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Evidence from the Ethiopian floriculture sector  
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**Firms' Adoption of International Standards:  
Evidence from the Ethiopian Floriculture Sector**

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Abstract

*Global trade in agriculture and food products is increasingly governed by an array of standards. A survey conducted in 2010 covering all operational firms in the nascent floriculture industry in Ethiopia revealed that only 36 per cent have managed to acquire certification for international private standards. This study uses a census-based panel dataset from Ethiopian floriculture to empirically examine the determinants of firms' adoption of international private standards. It also analyses overall industry level efforts and public–private partnership to launch and implement a national scheme for Good Agricultural Practice and build firms' capacity to comply with the standards.*

Key words: standards, certification, floriculture exports, estate farms, Ethiopia, Africa

JEL Classification: L15, O19, Q17

## 1. INTRODUCTION

Global trade in agriculture and food products is governed by an array of standards that through time have expanded in product coverage and become increasingly complex. The standards cover a wide range of issues, from safety or quality of the products to social (labour conditions) and environmental impacts. They can be classified as public (mandatory) or private (voluntary), although the line separating them is not always well defined. This is because most of the standards adopted by governments have their origin in private industry and private standards have also become *de facto* mandatory (Smith, 2009). Standards have become key instruments for governing global value chains, particularly for facilitating arm's length relationships, and in turn have been reinforced by the growing dominance of supermarkets and large retailers (Altenburg, 2006; International Trade Centre, ITC, 2011).

There is an ongoing debate on the impact of global standards on developing countries' export supply.<sup>1</sup> The widely shared view is that the standards adversely affect and serve to exclude developing country producers from global markets. Implementation of the standards is costly, time-consuming and particularly challenging for developing country firms due to their poor infrastructure and weaker technical, financial and institutional capabilities. This adverse effect is even harsher for small farms/firms (Dolan and Humphrey, 2000; Jaffee, 2003; Henson and Jaffee, 2006). In contrast, others argue that compliance with standards can help upgrading and learning, and thus be a catalyst for modernization of developing countries (Jaffee and Henson, 2005; Maertens and Swinnen, 2007). At the micro level, Nadvi (2004) identifies two advantages that compliance with global standards can

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<sup>1</sup> Altenburg (2006) and Maertens and Swinnen (2007) have excellent reviews of these debates.

potentially offer developing country producers: first as a means of raising their productivity through learning modern and improved production and management techniques; and second as a clear signal to global buyers about their competence.

In order to continue exporting, developing countries have little choice but to enhance private firms' compliance with the new requirements as well as strengthen institutional infrastructure and help demonstrating compliance (UNIDO, 2005). Identifying firm- as well as national level factors that improve or impede compliance with global standards is, therefore, crucial from a policy perspective. However, the main focus of empirical studies of standards in fresh produce in the context of developing countries has been smallholder farmers (Henson, Masakure and Cranfield, 2011), representing a politically charged topic (ITC, 2011). For example, the subject of many of the empirical studies on the determinants and/or impact of adoption of standards in the fresh produce of Africa (e.g. Okello, 2005; Chemnitz, 2007; Maertens and Swinnen, 2009; Asfaw, Mithöfer and Waibel, 2010) and elsewhere (e.g. Kleinwechter and Grethe, 2006; Diogo, Monteiro and Caswell, 2009; Kersting and Wollni, 2012; Handschuch, Wollni and Villalobos, 2013) was household farms.

Nonetheless, not all fresh horticulture exports from developing countries are produced by smallholders. On the contrary, existing studies (for example, Dolan and Humphrey, 2000 for Kenya and Zimbabwe; Jaffe, 2003 for Kenya; Henson and Jaffee, 2006 for Ghana; and Maertens and Swinnen, 2009 for Senegal) provide evidence of the consolidation of a small number of leading large-scale integrated producer-exporters at the expense of smallholders. This is because supermarkets and large retailers in the EU have been buying increasingly from large estate farms instead of from smallholders, following recent governance changes in the global value chain and increasing standards. And yet there is a dearth of empirical

studies on the factors that affect standard compliance decisions in the organized (large estate farms) sector in fresh produce (with the notable exception of Henson, et al., 2011).<sup>2</sup>

The present study aims to fill this gap in the literature by examining the determinants of firms' adoption of private standards in fresh horticultural produce in the large-scale estate farm sector, based on the nascent floriculture export industry in Ethiopia. It relies on unique firm level panel data that were collected in two rounds (2008 and 2010) of surveys, both of which were census-based, covering all operational flower farms in the country at the time. The sector constitutes large estate farms with average employment of 375 people and 12 hectares of land under flower cultivation. This study also provides analysis of the overall industry level efforts and public-private partnerships to launch and implement a national scheme of GAP (Good Agricultural Practice) known as the Ethiopian Horticulture Producer and Exporters Association (EHPEA) Code of Practice for Sustainable Flower Production and build the firms' capability to comply with the standards. Existing studies often overlook the role of local capability building and the institutional arrangements required to comply with international standards (Kersting and Wollni, 2012).

The Ethiopian flower industry represents one of the recent successful export diversification efforts in Africa. Despite its recent start, Ethiopia is currently the second largest floriculture exporter in Africa, next to Kenya. This sector has attracted a fair amount of attention from researchers (for example, Belwal and Chala, 2008; Melese and Helsing, 2010; Mano et al., 2011; Gebreeyesus and Iizuka, 2012; Gebreeyesus and Sonobe, 2012), but none address the determinants of firm level compliance with global standards.<sup>3</sup>

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<sup>2</sup> Henson et al. (2011) use survey data consisting of 102 fresh produce-exporting firms (including those sourcing from small out-growers and own farms) in ten African Caribbean and Pacific (ACP) countries. The sample was drawn from firms that had received support from the EU Pesticide Initiative Programme (PIP).

<sup>3</sup> Belwal and Chala (2008) analyse the catalysts and barriers to the growth of the flower industry, focusing on the promotional activity of the government and environmental impact. Melese and Helsing (2010) examine the impact of foreign dominance (particularly the Dutch) in the sector and the extent of endogenization. Mano et al. (2011) look at the roles of local and personal networks in the employment process, and the emergence and development of the labour market in Ethiopia's cut-flower industry. Gebreeyesus and Iizuka (2012) examine

The rest of the paper is organized as follows. The next section describes the EU flower market with a focus on the marketing channels and commonly applied standards in the sector. Section 3 gives some background of the Ethiopian flower industry. Section 4 sets the analytical framework and hypotheses on the determinants of firm level adoption of international private standards. Section 5 describes the data and provides some summary statistics. Section 6 discusses the estimation strategy and results, and the last section concludes.

## 2. THE EU FLORICULTURE MARKET AND STANDARDS

Floriculture can be divided into four sub-products: flowers, cut foliage, plants and bulbs. Table 1 gives the patterns in the world floriculture trade, as well as the EU's import share and sourcing over the last two and a half decades. In this period, world floriculture trade has surged, for example from 2.13 billion in 1988 to about 17 billion by 2012 (in current USD).<sup>4</sup> The European Union, EU (hereafter referring to the 27 members countries, EU-27), is the world's largest floriculture market, accounting for about two-thirds of the world's imports. The bulk of the EU's imports (above 80 per cent), however, come from other EU countries (intra-EU), suggesting the self-sufficient nature of the region.

<Table 1 about here>

Since the 1990s, European growers have started relocating their production in developing countries with favourable climatic conditions and lower labour costs. Production

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the successful emergence of the industry with a focus on public-private sector coordination. Gebreeyesus and Sonobe (2012), on the other hand, focus on the co-evolution of firm- and industry-level capabilities that were needed to enter the EU market, which they refer to as the 'market formation' process.

<sup>4</sup> Note that, unless explicitly stated, the world trade data used in this study are extracted from UN-COMTRADE.

of cut flowers in the EU is gradually decreasing (Centre for the Promotion of Exports from Developing Countries, CBI hereafter, 2013). As a result, developing countries such as Colombia, Kenya, Ecuador and Ethiopia have become new centres of production (Belgian Development Agency Trade for Development Centre, BTC hereafter, 2010) and the share of the EU's imports coming outside the EU-27 (extra-EU) has been rising. The rise in sub-Saharan Africa's share, from 1.5 per cent in 1988 to 8.1 per cent in 2012, is particularly notable, making the region the largest non-EU supplier to the EU market. On the other hand, the EU is the primary destination for floriculture exports from sub-Saharan Africa, accounting for above 80 per cent.

Flowers follow a wide range of different routes from the growers to the consumers in the European market. According to CBI (2007), a vital distinction can be made between flowers traded via one of the auctions and flowers bypassing the auction system, often referred as direct sales. Auctions have been historically the most important channel through which flowers are distributed to European wholesalers and retailers. Auctions in the Netherlands, in particular, play a central role in the European floriculture trade, both as marketplace and distribution hub for imports from developing countries. Although auctions still handle more than 60 per cent of imports to the EU, the share of direct sales has been on the rise in recent years. This is mainly driven by the growing role of supermarkets in the retail market in many EU countries (Wijnands, 2005).

Another major recent development in the EU market has been the proliferation of standards, initially applied in the food chain to other agriculture products, including floriculture. Since the 1990s, a variety of standards and labels has emerged in the flower value chain. In the literature, there are several ways of classifying the standards. For example, public versus private standards, and those that specify 'product' versus 'process' standards (Kaplinsky, 2010). Most of the standards operating in the European floriculture

market are private standards and typically the so-called ‘process’ standards specifying how flowers and plants should be produced (BTC, 2010).

A distinction can also be made based on the standard setters. Riisgaard (2009) and BTC (2010) identify four types. The early ones were mainly set by (i) dominant buyers such as supermarkets (for example, Tesco Nature’s Choice) and (ii) producer groups in the EU (for example, the Milieu Programma Sierteelt, MPS, and EUREP–GAP). The former standards are communicated to consumers (consumer labels), while the latter are the so-called business–to–business (B2B) standards. The later standards were mainly set by (iii) non–governmental organizations (NGOs) and trade unions, who introduced social, environmental and ethical standards into international trading (for example, Max Havellar/Fairtrade, Fair flowers Fair Plants (FFP), and Flower Label Program (FLP)) and (iv) producers’ associations in the developing countries that initiated self–regulation (for example, Kenya Flower Council, KFC, code of practice; Florverde standard by Asociolflores in Colombia; and Code of Practice for Sustainable Flower Production by Ethiopian Horticulture Producers and Exporters Association, EHPEA).

Many of the standards deal with similar issues, for example social and environmental conditions. This overlap has led to collaboration and attempts at harmonization. As a result, several producers’ associations have benchmarked their standards to GLOBALGAP, formerly known as EUREP–GAP (BTC, 2010). GLOBALGAP is applied to wide range of products, including crops, livestock, aquaculture and horticulture. It is the most important private standard, currently operating in more than 110 countries, and over 130,000 producers are GLOBALGAP certified.<sup>5</sup> But when it comes to the ornamental (flowers and plants) sector, the MPS is by far the largest in terms of certified producers. According to the official MPS website, currently there are about 4000 MPS certified growers operating in

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<sup>5</sup> Source, URL: <[http://www.globalgap.org/uk\\_en/what-we-do/](http://www.globalgap.org/uk_en/what-we-do/)>.

more than 55 countries.<sup>6</sup> The MPS was initiated by Dutch flower growers in 1995 and carries primarily an environmental label. Later it offered optional schemes such as ‘Social Qualification’ (MPS–SQ) based on the International Code of Conducts (ICC) and ‘Good Agricultural Practice’ (MPS–GAP), benchmarked to GLOBALGAP (Riisgaard, 2009).

### 3. THE ETHIOPIAN FLORICULTURE INDUSTRY

#### (a) Overview of the growth of the industry

Ethiopian floriculture is a new industry that started in the mid–1990s. But until 2003 there were only five flower firms that exported in total no more than USD 4 million. In 2004, the number of firms doubled, marking the start of the growth period of the industry. By 2008 the number of firms reached 81, estimated to generate employment for about 50,000 people, of which above 70 per cent were women. In 2008 flowers and plants became one of the five top export commodities for the country, with more than USD 120 million foreign exchange earnings. Floriculture exports continued to grow in the following years and reached about USD 220 million by 2012.

Similar to many other sub–Saharan countries, the primary destination of Ethiopian flower exports is the EU market, which accounts for above 90 per cent of the total export value. Table 2 shows a dramatic rise of the Ethiopian flower industry in the rank of top non–EU flower suppliers to the EU market. In 2003 Ethiopia ranked only 33rd, whereas in less than ten years (i.e. 2012) it became the second top exporter, surpassed only by Kenya, long established in the EU flower market.

<Table 2 about here>

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<sup>6</sup> Source: URL: <<http://www.my-mps.com/en/about-mps-producer/history>>.

Gebreeyesus and Iizuka (2012) argue that the exemplary collaboration between the government and the private sector was one of the major factors in the success of the flower industry in Ethiopia. According to them, a few private entrepreneurs discovered, through their costly experimentation starting the mid–1990s, that flowers could be produced and exported profitably. In 2002, these few early entrants formed an association in an effort to build a strong advocacy coalition and were successful in convincing the government about the opportunity offered by the sector. The government responded quickly and positively by adding floriculture to its priority list. With the participation of the association, representatives the government prepared the sector’s five–year action plan and set targets to put 1000 hectares of land under flower production by the end of five years, starting in 2003. To meet these targets, the government offered various supports to the private sector, including access to land and long–term credit on generous terms, as well as air transport coordination.

(b) Industry–self regulation; the development of a national scheme for GAP

The Ethiopian flower industry emerged at a time when the EU market, the primary export destination, was already characterized by complex rules and standards. Compliance with standards has, thus, become crucial for continued access to this market. The firms requested their association to develop a sector–wide tool to respond in an effective way to the growing demands to comply with international standards (Joosten, 2007). The need for a sector–wide code of practice linked to international standards (such as GLOBALGAP for the sector in general and MPS for the floriculture sub–sector) was then agreed in 2006 among various stakeholders such as the industry association, government and donors. Accordingly, EHPEA

Code of Practice (the Code, hereafter) was launched in 2007 under the auspices of the association.

According to the association document (EHPEA, 2011), the Code sets three standard levels: Bronze, Silver and Gold. Bronze is a minimum requirement and compulsory for a flower farm to obtain the EHPEA Code of Accreditation. Compliance with the Bronze level requires, among others, basic standards for internal monitoring, record keeping and environmental protection, responsible production and employment practices. The Silver and Gold are higher levels of standards, and optional. To achieve compliance at the Silver level the farm must implement Good Agricultural Practice (GAP), pest management, and further improved environmental and social performance in addition to the requirements for the Bronze level. The Gold level, on the other hand, requires the farm to go beyond normal market expectations and take part in Corporate Social Responsibility projects, Conservation and Product Quality Management, in addition to the Silver level requirements. A certificate of compliance is given to the farm only after verification of compliance by an international auditing company.

In an effort to implement the Code, the industry association offered extensive training to its members, starting with a pilot of 21 volunteer farms in 2007. The training courses comprise a number of topics relevant to the implementation of the Code, including internal auditing, environmental risk assessment, occupational safety and health on the farm, pesticide storekeeping, safe use of pesticides, crop scouting. They involved not only workers but also agronomists and managers from individual farms. In February 2009, the first ten flower farms received the certificate of Code of Practice after a one-year auditing process by a third party, a Dutch company known as Control Union Certification (Glenn, 2010). The association scaled up its training and certification activities to cover all its members. By the end of 2010, out of the 77 firms covered in our survey 67 (87 per cent)

reported having participated in the training and 63 (81 per cent) met the requirements and acquired the certificate for the industry Code of Practice (see Table 3).

The government and donors have also contributed in various ways to the development and implementation of the industry code of practice. Collaboration between the Netherlands and Ethiopian governments under the Ethio–Netherlands Horticulture Partnership project was particularly instrumental in this regard.<sup>7</sup> The government has also shown keen interest in the development of the Code and made the Bronze level mandatory for all floriculture producers in Ethiopia. Implementation of the national scheme for GAP is believed to have helped the private firms<sup>7</sup> to acquire additional certificates for private standards such as GLOBALGAP and MPS, as it is linked to them.

(c) Firms' compliance with international standards; some descriptive evidence

In addition to the certificate for the industry Code of Practice, several of the Ethiopian flower firms have started to acquire certificates for international private standards. According to responses to the 2010 survey, there were 25 firms with MPS, 4 with GLOBALGAP, and 10 with other private labels such as British Retail Consortium (BRC), Fair Trade, or Ethical Trading Initiative (ETI). In total, 28 firms had one or more certificates for private standards, which amounts to about 36 per cent of the total number of firms in our sample (see Table 3). All the firms with GLOBALGAP and other certificates except one were also MPS certified, suggesting the importance of MPS in the flower industry.

<Table 3 about here>

Table 3 also reports the upgrading efforts and costs incurred by the firms to comply with the industry Code of Practice and/or international private standards. According to the

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<sup>7</sup> The Swedish Chamber of Commerce (SCC) and the International Labour Organization (ILO) are among the other donors contributing to the development and implementation of the GAP.

responses, about 53 per cent of the firms made organizational arrangements and improved information and technology (IT) facilities, two-thirds constructed additional facilities for staff and inputs and another 58 per cent purchased new equipment. Three-quarters of the firms also reported having offered in-house training to their workers and improved waste management. We specifically asked about the amount of investment cost they incurred to comply with the standards, and above half of the firms reported having spent 100,000 Birr and more.<sup>8</sup>

The respondents also revealed their perception of the benefits gained from compliance with the standards, either the national GAP standards or international private ones. As can be seen from Table 3, the main benefit indicated by the majority of the farms is improvement in workers' skills (71 per cent), efficiency (58 per cent) and increased market access (46 per cent). On the other hand, the responses show that the direct monetary rewards were not that significant. For example, increased per unit price or sales growth was indicated as a benefit by only 25 per cent and 22 per cent of firms respectively. This is consistent with the previous observation that certified firms do not necessarily receive higher prices than they would for regular products (for example, BTC, 2010; Muradian and Pelupessy, 2005).

#### 4. FIRMS' DECISION TO ADOPT PRIVATE STANDARDS: THE MODEL AND HYPOTHESES

Let us assume that the certification of private standards is voluntary. The decision to adopt private standards is a function of the expected benefits of adoption and the costs of compliance relative to non-compliance. In an intertemporal setting, a representative

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<sup>8</sup> Although these costs were incurred in different years, they were reported as a cumulative sum of the preceding years. Thus we are not able to convert the cost exactly from Birr to the USD. But if we take the average exchange rate of the year 2008/09 (Birr/USD = 11), then 100,000 Birr is equivalent to USD 9000. This may be slightly higher or lower if the average exchange rate of respectively the preceding or following year is used.

producer (firm) will choose to certify if the expected discounted benefits exceed the discounted cost of compliance (i.e. if the expected net present value,  $\pi$ , of the investment in certification is positive).

$$E(\pi_i) = E(B_i) - E(C_i) > 0 \quad (1)$$

The benefits ( $B$ ) of certification may arise, among others, from an increase in efficiency, an increase in revenue due to the ability to raise price and/or quantity sold, reputation or market value of the firm, and market access; while the compliance costs ( $C$ ) arise from construction of grading and sanitation facilities, training of employees, personnel and management costs to implement the standards, and conformity assessment such as documentation, testing, or auditing through a third party (Smith, 2009).

Many of these benefits and costs are difficult to quantify (Holleran, Bredahl and Zaibet, 1999); thus the net benefit is unobserved. What we do observe is adopters ( $y_i = 1$ ) and non-adopters ( $y_i = 0$ ). This dichotomous outcome is implicitly based on the firm's value of the expected net gain; that is, adoption when  $E(\pi_i) > 0$  or non-adoption when  $E(\pi_i) \leq 0$ . Let us assume that there is a latent variable  $y_i^*$  underlying the dichotomous response (adoption and non-adoption) and that  $x_i'$  is a vector of exogenous variables affecting this outcome.

$$y_i^* = x_i' \beta + \varepsilon_i, \quad (2)$$

$$\text{where } y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases}, \quad (3)$$

Assuming that  $\varepsilon_i$ , the random disturbance term, follows the standard normal distribution, that is,  $\varepsilon_i \sim N(0, 1)$ , the probability of a given firm choosing to adopt the standards yields the following probit model:

$$Pr(y_i = 1|x_i) = Pr(y_i^* > 0|x_i) = Pr(\varepsilon_i > -x_i'\beta|x_i) = \Phi(x_i'\beta), \quad (4)$$

where  $\Phi$  is a cumulative normal distribution function (c.d.f.) of  $\varepsilon_i$ . It follows that

$$Pr(y_i = 0|x_i) = 1 - \Phi(x_i'\beta) \quad (5)$$

The joint probability of observing  $y_i = 1$  and  $y_i = 0$  in the entire sample is

$$f(y|x_i) = [\Phi(x_i'\beta)]^y [1 - \Phi(x_i'\beta)]^{1-y}, \quad y = 0, 1 \quad (6)$$

The log-likelihood function is then

$$l_i(\beta) = y_i \log [\Phi(x_i'\beta)] + (1 - y_i) \log [1 - \Phi(x_i'\beta)] \quad (7)$$

Using the maximum likelihood method, we can estimate the value of  $\beta_k$  ( $K \times 1$  vector of parameters) that maximizes the log likelihood function.

Following many of the previous studies (for example, Herath, Hassan and Henson, 2007; Diogo et al., 2009; Henson et al., 2011), we assume that observable factors such as firm attributes and the external environment through a set of firm level incentives would determine the size of the net benefits of certification. Exogenous variables that are expected to influence the certification decision are often derived from the literature on innovation diffusion (Rogers, 2003) and market participation (Hobbs, 1997). Firm characteristics (for example, size, age, ownership type, export orientation, product type) and external environment (for example, degree of pressure from customers or marketing channels) have been identified as determining firms' adoption decision in non-smallholder sectors, most of which are based on the food processing (manufacturing) and ISO family of standards (for example, Feder, Just and Zilberman, 1985; Holleran et al., 1999; Turner, Gerald and

Michael, 2000; Herath et al., 2007; Hudson and Orviska, 2013).<sup>9</sup> Below we draw on these and other relevant studies to formulate our hypotheses on the major factors that determine the decision to adopt private standards.

*Firm Size:* Previous empirical studies provide evidence that firm size has a positive impact on standards adoption (for example, Turner et al., 2000; Herath et al., 2007; Hudson and Orviska, 2013). There are various arguments as to why size positively influences the adoption decision of standards. One is the presence of economies of size (scale) in implementing standards. According to this view, the cost of compliance with standards is largely fixed; hence the average cost per unit of production is higher for small firms than for large firms (Antle, 1995). Large firms stand to benefit more from certification and are better able to spread the costs of adoption (Holleran et al., 1999). The presence of scale economies could thus act as an incentive for large firms but as a disincentive for smaller firms (Turner et al., 2000).

Others cite differences in resource availability between the small and large firms. Small firms have limited access to financial resources when compared with larger firms. Previous studies find that compliance with food standards represents significant up-front investment and these costs have proved a constraint on compliance, particularly for small firms (for example, Dolan and Humphrey, 2000; Hensen and Jaffee, 2006). Small firms might also face problems in accessing the expertise necessary to implement the relevant procedures. In contrast, large firms are believed to have better-trained professionals and greater capacity for managing the quality assurance system information (Holleran et al.,

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<sup>9</sup> Kersting and Wollni (2012) also distinguish three broad categories of factors that determine farmers' decision to adopt standards in fresh produce based on empirical studies that focus mainly on smallholder firms. These are household characteristics (age, education and experience, labour availability, household wealth), farm characteristics (land tenure, farm size, access to irrigation), and access-related variables (access to information and extension services, membership in farmer groups, distance to the next city, support by donors and downstream actors).

1999). Size might thus have confounding effects on such factors as fixed adoption costs, risk preference, human capital and credit constraints (Feder et al., 1985).

*Hypothesis 1: Larger size firms are more likely to comply with private standards than smaller firms.*

*Firm age:* In the innovation literature, there are different arguments regarding the relationship between firm age and innovation. Innovative spirit may be associated with age of the firm in the sense that firms have higher innovative capacity in the first stage of life cycle (Burns and Stalker, 1961; Thompson, 1967). In contrast, firm age could also represent accumulated resources, market knowledge and developed networks; thus older firms are more likely to become involved in innovation activities (Hadjimanolis, 2000). In the context of standards adoption, Turner et al. (2000) argue that older firms have had more time to achieve certification and are more likely to adopt standards than younger ones. Some empirical studies (for example, Turner et al., 2000; Hudson and Orviska, 2013) have shown that the probability of standard certification increases with firm age. Given the short history of the case of our study, the Ethiopian flower industry, firms that stay longer in the industry might have a better chance of complying with standards than new ones.

*Hypothesis 2: Older firms are more likely to adopt international private standards than younger ones.*

*Ownership type:* Some empirical studies have also shown that foreign-owned firms are more likely to comply with international standards (for example, Hudson and Orviska, 2013; Herath et al., 2007). This might be due to the fact that foreign-controlled firms are more likely to be aware of the international standards or have a greater exposure to a wider range of technologies (Gourlay and Pentecost, 2002). Perhaps they face greater internal pressure to

seek certification (Pekovic, 2010) or do so for the sake of reputation-related gains, as they are also more likely to be affiliated to multinational companies.

*Hypothesis 3: Foreign-owned firms are more likely to comply with private standards than domestically owned firms.*

*Marketing channels:* In addition to internal incentives, external factors such as the market power of customers and the degree to which they have leverage to enforce the requirements and regulations might affect the decision to adopt standards (Holleran et al., 1999). Flowers in Ethiopia and sub-Saharan Africa at large are produced mainly for export, the EU being the major destination. They are supplied to this market through two channels: auctions (mainly Dutch) and direct sales, the latter closely controlled by supermarkets and retailers. Riisgaard (2009) argues that the level of demand for social and environmental standards differs significantly between the direct sales ‘strand’ and the Dutch auction ‘strand’. Standards play an important role in the former chain because supermarkets and large retail buyers have a strong incentive and sufficient leverage to impose standards, in contrast to the auction chain. Tallontire et al. (2005) also argue that standards are not currently a requirement to access the Dutch auction chain, but firms supplying it adopt them as a way of accessing niche markets or as a management tool to enhance company reputation. In the direct sales channel, on the other hand, standards form part of the governance structure. We can, therefore, expect a strong association between the nature of the value chain and motives to adopt the standards. It follows that:

*Hypothesis 4: firms supplying mainly to the direct sales channel are more likely to adopt international private standards than those supplying mainly through auctions.*

## 5. DATA AND SUMMARY STATISTICS

The empirical analysis in this study is based on firm level data of the Ethiopian flower industry that were collected in two rounds (2008 and 2010) of surveys. Both surveys were census-based, covering all operational flower farms in the country at the time. The response rate was as high as 95 per cent (64 out of 67 firms) in 2008 and 96 per cent (77 out of 81 firms) in 2010. In each survey round, information was obtained on employment, production and costs, exports and marketing channels for up to three years before the survey period, in addition to the general firm characteristics. The survey instrument in the latest (2010) survey was particularly tailored to analysis of adoption of standards and certification in the Ethiopian flower industry. It thus contains additional information on firms' certification status, adjustments made and costs incurred to comply with the standards. The respondents were also asked to indicate the year when the private standard certificate was acquired, if certified. We were thus able to construct panel data over the years 2005–09 based on the two waves of the surveys and to match the variable indicating the status of private standard certification with the other explanatory variables. This gives over 270 firm/year observations, providing some room for more comprehensive econometric exercises given the small number of firms in the sector.<sup>10</sup>

<Table 4 about here>

To shed some light on the characteristics of standards adopters and non-adopters, Table 4 gives summary statistics of the main variables of interest. The table shows that the majority (69 per cent) of the Ethiopian flower firms were fully or jointly owned by

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<sup>10</sup> Note that 11 firms (24 firm/year observations) in the first round of the survey closed down before the second round; thus, without information on certification status, they are excluded from the empirical analysis.

foreigners.<sup>11</sup> The share of foreign-owned firms in the standard adopters group is higher (80 per cent) than in the non-adopters group (61 per cent). This difference is statistically significant. The overall average age of the firms in the sector is only 3.16 years, suggesting that most of them are young. And yet there is a statistically significant difference in average age between the adopters (3.16) and non-adopters (2.54).

The sector generally consists of large-size estate farms with an average employment of about 375 people and 12 hectares of land under flower cultivation. The standard adopter firms are larger than the non-adopters, employing on average about 167 more people and harvesting about 5.5 more hectares of land. The standard adopter firms also have on average higher sales revenue than the non-adopters. The size difference between these two groups is statistically significant when measured in terms of employment and land, but not in sales revenue. The major destination of Ethiopian flower exports is the EU market. In the given period, about 59 per cent of Ethiopian flower exports to the EU was supplied through auctions (mainly Dutch auctions), while 39 per cent used direct sales to retailers and supermarkets. Contrary to our expectations, the direct sales ratio of the adopters group is lower than that of the non-adopters group, although this difference is not statistically significant.

## 6. ESTIMATION STRATEGY AND RESULTS

### (a) Estimation strategy

To empirically examine the factors affecting firms' compliance with private standards, we use the firm level panel data from the Ethiopian flower industry described above. Based on

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<sup>11</sup> The foreign-owned category here consists of firms that are fully owned by foreigners (53.7 per cent) and those under joint ventures with foreign ownership the majority share (15.2 per cent). The Netherlands, India and Israel (in that order) are the largest foreign investors in the Ethiopian flower sector.

the panel nature of the data, we reformulate the binary choice model in equation (4) as follows:

$$y_{it}^* = x_{it}'\beta + c_i + a_{it}$$

$$y_{it} = \mathbf{1}(y_{it}^* > 0)$$

$$Pr(y_{it} = 1 | x_{it}, c_i) = \Phi(x_{it}'\beta + c_i), \quad (8)$$

where  $c_i$  represents unobserved individual (firm)-specific effects,  $t$  denotes time (year) and other variables are as defined earlier.

The main advantage of panel data is that we can take into account the problem of unobserved heterogeneity with more tools. Unfortunately, dealing particularly with the relation between the explanatory variables ( $\mathbf{x}_i$ ) and individual specific effects ( $c_i$ ) in non-linear models is not easy. There are different methods for addressing this problem, each relying on different assumptions. One may apply the fixed-effect (FE) probit analysis by adding  $N - 1$  individual dummies to the probit model, thus removing the unobserved-effect problem. However, estimation of  $c_i$ , along with  $\beta$ , will result in severely biased estimates, which is known as the incidental parameters problem, unless  $T$  is sufficiently large. An alternative is to use the traditional random (RE) probit estimation method. The key assumption underlying this estimator is that  $c_i$  and  $\mathbf{x}_i$  are independent, which is again very restrictive.

To address this problem we use the Mundlak approach, which relaxes the crucial RE assumption and allows for some dependence between  $c_i$  and  $\mathbf{x}_i$ . Mundlak (1978) assumes the unobserved effects,  $c_i$ , has the form:

$$c_i = \psi + \bar{x}_i\xi + a_i, \quad a_i \sim N(0, \sigma_a^2) \quad (9)$$

where  $\bar{x}_i$  is a vector of the averages of  $x_{it}$  across time periods,  $\psi$  is constant,  $\xi$  is a parameter vector, and  $a_i$  error term assumed to be uncorrelated with  $\bar{x}_i$ .

The probability of  $y_{it} = 1$  can now be written as

$$Pr(y_{it} = 1 | x_{it}, c_i) = Pr(y_{it} = 1 | x_{it}, \bar{x}_i, a_i) = \Phi(x_{it}'\beta + \psi + \bar{x}_i'\xi) \quad (10)$$

And the latent variable will have the following form:

$$y_{it}^* = x_{it}'\beta + \psi + \bar{x}_i'\xi + a_i + a_{it} = x_{it}'\beta + \psi + \bar{x}_i'\xi + v_{it} \quad (11)$$

where  $v_{it} = a_i + \varepsilon_{it}$  the new idiosyncratic error term with zero mean.

This is basically the traditional random-effects model, but now we allow correlation between the unobserved effect and regressors by adding group means of the time-varying explanatory variables as a set of control variables to the model. We can use the standard random-effects probit method to consistently estimate all the parameters. The coefficient of  $\beta$  is identical to the fixed-effect (within) estimator. The degree of statistical significance of the estimated coefficients on the time-averaged variables (with a null hypothesis  $\xi = 0$ ) can be used to test the assumption that the unobserved heterogeneity is uncorrelated with individual regressors (Wooldridge, 2010).

Below we reformulate the probit regression of the standard adoption model with the full set of variables (based on the hypotheses in Section 4) plus the group means of time-varying variables, henceforth referred to as the Mundlak-augmented regression model.

$$Y_{it} = \beta_1 Size_{it} + \beta_2 Age_{it} + \beta_3 FO_t + \beta_4 DSR_{it} + \beta_5 Z_t + \xi_R \sum_1^K \bar{x}_i + \psi + v_{it} \quad (12)$$

$Y_{it}$  is a dummy that takes value one if firm  $i$  has a certificate for a private standard (label) at year  $t$ . That means a zero value is assigned to certified firms for the years before

the certification, and to the non-certified ones over the whole period. Size is measured in terms of number of employed (in logs) and age as the number of years since establishment. *FO* is a dummy representing a firm with at least some foreign ownership. *DSR* is defined as the ratio of exports through direct sales, taking the value in the range of 0 to 1.  $\sum_{i=1}^k \bar{x}_i$  denotes the group mean for the time-varying variables consisting of size, age and direct sales ratio. *Z* represents other control variables such as year, product type and location dummies.

If we assume serial independence, the parameters of interest can be identified using the maximum likelihood estimator, MLE. Serial independence is, however, a strong assumption when repeated observations are made. Thus we use the generalized estimating equation (GEE) approach, which allows for dependence within clusters and relies on alternative ‘working’ assumptions on the correlation structure. Assuming an independent correlation in the GEE probit is equivalent to the pooled probit model. Here we use an equal correlation structure as the main ‘working’ assumption, which is later relaxed to allow for first-order autoregressive as a means of robustness checks. Pan and Connett (2002) argue that the attractive property of GEE is that one may use the ‘working’ correlation structure, which may be wrong, but the resulting regression coefficients estimate is still consistent and asymptotically normal. Moreover, consistent estimates of the standard errors can also be obtained using a robust estimator even if the ‘working’ correlation is incorrectly specified. If the ‘working’ correlation is correctly specified, then the GEE gives more efficient estimates of the parameters (Wooldridge, 2010).

Before estimating the main model we formally tested for the presence of endogenous regressors. The only explanatory variable suspected of potential endogeneity in our model is firm size measured by employment. To test the endogeneity of employment size we follow the common two-step procedure, deriving the residual from the reduced-form equation and including it as additional regressor in the structural equation. Drawing on the firm size

growth literature (for example, Evans, 1987; Hall, 1987), we use previous year employment size, firm age and ownership type as well as a full set of year dummies as explanatory variables in the reduced-form equation of employment size. This is estimated using fixed-effect estimator and results are reported in the appendix (Table A1, column 1).<sup>12</sup> In the second stage we use the GEE probit to estimate the main equation, whereby the residual from the reduced equation is included. We alternatively assume independent and equal correlation structure respectively, reported in columns 2 and 3 of Table A1. The coefficient of the residual is wholly insignificant in both columns, suggesting that employment size is not endogenous to our model.

#### (b) Results

Now we turn to discussion of our main estimation results. Table 5 reports the estimation results of the firms' adoption decision of private standards. All reported results are based on GEE probit estimation with robust standard errors. The marginal effects are reported in this table, given that the magnitude of the coefficients of the probit model is not easy to interpret. The marginal effect measures how the probability of being in the group of adopters  $Pr(y = 1)$  changes for a categorical explanatory variable when the status of the firm changes from zero to one and for a continuous explanatory variable for small (infinitesimal) changes. Marginal effects computed at the mean or any other fixed point are often criticized for ignoring other ranges of a set of values. Hence we report the average marginal effect (AME), a marginal effect computed for each case, and then the effects are averaged.

<Table 5 about here>

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<sup>12</sup> The estimation results show that the previous year firm size and foreign ownership indicators are positively related with current size, while age is negatively related with current size. These are consistent with most previous studies.

The first column reports the results without the control of group means, which is here used as a benchmark. Column 2 reports the Mundlak–augmented regression model results. The time–averaged variables are omitted from the table to save space. Both columns give qualitatively similar results with regard to most of the variables. A joint significance test of the time–averaged explanatory variables rejects the hypothesis that the group–mean variable is zero ( $\xi = 0$ ), suggesting that unobserved heterogeneity is correlated with the time–averaged variables. Thus the Mundlak–augmented approach is superior to the traditional random–effect estimators.<sup>13</sup> The discussion that follows thus relies mainly on the Mundlak–augmented regression results in column 2.

This estimation shows that the probability of certification increases with firm size, as measured by the number of employed. The average marginal effects suggest that increasing the employment size of the firm by 10 per cent increases the probability of adoption of private standards by about 16 per cent, all other things remaining constant. In column 3 we use the number of hectares of land under cultivation of flowers (in logs) as a measure of size instead of employment. The results are the same with the main specification, except now the magnitudes of the marginal effects are slightly higher, not only with regard to the size indicators but also for most of the other variables. According to the results in column 3, increasing the land size (in hectares) of the firm by 10 per cent increases the probability of adoption of private standards by about 24 per cent, all other things remaining constant. The fact that larger firms are more likely to adopt private standards is consistent with the theory and most previous empirical studies.

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<sup>13</sup> When looking at the individual time-averaged coefficients, the direct sales ratio (DSR) is the only statistically significant time-averaged coefficient. This suggests that DSR is correlated with the unobserved variables, but not the other time-varying explanatory variables such as size and age. The joint test (*F*-test) is, however, different from the variable specific test (*T*-test) in the sense that the former tells us that the variables are jointly different from zero even if only one of the variables under the joint test is different from zero, in our case DSR. Controlling only the DSR time-averaged instead of the full set of time-averaged variables does not, however, affect the results except to make a marginal change in the magnitudes of some variables.

Firm age is also positive and highly significant, suggesting that older firms are more likely to adopt the standards. The estimated average marginal effect of age implies that staying in the industry for one more year increases the probability of adoption of standards by about 15 per cent. Foreign ownership is also positively associated with adoption of private standards. According to the estimates, being foreign owned improves the probability of private standard adoption by about 19 percentage points, all other things remaining constant. This positive effect could be due to better awareness, exposure to new technologies or higher pressure to comply with international standards facing foreign firms in contrast to those owned by domestic entrepreneurs.

Another factor expected to determine a firm's adoption decision was the type of market channel it uses for its exports. In the benchmark model the DSR gives a negative and marginally significant coefficient. With the Mundlak correction this variable carries a positive sign but is statistically insignificant, providing no conclusive evidence with regard to the relation between marketing channels and standards adoption.<sup>14</sup> But at least it shows that our hypothesis that firms exporting through direct sales channels are more likely to comply with private standards is not supported by the data. This might suggest the presence of pressures or incentives to be standard compliant in the auction market, which is comparable to direct sales. For example, BTC (2010) indicates that about 80 per cent of flowers supplied to auctions are produced by growers who participated in MPS scheme. The reason is that, although certificates of standards are not compulsory, several growers supplying to auctions believe that certificates can enhance company reputation.

From the product type categories, cuttings and summer flowers take a negative sign, with the latter statistically significant. This suggests that summer flower growers are less likely to be certified in comparison with rose growers (the control group). On the other

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<sup>14</sup> Recall that above we have shown that the DSR is the only variable that exhibited high correlation with the unobserved effect.

hand, the location dummy representing the vicinity of the capital city, Addis Ababa, captures a positive and statistically significant effect.<sup>15</sup> According to the AME estimate, location in the vicinity of Addis Ababa increases the probability of being certified by about 19 per cent in comparison with the control group, the Holeta cluster. In column 4, we include a variable measuring the distance from Addis Ababa to the farm (in kilometres and in logs), in addition to the clusters dummy. The distance from Addis Ababa variable gives a negative but statistically insignificant coefficient. On the other hand, the vicinity of Addis Ababa variable remains positive, although now significant only at the 10 per cent level. This suggests that the Addis Ababa vicinity dummy does not necessarily represent distance but some type of urban agglomeration effect.

In columns 5 and 6 we alternatively introduce owner/manager total years of experience in related business (GM\_exp) and years of schooling (GM\_sch) to represent the human capital of the owner/manager.<sup>16</sup> A positive relation is expected between owner/manager human capital and probability of standards adoption.<sup>17</sup> The introduction of these extra controls causes no change to the estimates of the main variables of interest. Moreover, neither owner/manager experience nor years of schooling is statistically significant, suggesting the absence of association between the standard adoption decision and owner/managers' human capital in our data. Nor are we able to find any non-linearity between adoption decision and managerial experience (not reported here to save space). This result might not seem surprising, given that our sample constitutes organized and relatively larger size firms. Hyvärinen (1990) argues that the smaller the enterprise, the nearer its innovative behaviour is to that of an individual (i.e. the owner). But the larger the

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<sup>15</sup> Vicinity of Addis Ababa refers to flower farm clusters in Sendafa, Sebeta, Slulta and Menagesha, while the 'others' category contains farms dispersed throughout other areas.

<sup>16</sup> According to our recent survey, owners also act as general managers in about 42 per cent of the firms.

<sup>17</sup> Empirical studies on smallholder adoption of standards often found a positive effect of owner's human capital, particularly education (e.g. Asfaw et al., 2010; Kleinwechter and Grethe, 2006). In an organizational (firm) level study Hudson and Orviska (2013) use managerial experience and found a non-linear relationship with ISO certification.

enterprise, the more the personal traits of the manager are replaced by the characteristics of the enterprise, such as products, strategies, resources and organizational behaviour.

The results discussed so far are based on the assumption of an equal correlation structure. In column 7, we relax this assumption and instead rely on the first-order autoregressive assumption. The results for all variables are almost identical with the comparable Mundlak-augmented specification in column 2, except for marginal changes in magnitude. Assuming an independent correlation in the GEE probit, which is equivalent to the pooled probit model, also gives almost identical results (not reported here). This suggests that our results are not sensitive to changes in the ‘working’ assumption of the correlation structure within firms.

## 7. CONCLUSIONS

In recent decades, exports of high-value horticulture products to developed countries’ markets have faced increasingly complex and stringent standards, which have also become key instruments for governing the global value chain. A survey conducted in 2010 covering all operational firms in the nascent flower industry in Ethiopia revealed that only 36 per cent managed to acquire certification for international private standards. The present study uses a census-based panel dataset from the Ethiopian floriculture sector to examine the determinants of adoption of international private standards in fresh horticulture produce in the large-scale estate farm sector. The GEE probit regression model with Mundlak correction was estimated to identify the attributes of adopters and non-adopters.

The econometric analysis shows that firm size, age and foreign ownership are positively associated with the adoption decision of international private standards, implying that larger, older and foreign-owned firms are more likely to adopt the standards. In other

words, smaller and younger firms, and those owned by nationals, are less likely to adopt international private standards. Overall these variables demonstrate the importance of firms' access to resources in the adoption of private standards. This is consistent with many of the previous studies reviewed above and lends support to the resource-based view of the firm regarding organizational innovation: firms are heterogeneous in resources (tangible and intangible) they own and control and this affects their capacity to innovate (or adopt innovation) (Nelson and Winter, 1982; Dosi, 1988; Henderson and Cockburn, 1994). The analysis also shows that firms located in the vicinity of the capital city, Addis Ababa, are more likely to comply with private standards in comparison with those in other locations, providing some evidence of a positive urban agglomeration effect. Contrary to our expectations, we find no evidence that the firms supplying through the direct sales channel are any different from those using auctions in terms of standards compliance.

This study also demonstrates that the certification process requires firms to make various adjustments (for example, organizational change and skill improvement, construction of additional facilities, purchase of new equipment, improvement in waste management and ICT facilities) entailing significant investment and recurring costs. On the other hand, the present perception of the respondents of the benefits gained from adoption of standards is limited, involving mainly improvement in market access and efficiency but not direct monetary rewards such as higher price or revenue. This confirms the previous observation that, while compliance with standards most likely helps to minimize the risk of exclusion from the value chain, certified firms do not necessarily receive higher prices than firms supplying regular products. Failing to comply with international standards could, however, lead not only to exclusion of individual firms from the value chain but also an explicit ban on imports of particular products from the given country (Jaffee and Henson, 2005). The implication is that wider adoption of the standards, including adoption by

resource–constrained firms (small, young or domestic owned in our case) could provide greater social benefits compared with firm level benefits. This justifies increasing policy support to enhance the capabilities of firms as well as institutional infrastructure to enable them to comply with international standards.

Lastly, this study shows that the Ethiopian flower industry has exhibited extraordinary growth, making the country the second largest flower exporter in Africa, despite emerging at a time when the global value chain was already characterized by complex and stringent standards. The strong public–private partnership demonstrated in the course of the development of the sector in general, and collaborative efforts to develop and implement national schemes for GAP in alignment with internationally recognized standards in particular have played a vital role in this regard. The development implication is that, despite posing significant challenges, the proliferation of standards is not prohibitive for emerging non–traditional exports from developing countries. It may, however, require concerted efforts and coordination among the stakeholders (the private sector, government and the donor community). According to Jaffee (2006), the best strategy for developing countries striving to promote their exports is to assist their firms to comply with international standards because countries and individual producers that approach standards compliance as part of an overall competitive strategy are more likely to thrive.

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Table 1: EU–27 world share of floriculture imports and sourcing

Year	Total world imports (billion USD)	EU–27 share of world imports (%)	EU–27 imports sourcing by region (%)				SSA exports	
			Intra–EU–27	SSA	Latin America & Caribbean	Other regions	To the world (billions USD)	Destined for the EU–27 market (%)
1988	2.13	79.9	91.92	1.54	1.91	4.6	0.03	77.6
1992	5.45	70.5	84.40	2.93	5.19	7.5	0.13	87.5
1997	8.80	68.9	82.88	3.84	5.66	7.6	0.27	85.5
2002	9.99	69.7	82.97	5.38	5.42	6.2	0.43	87.4
2007	16.41	68.6	82.29	6.58	5.00	6.1	0.87	85.7
2012	16.96	63.5	82.45	8.10	4.35	5.1	1.09	80.3

Source: UN COMTRADE database.

Table 2: The top 10 extra–EU–27 exporter countries of floriculture products (2003–12)

Year 2012				Year 2008				Year 2003			
Rank	Country	Exports (value USD mil)	Share of extra–EU–27 imports	Rank	Country	Exports value (USD mil)	Share of extra–EU–27 imports	Rank	Country	Exports value (USD mil)	Share of extra–EU–27 imports
1	Kenya	503.5	26.6	1	Kenya	587.7	26.7	1	Kenya	265.9	19.9
2	<b>Ethiopia</b>	<b>199.9</b>	<b>10.6</b>	2	Israel	196.2	8.9	2	Israel	176.6	13.2
3	Ecuador	142.2	7.5	3	Colombia	171.5	7.8	3	Colombia	106.7	8.0
4	Colombia	138.9	7.3	4	Ecuador	166.7	7.6	4	Costa Rica	103.5	7.7
5	Israel	131.4	6.9	5	Costa Rica	117.1	5.3	5	USA	89.1	6.7
6	USA	88.5	4.7	<b>6</b>	<b>Ethiopia</b>	<b>114.8</b>	<b>5.2</b>	6	Ecuador	75.7	5.7
7	Costa Rica	78.3	4.1	7	USA	103.2	4.7	7	Zimbabwe	63.8	4.8
8	China	59.6	3.1	8	China	84.5	3.8	8	Guatemala	45.8	3.4
9	Uganda	56.5	3.0	9	S. Africa	58.5	2.7	9	China	44.9	3.4
10	S. Africa	40.5	2.1	10	Uganda	53.8	2.4	10	S. Africa	43.9	3.3
								<b>33</b>	<b>Ethiopia</b>	<b>3.5</b>	<b>0.3</b>

Source: UN COMTRADE database.

Table 3: Firm level efforts, costs and perception of benefits of compliance with standards

	(% of firms)
Firms certified with	
Industry code of practice	81.82
International private standards	36.36
Activities engaged in by the firm to comply with standards	
Organizational change	53.25
Construction of additional facilities for staff & inputs	64.94
Change the type of chemicals in use	62.34
Purchase of new equipment	58.44
Improving waste management	76.62
Introducing new plant varieties	24.68
Improved IT facilities	49.35
In-house training	76.62
Cost of compliance (Birr) incurred by firms	
<50,000	28.60
[50,000–100,000)	17.50
[100,000–250,000)	36.50
>=250,000	17.50
To what extent do certificates of compliance and labels affect your business?	
Improved worker/employee skills	71.43
Increased efficiency	58.44
Increased market access or attract more customers	46.05
Increased price per unit	24.68
Increased sales (volume)	22.08

Source: 2010 survey of flower industry.

Table 4: Summary statistics of Ethiopian flower firms, 2005–09

Variables	Statistics	All firms	Adopters	Non-adopters	Mean difference (adopters & non-adopters) test $Pr( T  >  t )$
Majority foreign owned	Mean	0.69	0.80	0.61	0.001
	Std. errors	(0.03)	(0.04)	(0.04)	
Firm age	Mean	2.81	3.16	2.54	0.002
	Std. errors	(0.10)	(0.17)	(0.11)	
Number of employed	Mean	374.89	469.86	302.25	0.000
	Std. errors	(23.46)	(43.83)	(22.75)	
Land under flower cultivation (ha)	Mean	12.11	15.34	9.66	0.000
	Std. errors	(0.66)	(1.22)	(0.65)	
Sales revenue (millions Birr)	Mean	23.73	26.37	21.80	0.176
	Std. errors	(1.67)	(2.77)	(2.06)	
Direct sales ratio	Mean	0.39	0.35	0.42	0.158
	Std. errors	(0.03)	(0.04)	(0.04)	
No. of observations		270	117	153	

Source: 2010 survey of flower industry.

Table 5: Estimation results of firms' adoption of private standards: average marginal effects

Explanatory variables	Mundlak–augmented regression results						
	Baseline model	Main model	Land size (hectares)	Distance from AA	MG experience	MG education	AR(1) correlation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log employment	0.126*** (0.042)	0.158*** (0.0530)		0.160*** (0.055)	0.156*** (0.0535)	0.160*** (0.0543)	0.147** (0.0665)
Firm age	0.077*** (0.018)	0.146** (0.072)	0.154** (0.075)	0.145** (0.071)	0.146** (0.072)	0.143** (0.072)	0.213** (0.097)
Foreign owned	0.158** (0.070)	0.193*** (0.068)	0.174** (0.074)	0.189*** (0.066)	0.199*** (0.073)	0.185*** (0.0676)	0.207*** (0.072)
DSR	-0.119* (0.063)	0.034 (0.079)	0.0576 (0.081)	0.049 (0.084)	0.033 (0.077)	0.0389 (0.080)	0.106 (0.089)
GM_exp					-0.001 (0.003)		
GM_sch						-0.003 (0.002)	
Log land (ha)			0.238*** (0.066)				
Log distance AA				-0.076 (0.085)			
Product type (control group roses)							
Cuttings	-0.0572 (0.123)	-0.0268 (0.108)	-0.008 (0.110)	-0.014 (0.112)	-0.0218 (0.111)	-0.0147 (0.111)	-0.081 (0.104)
Summer flowers	-0.180 (0.131)	-0.201* (0.106)	-0.221** (0.112)	-0.164** (0.065)	-0.158** (0.067)	-0.159** (0.067)	-0.211** (0.107)
Location (control group Heleta)							
Vicinity of AA	0.193** (0.095)	0.193** (0.088)	0.209** (0.092)	0.158* (0.084)	0.184** (0.079)	0.188** (0.081)	0.185** (0.086)
Debrezeit	0.144 (0.108)	0.148 (0.103)	0.139 (0.111)	0.133 (0.089)	0.126 (0.0928)	0.128 (0.091)	0.165 (0.110)
Ziway/Koka	0.042 (0.104)	0.097 (0.101)	0.137 (0.104)	0.146 (0.135)	0.087 (0.089)	0.0664 (0.085)	0.144 (0.112)
Other locations	0.183 (0.124)	0.207 (0.132)	0.206* (0.124)	0.244 (0.154)	0.202 (0.139)	0.201 (0.138)	0.237* (0.131)
Observations	270	270	269	270	270	270	253
No. of firms	77	77	77	77	77	77	64
Year control	yes	yes	yes	yes	yes	yes	yes
Mundlak	no	yes	yes	yes	yes	yes	yes
Corr. structure	equal	equal	equal	equal	equal	equal	AR(1)
Joint test time–average variables		chi2(3)=9.85 (p= 0.02)					chi2(3)=11.2 (p=0.01)

Robust standard errors in parentheses; \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1. All reported results are average marginal effects based on GEE probit estimation. Columns 1–6 assume equal correlation structure, while column 7 relies on first–order autoregressive correlation structure.

## Appendices

Table A1: Results of the endogeneity test

Dependent variable	Log of employment	Dummy for certification of private standards (firm/year)	
		GEE corr(ind)	GEE corr(exch)
Estimation method	Fixed effect	(2)	(3)
	(1)		
ln(empl)		0.538* (0.285)	0.506* (0.270)
ln(empl) <sub>t-1</sub>	0.397*** (0.0597)		
Firm age	-1.675*** (0.377)	0.466*** (0.120)	0.428*** (0.105)
Foreign owned	16.33*** (3.422)	0.671** (0.334)	0.810** (0.362)
DRS		-0.773** (0.338)	-0.616** (0.306)
residual		0.310 (0.330)	0.375 (0.347)
Product type			
Cuttings		-0.200 (0.551)	-0.263 (0.611)
Summer flowers		-1.245** (0.516)	-0.909 (0.704)
Location			
Vicinity of AA		1.087** (0.547)	0.965* (0.540)
Debrezeit		0.633 (0.574)	0.729 (0.595)
Ziway/Koka		0.342 (0.529)	0.300 (0.527)
Other locations		1.040 (0.706)	0.925 (0.683)
Constant		-6.366*** (1.951)	-6.523*** (1.743)
Observations		270	270
No. of firms		77	77

Robust standard errors in parentheses; \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1; full set of time dummies are controlled for in all columns.

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