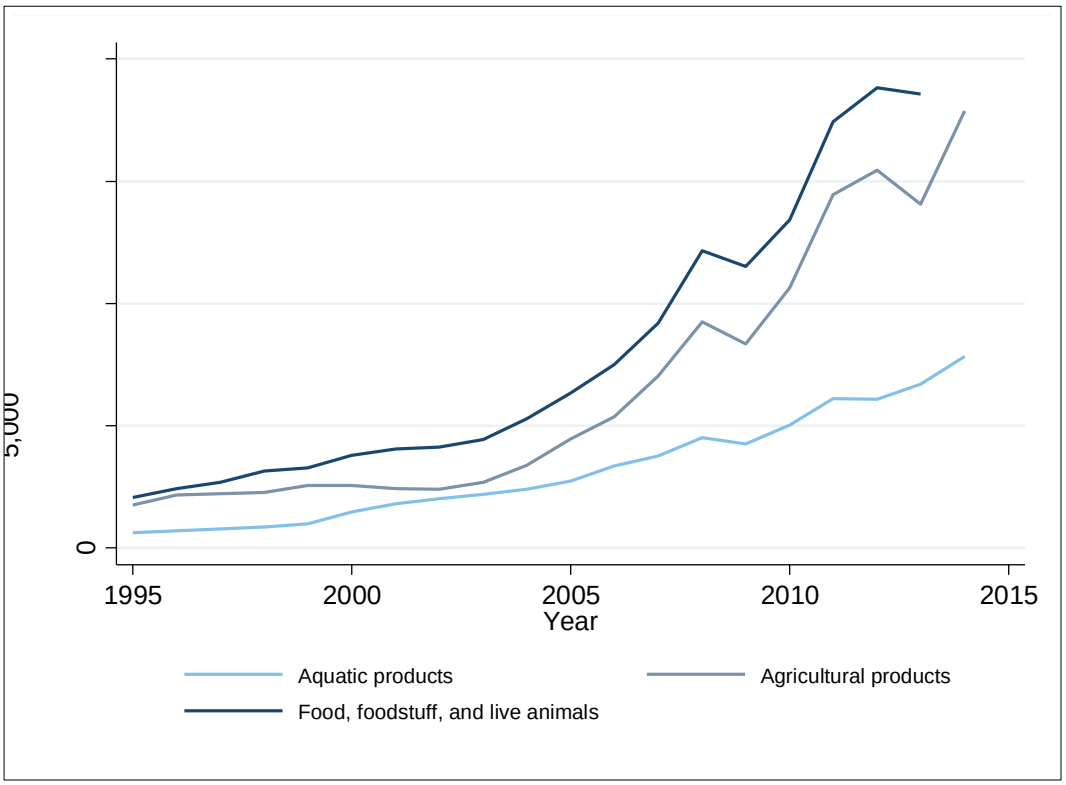
The food sector contributed to about 15 per cent of total export value in 2013. Figure 3 shows that the growth in food manufacturing was followed by a considerable growth in the export of food, and agricultural and aquatic products. Food exports reached 18.6 billion USD in 2013. As a comparison, all exported manufactured products were valued at 98.1 billion USD in 2013, with textiles and garment at 20.8 billion USD and footwear exports at 10.2 billion USD (GSO 2015a). The value of food export has grown nine times between 1995 and 2013, with yearly expansion of 12 per cent. The United States and the European Union are Viet Nam's two largest export markets.

Figure 2: Main products in the Vietnamese food manufacturing sector



Source: Author's calculations based on GSO (2015a).

Figure 3: Export of food from Viet Nam



Source: Author's calculations based on GSO (2015a).

3 Conceptual background

Certification of private standards facilitates activities between different economic agents (e.g. suppliers and buyers) by transferring non-market information about product and process characteristics, such as product quality and safety or the way a firm treats environment and labour. This paper considers private standards set by non-governmental bodies that are verified through third-party certification in which a certificate is awarded after a production process is checked by authorized independent domestic or international persons or organizations. Internationally recognized standards reduce cross-country differences of national government regulations, so they are assessed as a useful governance mechanism for firm behaviour (Christmann and Taylor 2006). Private standards usually require that firms implement specific activities that go beyond what is required by the national regulatory framework. Implementation of ISO standards usually includes: examining adequacy of work processes and methods for meeting product specifications; documenting work processes, work instructions, and quality assurance procedures; internal auditing to verify that activities comply with the procedures; and designing preventive and applying corrective actions in response to audits (Naveh and Erez 2004).

Labour productivity can change because of the adjustments in the firm's work system after implementation of standards. It is not a priori known how standards will affect labour productivity. The implementation of standards requires organizational changes, improving operating procedures, management practices, and production processes, which translate into increased sales (Levine and Toffel 2010). It was shown in other contexts that organizational changes lead to better productivity (Caliendo and Rossi-Hansberg 2012). Naveh and Marcus (2005) reported that standards lead to improved operating performance measured by lower defect rates, reduced cost of quality, on-time delivery, and customer satisfaction. Standards lower transaction costs between trade partners in global value chains, which helps to increase customer demand. They also enable firms to charge a price premium for investments in the innovations put in place in order to obtain certificates (Paunov 2016). Furthermore, firms are required to train employees about quality, safety, record-keeping, implementation of new procedures, and audits. These potentially manifest in higher levels of interpersonal interaction or greater employee engagement in business operations, which can lead to increased job satisfaction, more effective knowledge transfer, or innovative ideas that improve productivity (Delmas and Pekovic 2013). Indeed, Elmuti and Kathawala (1997) found support for improvements in quality of work life and several studies found wage increase due to certification (Colen et al. 2012; Levine and Toffel 2010; Schuster and Maertens 2016). However, wage and productivity increase due to standards need not follow parallel trends.

If the costs of implementation of standards are too high, compensation for additional employee effort and skills may be insufficient to trigger positive productivity effects. Antle (2000) showed that food safety regulations increased production costs in the United States meat industry. The costs increased because of the necessary modifications of the production process and a loss in operating efficiency. Similar findings are evident in other United States industries, such as poultry (Goodwin and Shipstova 2002). Other costs associated with standards include repairs, documentation, audits, and certification. Such costs are expected to vary with product and firm size, as well as sector and geographical location (Masakure et al. 2009). It is usually not enough to comply with one standard, but producers are required to certify several standards, each likely targeted at a particular destination market, which can further increase costs. The costs related to standards are especially burdensome for small firms (Wang et al. 2009). It is also argued that the gains from standards come at the expense of workers' earnings. Formalization and documentation of work practices that accompany implementation of standards can negatively affect workers by creating routinized work places, with lower skill requirements, which make individual workers

more easily replaceable and decrease worker bargaining power (Brenner et al. 2004; Levine and Toffel 2010).

Empirical evidence on the impact of private standards and productivity is ambiguous. Environmental and food safety regulations are argued to have a negative impact on firms' performance (Bontemps et al. 2012), but it may not always be so. Several studies attribute productivity improvements to standards and certification (Alpay et al. 2002; Corbett et al. 2005; Elmuti and Kathawala 1997; Foster and Gutierrez 2013; Lanoie et al. 2008; Porter and van der Linde 1995). Considering that standards introduce changes in firm operations and processes, they can be considered as innovation, but just as with other types of innovation, the effect could go in any direction. Indeed, the evidence of the impact of innovation on productivity is mixed. In a study of Spanish manufacturing firms, Huergo and Jaumandreu (2004) as well as Cassiman et al. (2010) found that process innovation caused productivity increase, whereas Cozzarin (2016) found a negative effect of product innovation on productivity among Canadian firms. Van Leeuwen and Klomp (2006) found that process innovation does not increase labour productivity.

4 Data

The analysis is based on the data from the SME survey from Viet Nam. This survey has been conducted every second year since 2005 with the aim of evaluating characteristics of the Vietnamese business environment. It is implemented in 10 provinces in Viet Nam: Ho Chi Minh City, Hanoi, Hai Phong, Long An, Ha Tay, Quang Nam, Phu Tho, Nghe An, Khanh Hoa, and Lam Dong. The sampling frame consists of a consolidated list of formal enterprises obtained from the Establishment Census from 2002 (GSO 2004) and the Industrial Survey 2004–06 (GSO 2007). Firms are randomly drawn from this list, accounting for ownership type to obtain representative data on household-owned, private, cooperative, limited liability, and joint stock enterprises. Apart from the officially registered firms, the survey also includes informal firms that were identified randomly on-site.[2] As the survey traces the same firms over the years, it is able to capture legal structure changes and formalization of unregistered businesses. Firms that stop operating are randomly replaced based on: (i) the need to maintain a constant level of household firms based on the information in GSO (2004), and (ii) the new 2014 population of firms registered under the Law on Enterprises obtained from GSO (2015b).

The analysis in this paper is based on the data from 2011, 2013, and 2015 survey rounds because the question about the compliance with internationally recognized standards was introduced in 2011. The survey targets non-state manufacturing enterprises from different sectors but this study focuses on formal firms registered as manufacturers of food products due to disproportionately higher relevance of standards for this sector.[3] The total sample used in the analysis consists of 777 firms in 2015, 714 firms in 2013, and 689 food firms in 2011. Compared with the enterprise census, this sample represents around 12 per cent of all firms in the food sector.[4] The sample of formal firms has 645 firms in 2015, 400 firms in 2013 and 393 firms in 2011. The balanced sample of

[2] Detailed information about sampling is available in CIEM et al. (2012, 2014) and UNU-WIDER (2015).

[3] On the importance of standards for the food sector, see Beghin et al. (2015), Henson and Humphrey (2010), and Lee et al. (2010).

[4] GSO (2014) reports that there were 5,498 registered food firms in 2011 and 5,820 in 2013.

formal firms includes 249 firms and the balanced sample with informal firms includes 475 firms per year.

The main questionnaire includes information on enterprise characteristics and practices. It has stayed almost the same over the years. One notable exception is that the questionnaire from 2015 asks about international and domestic standards specifically. All questions refer to the situation in the previous calendar year, namely 2010, 2012, and 2014, whereas the economic accounts contain information on two consecutive years before the survey. The 2011 and 2013 survey rounds only contain an indicator for whether firms apply any of the internationally recognized standards, and the 2015 round reveals which standards exactly are applied. The most frequent are ISO 9001, ISO 14001, HACCP, and ISO 22000.

5 Empirical specification

The main goal is to estimate the causal effect of international standards on labour productivity over the period 2010–14. This is done by estimating Equation (1):

$$y_{it} = a_i + b_i S_{it} + dX_{it} + r_j + t_t + e_{ijt}, \quad (1)$$

where i denotes firm, j denotes location, and t denotes time period. α_i, ρ_i, and τ_t are, respectively, firm, location, and time fixed effects. e_{ijt} is the statistical noise term. The dependent variable, y_{it}, is the firm-level labour productivity measured as real value added per employee, expressed in 2010 Vietnamese Dong (VND). Value added is measured as revenue from sales minus total costs that include expenses on intermediate goods and raw materials and indirect costs. Table 1 shows that the average real value added per employee has increased from around 20 million VND in 2010 to 61 million VND in 2014, achieving an annual growth rate of 25 per cent.

The variable of interest, S_{it}, takes a value 1 if a firm applies any private standard and 0 otherwise. The proportion of firms with internationally recognized private standards in the sample is about 5 per cent. The number of certified firms decreased by around 1.7 percentage points between 2010 and 2014. The ISO survey shows large variation in the number of ISO certificates issued in Viet Nam since 2000. For example, there were 7,333 valid ISO certificates in 2009 and 3,786 in 2014 (ISO 2016). The most commonly applied standards among the Vietnamese SMEs from the food sector are ISO 9001 and ISO 22000. Only 13 firms (14 per cent) have certified more than one standard.

The X_{it} are time-varying firm-specific control variables, such as firm size, value of physical assets, and the age of firm. Firm size is controlled for as larger firms have an advantage in complying with standards. A positive size effect on the adoption of standards was found in previous studies (Herath et al. 2007; Masakure et al. 2011; Nakamura et al. 2001). One explanation could be that fixed costs that are bound to be incurred in relation to implementation of standards are less significant for larger firms. Also, owing to the well-established labour productivity–size relationship (Van Biesebroeck 2005), firm size is expected to positively affect labour productivity. Firm size is measured as the total number of regular full-time employees. Summary statistics in Table 1 show that the average firm from the sample employed eight employees and that the average size has slightly declined between 2010 and 2014. This is in line with the general trend of declining firm size in Viet Nam (CIEM et al. 2014).

Value of capital is also included in the estimation, as a way of controlling for the cost and the nature of technology. This is measured as the deflated value of the total assets of the firm at the

end of the year. Table 1 shows that the real value of assets in the surveyed SMEs went up between 2010 and 2014. Firm age is also added as productivity may differ between old and young firms. New firms are shown to have lower average productivity than incumbents (Aw et al. 2001). The average age of firms in the sample is 19 years. The adoption of standards may be influenced by the position in the supply chain, so it is important to control for the type of output, that is, whether a firm produces final or intermediate goods.

Table 1: Summary statistics

Variable	Description	2010		2012		2014	
		Mean	SD	Mean	SD	Mean	SD
Standards	Proportion of firms applying internationally recognized standards (%)	4.58	(20.92)	4.91	(21.63)	3.22	(17.67)
Labour productivity	Real value added per worker (1,000 VND)	19.85	(30.93)	50.53	(51.43)	60.68	(226.56)
Firm size	Total full-time regular labour force	8.95	(20.24)	8.71	(20.18)	8.00	(18.87)
Assets	Real value of total assets (1,000 VND)	1,137	(3,468)	2,619	(9,265)	1,912	(6,491)
Age of the firm	Number of years since the firm has been established	19.25	(10.09)	19.23	(10.55)	18.37	(10.88)
Final goods share	Proportion of output used for final consumption (%)	38.88	(37.25)	48.30	(37.99)	52.17	(38.25)
Distance	Distance to the main buyer in km	23.28	(73.30)	19.22	(48.76)	24.16	(65.23)
Export	Firm sells to foreign countries (%)	3.84	(19.23)	2.89	(16.77)	2.84	(16.61)
Owner has higher education	Owner has completed secondary education (%)	44.46	(49.73)	52.60	(49.97)	55.80	(49.69)
Professionals share	Proportion of professional workers in a firm (%)	1.83	(5.68)	1.36	(4.29)	0.94	(3.48)
Formally registered firms	Proportion of formally registered firms (%)	56.87	(49.56)	55.35	(49.75)	82.99	(37.60)
Competition	Firm perceives competition in their line of activity (%)	88.04	(32.49)	88.50	(31.94)	86.51	(34.17)
Legal ownership form							
Household establishment	Proportion of firms listed as household establishment (%)	85.52	(35.21)	84.97	(35.76)	86.08	(34.64)
Private/sole proprietorship	Proportion of firms listed as private or sole owner establishment (%)	4.58	(20.92)	4.05	(19.72)	2.96	(16.97)
Partnership/ Collective/ Cooperative	Proportion of firms listed as partnership, collective or cooperative (%)	0.30	(5.43)	0.87	(9.28)	0.52	(7.17)
Limited liability company	Proportion of firms listed as limited liability company (%)	8.27	(27.57)	8.24	(27.51)	8.63	(28.10)
Joint stock company	Proportion of firms listed as joint stock company (%)	1.33	(11.46)	1.88	(13.59)	1.80	(13.32)
Observations		677		692		776	

Note: Average 2010 exchange rate: 1 USD = 19,128 VND.

Source: Author's compilation based on SME data.

Linkages with foreign markets enter estimation as firms are more likely to implement standards if their business is export-oriented. It is also well established in the literature that export firms have higher productivity (Bernard et al. 2012). Certification improves market access and reduces relational uncertainty and trade costs, enabling creation of long-term trading relationships, which reflect positively on firm performance. The indicator variable takes a value 1 if a firm exports any share of its output and 0 otherwise. Table 1 shows that only 3 per cent of the firms in the sample export and that the trend was negative in the 2010–14 period.

The estimation also controls for legal ownership form as potential benefits can be accrued by changing legal ownership status. Most firms are registered as household establishments (around 80 per cent) and, as most of them are not formally registered, they experience different circumstances related to certification. Legal ownership form enters estimation as a set of dummy variables that represent the specific legal form of the firm (household, private, collective/partnership, limited-liability, or joint-stock enterprise). Table 1 shows small change between 2010 and 2014, the most notable being a decline in the proportion of firms registered as private or sole proprietor establishments and a small rise in all other categories.

Identifying the causal effect of standards on labour productivity requires accounting for the fact that the application of standards is not random among the firms from the sample. The estimation needs to account for simultaneity, whereby firms with already higher levels of labour productivity are more likely to adopt standards. Another difficulty in estimating the causal impact is the presence of unobserved firm-specific characteristics that influence labour productivity and correlate with the firm's decision to adopt standards. For example, a manager of a firm may have access to specific information, which could both lead to certification of standards and higher labour productivity.

A fixed-effects estimation would control directly for all time-invariant unobserved firm-specific factors, such as manager characteristics (given that managers do not change over time). Location fixed effects, ρ_i, control for policy changes that may differentially impact productivity of firms in different regions. The estimation controls for the province in which the firm is located through dummy variables, using Ho Chi Minh City as a baseline. This is important because of relative autonomy of Vietnamese provinces, which differ in the extent to which they implement government initiatives (Nguyen et al. 2007). Time dummies, τ_t, control for general trends that affect all firms.

Firms can also have unobservable characteristics that change over time and that are correlated with implementation of standards and labour productivity. For example, there may be omitted time-varying firm-specific factors that impact the decision to implement standards and labour productivity such as, for example, a change in management. In the presence of these factors, standard OLS fixed-effects estimates will be biased, but the direction of the bias is not easy to forecast. For example, a change in management could lead a firm to be more productive and to implement standards, in which case OLS estimates will have a positive bias. Alternatively, new management could reduce the extent of activities related to standards in order to invest in productivity-enhancing activities. Also, a demand for certification of private standards coming from trade partners could divert from productivity-enhancing firm decisions. These would lead to a negative bias in OLS estimates.

A traditional fixed-effects approach is complemented with the Anderson and Hsiao (1982) GMM levels estimator, which uses $t-2$ lags of endogenous variables as instruments.[5] In this way, the parameters are identified using the within-firm variation in the application of standards and labour productivity over time. Distance to the main buyer, location, legal ownership status, and time dummies are treated as exogenous, whereas standards S_{it} and firm characteristics X_{it} enter estimation as endogenous. Endogenous variables are instrumented with all available lags (first and second) in the difference equation and with contemporaneous first differences in the levels equation. The validity of all instruments is checked with the Hansen test of over-identification

[5] Difference GMM (Arellano and Bond 1991; Arellano and Bover 1995; Blundell and Bond 1998) is a preferred estimation method, but possible only at $t=4$, whereas data have only three rounds.

restrictions. The short time series of the panel data (2010–14) may limit the extent of variation used to identify parameters and the estimates could be influenced by the exit and entry of firms rather than within-firm variations. Resolving this issue calls for the balanced panel estimates, which are shown in addition to the results of the unbalanced panel estimation.

Additional causal evidence is provided in a two-stage least squares (2SLS) estimation where the endogenous variable, S_{it}, is instrumented by a 2-year sector and district share of total ISO 9001, ISO 14000, and ISO 22000 certificates issued in Viet Nam, the number of which is obtained from the ISO survey (ISO 2016). This IV captures the potential of a firm to obtain information about standards, without influencing labour productivity directly. The underlying assumption is that the distribution of relevant knowledge about standards is more efficient within than across districts and sectors. Aggregating the IV to the district and sector level allows minimization of the correlation with the unobservable factors such as managerial skills. The efficiency of information flows has previously been linked with the adoption of standards. For example, firms are more likely to adopt environmental management systems if their rivals already have certificates (Grekova et al. 2014; Hofer et al. 2012). The first-stage results in Appendix Table A1 show that the IV is valid; that is, it significantly increases the probability of the adoption of standards. The *F* statistic for the tests of significance of the IV shows no concerns over weak instruments.[6] Further, Appendix Table A2 shows that there is no direct effect of the IV on the dependent variable.

5.1 Descriptive statistics

Table 2 shows the average performance at the firm level by certification of international standards using data from all years. Firms applying standards show two times higher labour productivity levels than non-certified firms. These firms also tend to be larger (employ more full-time workforce) and to have more capital on average. Figure 4 shows that labour productivity increases with firm size, capital, and application of standards. This is explored more rigorously in the estimations that follow.

Returning to Table 2, it is visible that certified firms are also more likely to be younger, to produce intermediate goods, and to export. Non-certified firms tend to sell locally with the distance to the main buyer being only 19 km. Firms with standards tend to have more educated owners and a larger proportion of professionals in the total workforce.

[6] Critical values for the Stock and Yogo (2005) identification test are 16.38 (10 per cent maximal IV size), 8.96 (15 per cent maximal IV size), 6.66 (20 per cent maximal IV size), and 5.53 (25 per cent maximal IV size). The rule of thumb for Kleibergen–Paap *F* statistic is that it should be over 10.

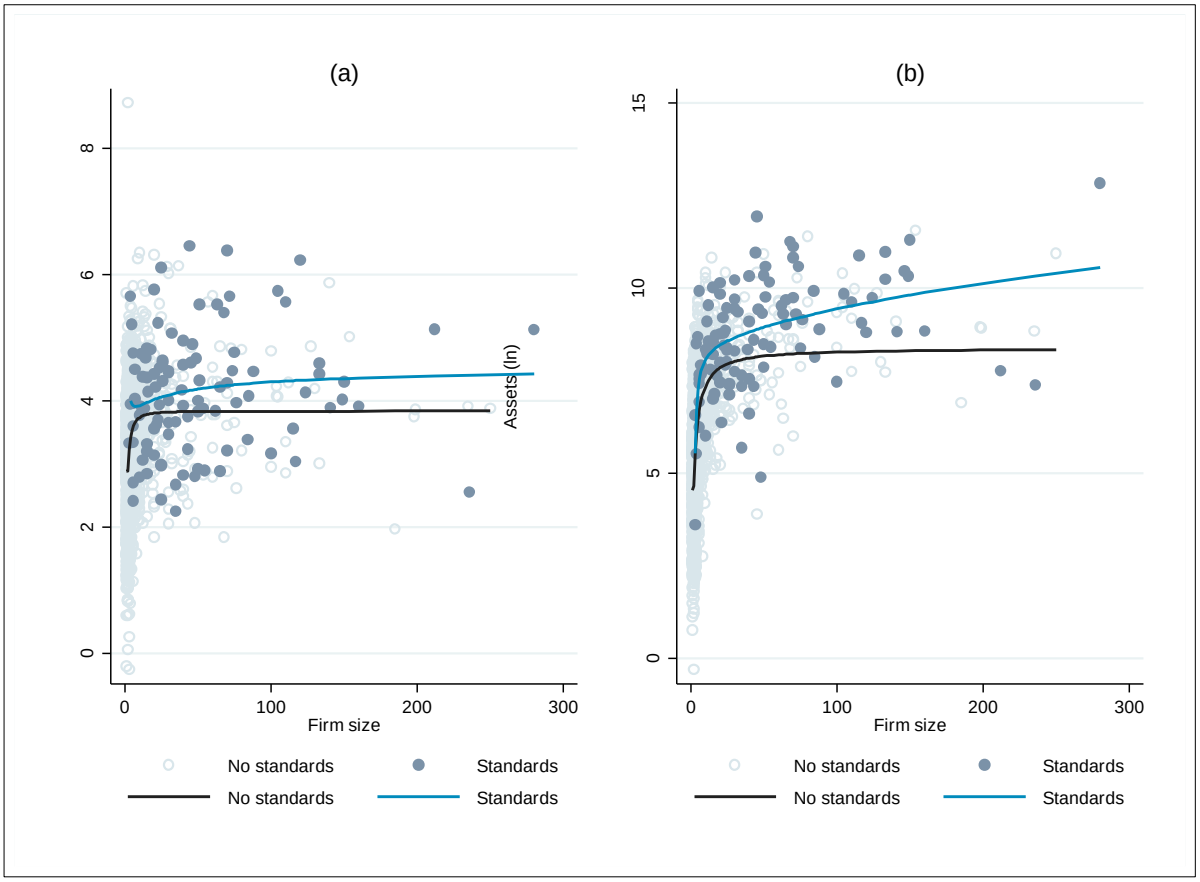
Table 2: Differences between firms by implementation of standards, 2010–14

Variable	All	Standards	No standards	Difference	*t* Value
Labour productivity (ln)	44.52	100.68	42.06	58.62	3.86***
	(141.44)	(121.20)	(141.78)		
Firm size (ln)	8.53	50.34	6.70	43.64	22.92***
	(19.73)	(47.47)	(15.12)		
Assets (ln)	1,895	14,405	1,348	13,058	19.12***
	(6,858)	(22,641)	(4,442)		
Age of the firm (years)	18.92	16.71	19.02	–2.31	–2.04**
	(10.54)	(11.02)	(10.51)		
Final goods share (%)	46.73	25.94	47.64	–21.69	–5.30***
	(38.24)	(34.09)	(38.16)		
Distance (km)	22.29	87.85	19.42	68.43	10.29***
	(63.27)	(156.78)	(54.00)		
Export (%)	3.17	44.44	1.36	43.08	26.23***
	(17.52)	(49.97)	(11.60)		
Owner has higher education (%)	51.19	94.44	49.29	45.15	8.52***
	(50.00)	(23.03)	(50.01)		
Professionals (%)	1.35	8.32	1.05	7.27	15.69***
	(4.54)	(7.83)	(4.08)		
Competition (%)	87.68	87.64	87.68	0.39	0.01
	(0.88)	(3.51)	(0.90)		

Note: Average 2010 exchange rate: 1 USD = 19,128 VND. Standard deviation in parentheses. Significance levels: *p<0.10, **p<0.05, ***p<0.01. Number of observations: 2,145.

Source: Author's compilation based on SME data.

Figure 4: Labour productivity (a) and real value of assets (b) by application of standards



Source: Author's calculations based on SME data.

6 Results

Table 3 shows the estimates of the impact of international standards on labour productivity among the Vietnamese SMEs from the food sector, where labour productivity is measured by real value added per employee (in 1,000 VND). Equation (1) is estimated using OLS, a firm fixed-effects estimator, and the difference GMM estimator. All models include location, legal ownership, and time dummies. Column (1) shows the pooled OLS estimates on a balanced panel with location, legal ownership, and time fixed effects in addition to the variables reported. The coefficient points to a significant relationship between application of standards and labour productivity.

Table 3: Impact of standards on labour productivity

	OLS balanced (1)	FE balanced (2)	FE unbalanced (3)	FE balanced, additional controls (4)	FE unbalanced, 2010–12 (5)	FE balanced, 2010–12 (6)	GMM unbalanced (7)	GMM balanced (8)	IV, unbalanced (9)	IV, balanced (10)
Standards	0.241**	0.200**	0.198***	0.197**	0.305***	0.281**	0.397**	0.426***	0.758**	0.853*
	(0.098)	(0.078)	(0.075)	(0.083)	(0.117)	(0.128)	(0.154)	(0.141)	(0.367)	(0.454)
Firm size (ln)	0.051	–0.030	0.014	–0.035	–0.045	–0.040	–0.028	–0.062	0.023	–0.026
	(0.045)	(0.070)	(0.060)	(0.071)	(0.074)	(0.083)	(0.137)	(0.127)	(0.064)	(0.071)
Assets (ln)	0.156***	0.157***	0.152***	0.152***	0.108***	0.106**	0.166***	0.127**	0.144***	0.139***
	(0.025)	(0.028)	(0.025)	(0.028)	(0.039)	(0.043)	(0.056)	(0.050)	(0.029)	(0.032)
Age of the firm	–0.006**	–0.006	–0.004	–0.006	0.000	–0.003	0.026	0.020	–0.006	–0.006
	(0.002)	(0.010)	(0.009)	(0.010)	(0.010)	(0.011)	(0.025)	(0.022)	(0.009)	(0.009)
Final goods share	–0.001	–0.000	–0.000	–0.000	–0.001	–0.001	–0.002**	–0.002	–0.001	–0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Distance (ln)	0.028	0.018	0.020	0.017	0.027	0.027	0.014	0.009	0.018	0.015
	(0.017)	(0.019)	(0.016)	(0.019)	(0.021)	(0.024)	(0.018)	(0.019)	(0.016)	(0.018)
Export				0.058	–0.226	–0.192	0.230	0.020	–0.017	–0.218
				(0.160)	(0.176)	(0.185)	(0.393)	(0.426)	(0.197)	(0.245)
Owner has higher education				0.001	0.002*	0.001	–0.001	–0.001	0.001	0.001
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Professionals				0.001	0.009	0.007	0.001	–0.008	0.003	0.003
				(0.006)	(0.007)	(0.008)	(0.011)	(0.010)	(0.005)	(0.007)
Competition				–0.021	0.103	0.136	–0.119	–0.078	–0.043	–0.034
				(0.078)	(0.087)	(0.101)	(0.107)	(0.092)	(0.062)	(0.072)
Year dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Legal form dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2.939***	3.026***	2.866***	3.054***	3.118***	3.222***				
	(0.196)	(0.314)	(0.263)	(0.312)	(0.436)	(0.482)				
Number of observations	747	747	1,007	746	767	497	609	497	1006	746
Number of firms		249	379	249	474	249	361	249	379	249
R^2	0.36	0.09	0.09	0.09	0.15	0.13			0.05	0.03
Hansen test statistics							7.16	8.44		
Hansen test *p* value							0.41	0.21		

Note: Dependent variable: value added per worker (ln). Estimation on the unbalanced panel in column (3) includes firms for which data are available in at least 2 years. Robust standard errors clustered at the firm level are in parentheses. Significance levels: *p<0.10, **p<0.05, ***p<0.01.

Source: Author's compilation based on SME data.

Column (2) is a counterpart to column (1) with added firm-specific fixed effects that control for all firm-specific time-invariant heterogeneity, whereas column (3) uses the full sample available (unbalanced panel) in the same type of estimation. As expected, the size of the coefficient drops slightly compared with column (1). The fixed effects estimations show that firms that have adopted private standards enjoy around 22 per cent higher labour productivity than firms that have not adopted such standards. Column (4) contains additional control variables, which reduce slightly the magnitude of the coefficient. Columns (5) and (6) show the estimation results for the sample restricted to 2010 and 2012 data as the structure of the questionnaire changed somewhat in 2015. Restricting the sample in such way results in a sizeable increase of the coefficient that measures the impact of standards. This shows that the change in the questionnaire structure is not a serious threat to estimation validity.

Columns (7) and (8) show the results of GMM estimation on unbalanced and balanced panel, applied to address identification challenges in inferring a causal relationship between standards and labour productivity. The magnitude of the effect of standards on labour productivity is found to increase by a notably large amount, suggesting a downward bias in the OLS estimates. The magnitude of the coefficient suggests that standards can increase a firm's labour productivity by 49 per cent. As shown in the lower part of Table 3, Hansen's test for the validity of the instruments is satisfied. Finally, columns (9) and (10) show the results of the IV 2SLS estimation. They confirm the positive impact of standards on labour productivity.

The results of this study complement earlier findings of the positive impact of standards on work conditions (Colen et al. 2012; Levine and Toffel 2010; Schuster and Maertens 2016) and total factor productivity (Goedhuys and Sleuwaegen 2013). They also support earlier results of the positive impact of environmental standard ISO 14001 on labour productivity among French firms (Delmas and Pekovic 2013). Using cross-sectional data, Delmas and Pekovic (2013) found that the adoption of environmental standards (ISO 14001) is associated with 16–21 per cent increase of labour productivity above the average. The GMM results from the present study are quantitatively larger, but the OLS and fixed-effects results are in the same order of magnitude. The downward bias of the OLS estimation likely originates from unobservable characteristics that are negatively correlated with the covariates. The unobserved characteristics that lower the probability of applying standards lead to better labour productivity, indicating perhaps that firms with weaker managerial capabilities are more likely to seek to improve performance through standards, whereas more capable firms may not need standards for this purpose. This may point to a trade-off between the investment in private standards and labour productivity for financially constrained firms.

Looking at the control variables, the positive and significant coefficient on the firm size in the OLS estimation disappears after controlling for unobserved heterogeneity. The value of assets is, however, consistently positive in all estimations, implying higher labour productivity among more technology-endowed firms. The relationship between firm age and worker wages is negative, but imprecisely determined in all estimations apart from OLS. The relationship between producing final goods and labour productivity is negative, implying better outcomes for firms that produce intermediate goods. The estimates do not show consistent evidence for the returns on export, professional workforce, and owner education.

That private standards affect firm operational practices is established in Appendix Table A3, which shows the results of a falsification exercise on the relationship between labour productivity and buyers' requests for certifying standards. Appendix Table A3 shows that buyers' requests for certification are not significantly related to labour productivity when firm, location, legal ownership, and time effects are accounted for. This implies that standards indeed introduce meaningful operational changes, which, as hypothesized, lead to better operating procedures, management practices, production processes, and improved labour productivity.

Table 4 shows the impact of standards on the sample with informal firms. Informal firms are unlikely to obtain a certificate of compliance with standards as certificates normally carry the firm registration number. Indeed, none of the certified firms from the sample are informal. Informal firms, however, make around one-third of the sample, but including these firms does not affect the main results. The results are very close in significance and magnitude to the estimation in Table 3, with the exception of GMM estimates in columns (7) and (8), which show that standards increase labour productivity by 36 per cent.

Table 4: Impact of standards on labour productivity: estimation on the sample with informal firms

	OLS balanced	FE balanced	FE unbalanced	FE balanced	FE unbalanced, 2010–12	FE balanced, 2010–12	GMM unbalanced	GMM balanced
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Standards	0.216**	0.200**	0.179**	0.187**	0.308***	0.296**	0.328**	0.343**
	(0.097)	(0.078)	(0.073)	(0.082)	(0.119)	(0.132)	(0.158)	(0.135)
Firm size (ln)	0.087**	–0.061	–0.035	–0.062	–0.083	–0.067	–0.018	–0.042
	(0.037)	(0.057)	(0.049)	(0.057)	(0.063)	(0.069)	(0.125)	(0.113)
Assets (ln)	0.162***	0.145***	0.153***	0.145***	0.107***	0.109***	0.199***	0.177***
	(0.019)	(0.025)	(0.022)	(0.025)	(0.030)	(0.032)	(0.046)	(0.040)
Age of the firm	–0.005***	0.003	0.005	0.002	0.008	0.005	–0.002	–0.005
	(0.002)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.020)	(0.018)
Final goods share	–0.002***	–0.002**	–0.001**	–0.001**	–0.003***	–0.003***	–0.002**	–0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Distance (ln)	0.014	0.009	0.008	0.008	0.010	0.014	0.015	0.015
	(0.013)	(0.014)	(0.012)	(0.014)	(0.017)	(0.018)	(0.013)	(0.013)
Export				0.122	–0.231	–0.219	0.304	0.107
				(0.138)	(0.181)	(0.188)	(0.319)	(0.336)
Owner has higher education				0.001**	0.002***	0.002***	–0.000	–0.000
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Professionals				0.002	0.011	0.010	0.007	–0.009
				(0.006)	(0.007)	(0.008)	(0.011)	(0.011)
Competition				–0.032	0.046	0.048	–0.171**	–0.145**
				(0.051)	(0.062)	(0.068)	(0.067)	(0.067)
Year dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legal form dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2.888***	2.871***	2.699***	2.859***	2.949***	2.980***		
	(0.155)	(0.220)	(0.193)	(0.222)	(0.268)	(0.287)		
Number of observations	1425	1425	1837	1423	1367	948	1134	948
Number of firms		475	681	475	829	475	661	475
R^2	0.42	0.06	0.07	0.07	0.12	0.11		
Hansen test statistics							4.82	6.27
Hansen test *p* value							0.68	0.39

Note: Dependent variable: value added per worker (ln). Estimation on the unbalanced panel in column (3) includes firms for which data are available in at least 2 years. Robust standard errors clustered at the firm level are in parentheses. Significance levels: *p<0.10, **p<0.05, ***p<0.01.

Source: Author's compilation based on SME data.

As mentioned in Section 3, some firms apply more than one standard, which could affect the precision of estimates if multiple standards bring synergic benefits. To address this challenge, the sample is restricted to formal firms that apply only one standard. Table 5 shows that the results remain very close in significance and magnitude to the original estimation.

As it may take time for productivity to reach its long-run level whenever factors of production are changed, Equation (1) is re-estimated in a dynamic form by introducing a lagged dependent variable on the right-hand side. The results shown in Appendix Table A4 generally confirm the finding that standards increase labour productivity.

Table 5: Impact of standards on labour productivity: estimation on the subsample of formal firms that apply only one standard

	OLS balanced	FE balanced	FE unbalanced	FE balanced	FE unbalanced, 2010–12	FE balanced, 2010–12	GMM unbalanced	GMM balanced
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Standards	0.248**	0.201**	0.199**	0.200**	0.305***	0.281**	0.514***	0.401***
	(0.109)	(0.082)	(0.084)	(0.088)	(0.117)	(0.128)	(0.190)	(0.151)
Firm size (ln)	0.056	–0.026	0.019	–0.030	–0.045	–0.040	–0.022	–0.068
	(0.045)	(0.073)	(0.062)	(0.074)	(0.074)	(0.083)	(0.141)	(0.150)
Assets (ln)	0.157***	0.145***	0.141***	0.139***	0.108***	0.106**	0.137**	0.125**
	(0.024)	(0.030)	(0.027)	(0.030)	(0.039)	(0.043)	(0.057)	(0.055)
Age of the	–0.006**	–0.004	–0.002	–0.004	0.000	–0.003	0.020	0.025
firm	(0.002)	(0.008)	(0.008)	(0.008)	(0.010)	(0.011)	(0.029)	(0.029)
Final goods	–0.001*	–0.000	–0.000	–0.000	–0.001	–0.001	–0.002*	–0.001
share	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Distance (ln)	0.029	0.020	0.022	0.019	0.027	0.027	0.008	0.012
	(0.018)	(0.019)	(0.017)	(0.019)	(0.021)	(0.024)	(0.020)	(0.021)
Export				0.018	–0.226	–0.192	0.114	–0.080
				(0.167)	(0.176)	(0.185)	(0.327)	(0.412)
Owner has				0.001	0.002*	0.001	–0.000	–0.001
higher education				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Professionals				–0.000	0.009	0.007	–0.011	–0.014
				(0.006)	(0.007)	(0.008)	(0.012)	(0.010)
Competition				–0.014	0.103	0.136	–0.057	–0.096
				(0.076)	(0.087)	(0.101)	(0.115)	(0.094)
Year dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legal form dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2.935***	3.054***	2.889***	3.088***	3.118***	3.222***		
	(0.192)	(0.333)	(0.281)	(0.333)	(0.436)	(0.482)		
Number of observations	732	732	986	731	767	497	589	482
Number of firms		249	379	249	474	249	356	249
R^2	0.34	0.08	0.09	0.08	0.15	0.13		
Hansen test statistics							8.08	10.46
Hansen test *p* value							0.33	0.11

Note: Dependent variable: value added per worker (ln). Estimation on the unbalanced panel in column (3) includes firms for which data are available in at least 2 years. Robust standard errors clustered at the firm level are in parentheses. Significance levels: *p<0.10, **p<0.05, ***p<0.01.

Source: Author's compilation based on SME data.

The final part of the analysis estimates whether the impact of standards on labour productivity depends on the intensity of labour use. Labour intensity is measured as annual real costs of labour as a share of value added. Table 6 shows that the impact of standards on labour productivity goes through labour intensity and that the direction of the relationship is convex, with a negative first interaction and a positive interaction on the quadratic term. This indicates that the benefits from standards accrue to firms with labour intensity above a certain threshold. As an illustration, Figure 5 shows how average labour costs and productivity differ by application of standards, comparing the firms with low and high labour productivity and firms with low and high labour intensity, respectively. Panel (a) shows that more productive firms applying standards also have higher labour compensation rates, measured as average real labour costs. Panel (b) shows that more labour-intensive firms applying standards also have higher labour productivity.[7]

Table 6: Impact of standards on labour productivity depending on labour intensity

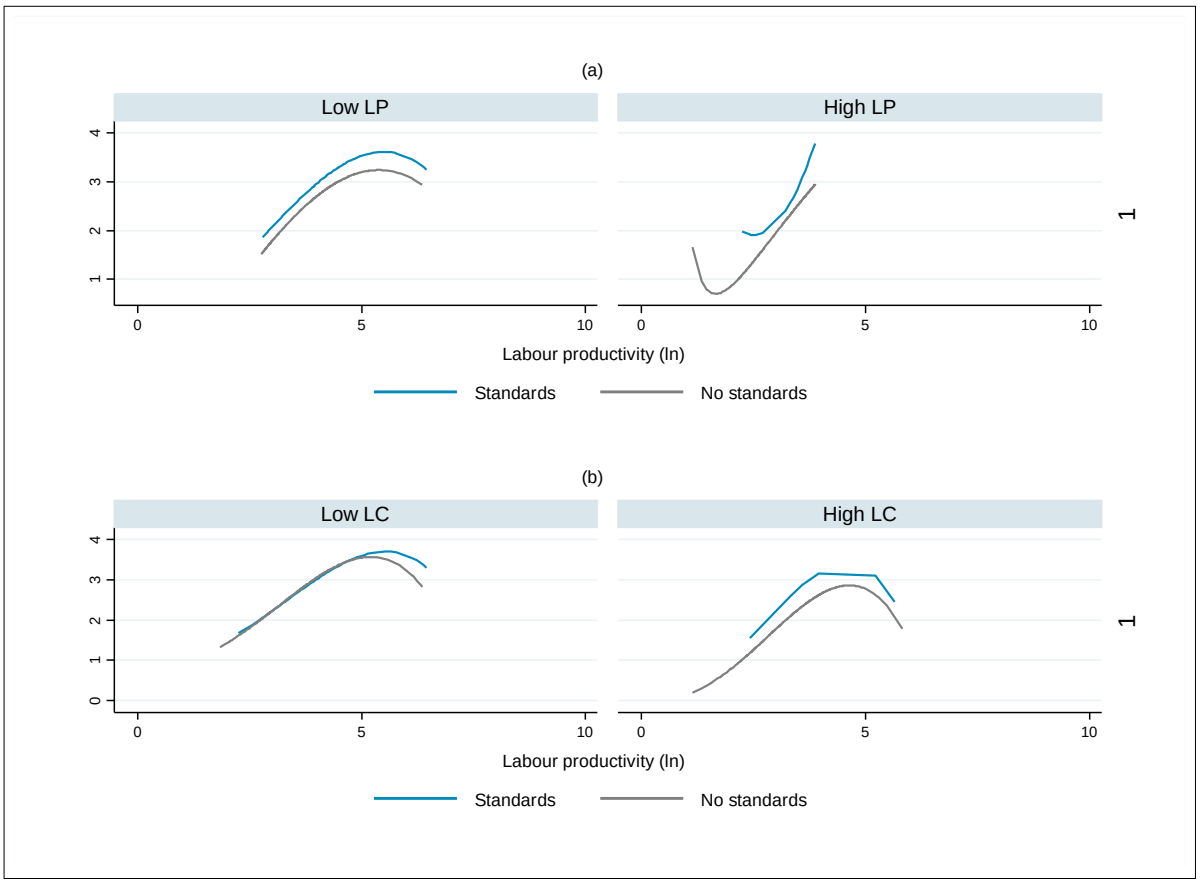
	OLS balanced	FE balanced	FE unbalanced	FE unbalanced, 2010–12	FE balanced, 2010–12	GMM unbalanced	GMM balanced
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Standards	1.679***	1.057**	1.057***	1.533***	1.565***	1.332**	1.138***
	(0.261)	(0.449)	(0.399)	(0.417)	(0.477)	(0.540)	(0.322)
Standards×Labour intensity interaction	–5.255***	–3.067	–3.371*	–5.789***	–5.780**	–4.784**	–3.485***
	(1.125)	(1.914)	(1.738)	(2.082)	(2.280)	(2.415)	(1.131)
Standards×Labour intensity^2 interaction	3.505***	2.084	2.583	5.633**	5.558**	5.228*	3.045**
	(1.140)	(1.811)	(1.690)	(2.315)	(2.530)	(2.685)	(1.436)
Labour intensity	–0.534**	–0.595***	–0.716***	0.127	0.228	–1.914***	–1.527***
	(0.213)	(0.213)	(0.174)	(0.433)	(0.470)	(0.313)	(0.305)
Labour intensity^2	–0.252	–0.145	–0.007	–1.401***	–1.496***	0.631***	0.393**
	(0.177)	(0.120)	(0.064)	(0.515)	(0.561)	(0.165)	(0.185)
Constant	2.990***	3.124***	3.065***	2.955***	2.997***		
	(0.196)	(0.276)	(0.236)	(0.352)	(0.384)		
Number of observations	746	746	1,006	767	497	609	497
Number of firms		249	379	474	249	361	249
R^2	0.48	0.20	0.21	0.31	0.28		
Hansen test statistics						30.80	21.43
Hansen test *p* value						0.01	0.09

Note: Dependent variable: value added per worker (ln). Labour intensity is measured as ln(labour costs per value added). Estimation on the unbalanced panel in column (3) includes firms for which data are available in at least two years. Each model includes following covariates: firm size (ln), real value of assets (ln), firm age, final goods, distance to the main buyer (ln), export status, owner having higher education, professional workforce, time, legal ownership form, and location fixed effects. Robust standard errors clustered at the firm level are in parentheses. Significance levels: *p<0.10, **p<0.05, ***p<0.01.

Source: Author's compilation based on SME data.

[7] Note that the estimation in Table 6 includes a continuous measure of labour costs, whereas Figure 5 separates firms into groups with below and above median labour costs per employee and below and above median labour productivity.

Figure 5: Average labour costs by application of standards among firms with low and high labour productivity and intensity



Note: Panel (a) separates firms based on labour productivity (LP) measured as real value added per employee into firms with low and high productivity, where 'Low LP' consists of firms with LP below median and 'High LP' includes firms with LP above median. Panel (b) separates firms based on labour costs (LC), measured as real value of labour at the end of previous accounting year. 'Low LC' are firms with LC below median and 'High LC' are firms with LC higher than median.

Source: Author's calculations based on SME data.

7 Conclusion

Private standards in developing countries are mostly studied with respect to financial performance and access to export markets, leaving limited evidence about the impact on employee outcomes, especially on labour productivity. This issue is highly relevant, especially in light of the recent reports of stagnating labour productivity in developing countries (e.g., see Rodrik 2011).

Earlier research has been ambiguous about the direction of the relationship between private standards and labour productivity. This paper presents evidence that private standards have a positive effect on labour productivity among the SMEs from the food sector in Viet Nam, showing that standards can contribute to more than market access and profits. This finding supports earlier research on the relationship between private standards and work conditions (Colen et al. 2012; Delmas and Pekovic 2013; Levine and Toffel 2010; Schuster and Maertens 2016).

It has been argued in earlier research that productivity increases with the application of standards only if the labour is adequately compensated. This paper indeed shows that productivity gains from standards depend on the level of labour compensation, but this relationship is not linear. Positive

productivity effects from standards are observable for highly labour-intensive firms, pointing to the presence of a threshold level of labour compensation necessary for productivity gains. Firms with low levels of labour intensity are not likely to improve labour productivity by applying private standards. This implies that employee wage increase due to standards is a likely mechanism for further labour productivity gains. This is an important finding in the context of weak institutional environments of developing countries, where substitutes for official regulation in the form of private standards appear to be able to generate additional benefits for SMEs. Indeed, Goedhuys and Sleuwaegen (2013) found that certification increases total factor productivity, especially in countries with weak institutional framework.

The results are reliable as they are based on the three rounds of panel data, which allow controlling for confounding effects, such as self-selection and unobserved firm-specific characteristics that may or may not change over time. Time-invariant confounding factors are addressed with firm-specific fixed effects, the influence of region-specific characteristics with location fixed effects, and general trends that affect all firms with time dummies. GMM estimation is applied to address the influence of time-varying firm-specific factors. Finally, the results are robust to a number of specification changes: placebo exercise, inclusion of lagged dependent variable, and restriction of the sample to only formal firms or to firms that apply only one private standard.

The results could be extended in a couple of ways. First, the application of standards is not very common among SMEs from the food sector in Viet Nam. Moreover, the range of standards applied is quite limited compared with other countries. This has prevented measuring the benefits of different types of standards at the intensive margin. Future work could thus estimate the effect of different types of standards on labour productivity. Second, future work could perhaps focus in greater detail on labour productivity mechanisms, some of which could be due to management or labour force skills.

References

Alpay, E., S. Buccola, S., and J. Kerkvliet (2002). 'Productivity Growth and Environmental Regulation in Mexican and U.S. Food Manufacturing'. *American Journal of Agricultural Economics*, 84: 887–901.

Anderson, T.W., and C. Hsiao (1982). 'Formulation and Estimation of Dynamic Models Using Panel Data'. *Journal of Econometrics*, 18: 47–82.

Antle, J.M. (2000). 'No Such Thing as a Free Safe Lunch: The Cost of Food Safety Regulation in the Meat Industry'. *American Journal of Agricultural Economics*, 82: 310–322.

Arellano, M., and S. Bond (1991). 'Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations'. *Review of Economic Studies*, 58: 277–97.

Arellano, M., and O. Bover (1995). 'Another Look at the Instrumental Variable Estimation of Error-Components Models'. *Journal of Econometrics*, 68: 29–51.

Aw, B.Y., C. Chen, and M.J. Roberts (2001). 'Firm-Level Evidence on Productivity Differentials and Turnover in Taiwanese Manufacturing'. *Journal of Development Economics*, 66: 51–86.

Beck, T., A. Demirguc-Kunt, and R. Levine (2005). 'SMEs, Growth, and Poverty: Cross-Country Evidence'. *Journal of Economic Growth*, 10: 199–229.

Beghin, J.C., M. Maertens, and J. Swinnen (2015). 'Nontariff Measures and Standards in Trade and Global Value Chains'. *Annual Review of Resource Economics*, 7: 425–50.

Bernard, A.B., J.B. Jensen, S.J. Redding, and P.K. Schott (2012). 'The Empirics of Firm Heterogeneity and International Trade'. *Annual Review of Economics*, 4: 283–313.

Blunch, N.-H., and P. Castro (2005). 'Multinational Enterprises and Training Revisited: Do International Standards Matter?'. Social Protection Discussion Paper 32546. Washington, DC: World Bank. Available at: http://documents.worldbank.org/curated/en/513301468268183284/pdf/325460PAPER0mu1terprises0SP00504web.pdf (accessed 30 November 2016).

Blundell, R., and S. Bond (1998). 'Initial Conditions and Moment Restrictions in Dynamic Panel Data Models'. *Journal of Econometrics*, 87: 115–43.

Bontemps, C., C. Nauges, V. Réquillart, and M. Simioni (2012). 'Food Safety Regulation and Firm Productivity: Evidence from the French Food Industry'. TSE Working Paper 12-275. Toulouse, France: Toulouse School of Economics (TSE). Available at: http://idei.fr/sites/default/files/medias/doc/by/requillart/foodsafety.pdf (accessed 30 November 2016).

Brenner, M.D., D. Fairris, and J. Ruser (2004). ' "Flexible" Work Practices and Occupational Safety and Health: Exploring the Relationship Between Cumulative Trauma Disorders and Workplace Transformation'. *Industrial Relations: A Journal of Economy and Society*, 43: 242–66.

Caliendo, L., and E. Rossi-Hansberg (2012). 'The Impact of Trade on Organization and Productivity'. *Quarterly Journal of Economics*, 127: 1393–467.

Cassiman, B., E. Golovko, and E. Martínez-Ros (2010). 'Innovation, Exports and Productivity'. *International Journal of Industrial Organization*, 28, 372–6; Selected Papers, European Association for Research in Industrial Economics 36th Annual Conference, 3–5 September 2009, Ljubljana, Slovenia..

Christmann, P., and G. Taylor (2006). 'Firm self-regulation through international certifiable standards: determinants of symbolic versus substantive implementation'. *Journal of International Business Studies*, 37: 863–78.

CIEM, DoE, ILSSA, and UNU-WIDER (2012). *Characteristics of the Vietnamese Business Environment: Evidence from a SME Survey in 2011*. CIEM–DANIDA Project: The Small and Medium Enterprise (SME) Survey. Hanoi, Viet Nam: Central Institute for Economic Management (CIEM).

CIEM, DoE, ILSSA, and UNU-WIDER (2014). *Characteristics of the Vietnamese Business Environment: Evidence from a Survey in 2013*. Hanoi, Viet Nam Central Institute of Economic Management (CIEM).

Colen, L., M. Maertens, and J.F.M. Swinnen (2012). 'Private Standards, Trade and Poverty: GlobalGAP and Horticultural Employment in Senegal'. *World Economics*, 35: 1073–88.

Corbett, C.J., M.J. Montes-Sancho, and D.A. Kirsch (2005). 'The Financial Impact of ISO 9000 Certification in the United States: An Empirical Analysis'. *Management Science*, 51: 1046–59.

Cozzarin, B.P. (2016). 'Advanced Technology, Innovation, Wages and Productivity in the Canadian Manufacturing Sector'. *Applied Economics Letters*, 23: 243–9.

Delmas, M. (2001). 'Stakeholders and Competitive Advantage: The Case of ISO 14001'. *Production and Operations Management*, 10: 343–58.

Delmas, M., and S. Pekovic (2013). 'Environmental Standards and Labor Productivity: Understanding the Mechanisms that Sustain Sustainability'. *Journal of Organizational Behavior*, 34: 230–52.

Elmuti, D., and Y. Kathawala (1997). 'An Investigation into the Effects of ISO 9000 on Participants' Attitudes and Job Performance'. *Production and Inventory Management Journal*, 38: 52–7.

Fontagné, L., G. Orefice, R. Piermartini, and N. Rocha (2015). 'Product Standards and Margins of Trade: Firm-Level Evidence'. *Journal of International Economics*, 97: 29–44.

Foster, A.D., and E. Gutierrez (2013). 'The Informational Role of Voluntary Certification: Evidence from the Mexican Clean Industry Program'. *American Economic Review*, 103: 303–8.

Fulponi, L. (2006). 'Private Voluntary Standards in the Food System: The Perspective of Major Food Retailers in OECD Countries'. *Food Policy*, 31: 1–13.

Goedhuys, M., and L. Sleuwaegen (2013). 'The Impact of International Standards Certification on the Performance of Firms in Less Developed Countries'. *World Development*, 47: 87–101.

Goodwin, H.L., Jr, and R. Shiptsova (2002). 'Changes in Market Equilibria Resulting from Food Safety Regulation in the Meat and Poultry Industries'. *International Food and Agribusiness Management Review*, 5: 61–74.

Grekova, K., H.J. Bremmers, J.H. Trienekens, R.G.M. Kemp, and S.W.F. Omta (2014). 'Extending Environmental Management Beyond the Firm Boundaries: An Empirical Study of Dutch Food and Beverage Firms'. *International Journal of Production Economics*, 152: 174–87.

GSO (2004). *Results of Establishment Census of Vietnam 2002: Volume 2 – Business Establishments*. Hanoi, Viet Nam: Statistical Publishing House.

GSO (2007). *The Real Situation of Enterprises: Through the Results of Surveys Conducted in 2004, 2005, 2006*. Hanoi, Viet Nam: Statistical Publishing House.

GSO (2014). *Statistical Yearbook of Vietnam 2014*. Hanoi, Viet Nam: General Statistics Office (GSO).

GSO (2015a). 'Statistical Data'. Hanoi, Viet Nam: General Statistics Office (GSO). Available at: https://www.gso.gov.vn/default_en.aspx?tabid=779 [Accessed 27 January 2016].

GSO (2015b). *Results of a Survey on Non-Farm Individual Business Establishments 2014*. Hanoi, Viet Nam: General Statistics Office (GSO).

Hatanaka, M., C. Bain, and L. Busch (2005). 'Third-Party Certification in the Global Agrifood System'. *Food Policy*, 30: 354–69.

Henson, S., and J. Humphrey (2010). 'Understanding the Complexities of Private Standards in Global Agri-Food Chains as They Impact Developing Countries'. *Journal of Development Studies* 46: 1628–46.

Henson, S., O. Masakure, and J. Cranfield (2011). 'Do Fresh Produce Exporters in Sub-Saharan Africa Benefit from GlobalGAP Certification?'. *World Development*, 39: 375–86.

Herath, D., Z. Hassan, and S. Henson (2007). 'Adoption of Food Safety and Quality Controls: Do Firm Characteristics Matter? Evidence from the Canadian Food Processing Sector'. *Canadian Journal of Agricultural Economics*, 55: 299–314.

Hofer, C., D.E. Cantor, and J. Dai (2012). 'The Competitive Determinants of a Firm's Environmental Management Activities: Evidence from US Manufacturing Industries'. *Journal of Operations Management*, 30: 69–84.

Huergo, E., and J. Jaumandreu (2004). 'Firms' Age, Process Innovation and Productivity Growth'. *International Journal of Industrial Organization*, 22: 541–59.

ISO (2016). *The ISO Survey*. Geneva: International Organization of Standardization (ISO). Available at: http://www.iso.org/iso/home/standards/certification/iso-survey.htm?certificate=ISO%209001&countrycode=VN#countrypick (Accessed 4 March 2016.

Lanoie, P., M. Patry, and R. Lajeunesse (2008). 'Environmental Regulation and Productivity: Testing the Porter Hypothesis'. *Journal of Productivity Analysis*, 30: 121–8.

Lee, J., G. Gereffi, and J. Beauvais (2010). 'Global Value Chains and Agrifood Standards: Challenges and Possibilities for Smallholders in Developing Countries'. *Proceedings of the National Academy of Sciences*, 109: 1–6.

Levine, D.I., and M.W. Toffel (2010). 'Quality Management and Job Quality: How the ISO 9001 Standard for Quality Management Systems Affects Employees and Employers'. *Management Science*, 56: 978–96.

Maertens, M., and J.F.M. Swinnen (2009). 'Trade, Standards, and Poverty: Evidence from Senegal'. *World Development*, 37: 161–78.

Martincus, C.V., S. Castresana, and T. Castagnino (2010). 'ISO Standards: A Certificate to Expand Exports? Firm-Level Evidence from Argentina'. *Review of International Economics*, 18: 896–912.

Masakure, O., J. Cranfield, and S. Henson (2011). 'Factors Affecting the Incidence and Intensity of Standards Certification Evidence from Exporting Firms in Pakistan. *Applied Economics*, 43: 901–15.

Masakure, O., S. Henson, and J. Cranfield (2009). 'Standards and Export Performance in Developing Countries: Evidence from Pakistan'. *Journal of International Trade & Economic Development*, 18: 395–419.

Maskus, K.E., T. Otsuki, and J.S. Wilson (2013). 'Do Foreign Product Standards Matter? Impacts on Costs for Developing Country Exporters'. *Asia-Pacific Journal of Accounting & Economics*, 20: 37–57.

Nakamura, M., T. Takahashi, and I. Vertinsky (2001). 'Why Japanese Firms Choose to Certify: A Study of Managerial Responses to Environmental Issues'. *Journal of Environmental Economics and Management*, 42: 23–52.

Naveh, E., and M. Erez (2004). 'Innovation and Attention to Detail in the Quality Improvement Paradigm'. *Management Science*, 50: 1576–86.

Naveh, E., and A. Marcus (2005). 'Achieving Competitive Advantage Through Implementing a Replicable Management Standard: Installing and Using ISO 9000'. *Journal of Operations Management*, 24: 1–26.

Nguyen, B.T., J.W. Albrecht, S.B. Vroman, and M.D. Westbrook (2007). 'A Quantile Regression Decomposition of Urban–Rural Inequality in Vietnam'. *Journal of Development Economics*, 83: 466–90.

Otsuki, T. (2011). 'Effect of International Standards Certification on Firm-Level Exports: An Application of the Control Function Approach'. OSIPP Discussion Paper DP-2011-E-005. Japan: Osaka School of International Public Policy, Osaka University. Available at: http://www.osipp.osaka-u.ac.jp/archives/DP/2011/DP2011E005.pdf (Accessed 30 November 2016).

Paunov, C. (2016). 'Corruption's Asymmetric Impacts on Firm Innovation'. *Journal of Development Economics*, 118: 216–31.

Porter, M., and C. van der Linde (1995). 'Green and Competitive: Ending the Stalemate'. *Harvard Business Review*, 73: 120.

Raynolds, L.T. (2002). 'Consumer/Producer Links in Fair Trade Coffee Networks'. *Sociologia Ruralis*, 42: 404–24.

Rodrik, D. (2011). 'The Future of Economic Convergence'. NBER Working Paper 17400. Cambridge, MA: National Bureau of Economic Research (NBER). Available at: http://www.development.wne.uw.edu.pl/uploads/Courses/dw_rodrik_2011.pdf (Accessed 30 November 2016).

Schuster, M., and M. Maertens (2015). 'The Impact of Private Food Standards on Developing Countries' Export Performance: An Analysis of Asparagus Firms in Peru'. *World Development*, 66: 208–21.

Schuster, M., and M. Maertens (2016). 'Do Private Standards Benefit Workers in Horticultural Export Chains in Peru?'. *Journal of Cleaner Production*, 112(Part 4): 2392–406.

Stock, J.H., and M. Yogo (2005). 'Testing for Weak Instruments in Linear IV Regression'. In: D.W.K. Andrews and J.H. Stock (eds), *Identification and Inference for Econometric Models. Essays in Honor of Thomas Rothenberg*. Cambridge, MA: Cambridge University Press, pp. 80–108.

Terlaak, A., and A.A. King (2006). 'The Effect of Certification with the ISO 9000 Quality Management Standard: A Signaling Approach'. *Journal of Economic Behaviour and Organization*, 60: 579–602.

UNU-WIDER (2015). 'The Small and Medium Enterprise Survey in Vietnam'. Helsinki: UNU-WIDER. Available at: https://www.wider.unu.edu/research-uptake/small-and-medium-enterprise-survey-vietnam (Accessed 27 February 2016).

Van Leeuwen, G., and L. Klomp (2006). 'On the Contribution of Innovation to Multi-Factor Productivity Growth'. *Economics Innovation and New Technology*, 15: 367–90.

Van Biesebroeck, J. (2005). 'Firm Size Matters: Growth and Productivity Growth in African Manufacturing'. *Economic Development and Cultural Change*, 53: 545–83.

Wang, Z., H. Yuan, and F. Gale (2009). 'Costs of Adopting a Hazard Analysis Critical Control Point System: Case Study of a Chinese Poultry Processing Firm'. *Applied Economic Perspective and Policy*, 31: 574–88.

Appendix

Table A1: Determinants of the adoption of standards (first stage of the 2SLS estimation)

	(1) lnlp2_all	(2) lnlp2_all
IV	43.182*** (10.754)	39.490*** (11.566)
Firm size (ln)	–0.032 (0.024)	–0.019 (0.029)
Assets (ln)	0.016 (0.011)	0.022** (0.011)
Age of the firm	0.003 (0.003)	0.000 (0.002)
Final goods share	–0.000 (0.000)	–0.000 (0.000)
Distance (ln)	–0.006 (0.005)	–0.001 (0.005)
Export	0.276** (0.117)	0.344** (0.135)
Owner has higher education	–0.000 (0.000)	0.000 (0.000)
Professionals	–0.003 (0.003)	–0.004 (0.003)
Competition	–0.011 (0.020)	–0.012 (0.019)
Year dummies	Yes	Yes
Location dummies	Yes	No
Legal form dummies	Yes	Yes
Kleibergen–Paap *F* statistic	16.13	11.66
Cragg–Donald *F* statistic	43.56	32.00
Observations	1,006	746

Note: Robust standard errors are in parentheses. Significance levels: *p<0.10, **p<0.05, ***p<0.01.

Source: Author's compilation based on SME data.

Table A2: Correlation between the instrumental and the dependent variable

	(1) OLS
IV	11.009 (13.053)
Firm size (ln)	0.025 (0.030)
Assets (ln)	0.153*** (0.016)
Age of the firm	–0.001 (0.002)
Final goods share	–0.001** (0.000)
Distance (ln)	0.031** (0.013)
Export	0.187* (0.111)
Owner has higher education	0.001*** (0.000)
Professionals	0.005 (0.003)
Competition	0.074 (0.062)
Year dummies	Yes
Location dummies	Yes
Legal form dummies	Yes
Constant	2.856*** (0.154)
Observations	1,006

Source: Author's compilation based on SME data.

Table A3: Placebo test: Impact of requesting private standards on labour productivity

	OLS balanced	FE balanced	FE unbalanced	FE balanced	FE unbalanced, 2010–12	FE balanced, 2010–12	GMM unbalanced	GMM balanced
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Buyers' request for standards	0.082	−0.079	−0.096	−0.084	−0.156	−0.099	−0.025	0.005
	(0.093)	(0.100)	(0.087)	(0.103)	(0.251)	(0.275)	(0.141)	(0.180)
Firm size (ln)	0.054	−0.031	0.009	−0.038	−0.048	−0.039	−0.108	−0.122
	(0.045)	(0.070)	(0.060)	(0.071)	(0.077)	(0.085)	(0.118)	(0.129)
Assets (ln)	0.159***	0.165***	0.159***	0.160***	0.123***	0.119***	0.157***	0.125**
	(0.026)	(0.029)	(0.025)	(0.028)	(0.037)	(0.041)	(0.058)	(0.054)
Age of the firm	−0.006**	−0.006	−0.003	−0.005	0.001	−0.003	0.035	0.024
	(0.002)	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.026)	(0.030)
Final goods share	−0.001*	−0.000	−0.000	−0.000	−0.001	−0.001	−0.003**	−0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Distance (ln)	0.028	0.018	0.020	0.017	0.026	0.025	0.011	0.008
	(0.017)	(0.019)	(0.016)	(0.019)	(0.022)	(0.024)	(0.018)	(0.020)
Export				0.153	0.205	0.166	0.456	0.121
				(0.146)	(0.232)	(0.249)	(0.349)	(0.360)
Owner has higher education				0.001	0.001*	0.001	−0.001	−0.001
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Professionals				0.001	0.008	0.006	0.000	−0.012
				(0.006)	(0.007)	(0.009)	(0.010)	(0.010)
Competition				−0.022	0.098	0.131	−0.124	−0.074
				(0.078)	(0.088)	(0.101)	(0.096)	(0.093)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legal form dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2.913***	2.974***	2.821***	2.996***	2.994***	3.114***		
	(0.198)	(0.299)	(0.255)	(0.295)	(0.403)	(0.437)		
Number of observations	747	747	1007	746	767	497	609	497
Number of firms		249	379	249	474	249	361	249
R^2	0.35	0.08	0.09	0.08	0.14	0.12		
Hansen test statistics							6.32	8.36
Hansen test *p* value							0.50	0.21

Note: Dependent variable: value added per worker (ln). Robust standard errors clustered at the firm level are in parentheses. Significance levels: *p<0.10, **p<0.05, ***p<0.01.

Source: Author's compilation based on SME data.

Table A4: Dynamic estimation of the impact of standards on labour productivity

	OLS balanced (1)	FE balanced (2)	FE unbalanced (3)	FE balanced (4)	GMM balanced (5)	GMM unbalanced (6)
Standards	0.064	0.337*	0.350**	0.337*	0.486*	0.376
	(0.112)	(0.183)	(0.166)	(0.183)	(0.257)	(0.368)
Lag labour productivity (ln)	0.358***	−0.338***	−0.351***	−0.338***	0.303*	0.302*
	(0.051)	(0.071)	(0.071)	(0.071)	(0.159)	(0.163)
Firm size (ln)	0.016	−0.124	−0.110	−0.124	−0.102	−0.229
	(0.044)	(0.094)	(0.092)	(0.094)	(0.319)	(0.307)
Assets (ln)	0.118***	0.127***	0.119***	0.127***	0.235*	0.176*
	(0.025)	(0.039)	(0.038)	(0.039)	(0.121)	(0.107)
Age of the firm	−0.005**	−0.004	−0.003	−0.004	−0.062	−0.032
	(0.002)	(0.018)	(0.018)	(0.018)	(0.159)	(0.154)
Final goods share	−0.001	0.000	0.000	0.000	−0.002	−0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Distance (ln)	0.003	−0.007	−0.005	−0.007	−0.019	−0.029
	(0.022)	(0.025)	(0.024)	(0.025)	(0.037)	(0.039)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Location dummies	Yes	Yes	Yes	Yes	Yes	Yes
Legal form dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.752***	4.738***	4.787***	4.738***		
	(0.281)	(0.624)	(0.607)	(0.624)		
Number of observations	498	498	627	498	261	249
Number of firms		249	366	249	261	249
R^2	0.42	0.20	0.19	0.20		
Hansen test statistics					3.64	4.30
Hansen test *p* value					—	—

Note: Dependent variable: value added per worker (ln). Robust standard errors clustered at the firm level are in parentheses. Significance levels: *p<0.10, **p<0.05, ***p<0.01.

Source: Author's compilation based on SME data.