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What drives a textile firm to adopt an eco-label?

Naveed Hayat
Pakistan Institute of Development Economics (PIDE)

Anwar Hussain
Pakistan Institute of Development Economics (PIDE)

Heman Das Lohano
Institute of Business Administration, Karachi, Pakistan

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What drives a textile firm to adopt an eco-label?

Naveed Hayat · Anwar Hussain · Heman D. Lohano

Abstract This paper investigates the factors that influence a textile firm's decision to adopt an eco-label. Logit regression is conducted using data from 128 textile firms listed on the Pakistan Stock Exchange. Results reveal that environmental performance, profitability, market share and firm size have significant positive effect on the adoption of eco-labels whereas tax burden has a significant negative effect. Furthermore, an exporting textile firm is more likely to adopt an eco-label than the others. Likewise, a yarn manufacturing firm is more likely to take on an eco-label relative to a fabric or textile composite manufacturing firm.

Keywords Eco-label · Environment friendly products · Textile · Exporting firm · Logit regression.

1 Introduction

An eco-label is a seal of certification awarded to an environment friendly product which meets the criteria specified by the eco-label awarding authority (UNOPS 2009). Germany was the first country in the world to launch a national eco-label scheme 'Blue Angel' in 1978 (Muller 2002). After Germany, other countries introduced their own national eco-label schemes, such as Nordic Swan by Nordic countries, EU Flower by European countries, Energy Star by USA, and Eco Material by Russia. Recently, Asian countries have also introduced their own eco-label schemes, such as Eco Mark by Japan and India, and Green Label by Singapore and Thailand.

Naveed Hayat
Pakistan Institute of Development Economics (PIDE), Islamabad-Pakistan
E-mail: naveedhayat21@gmail.com

Anwar Hussain
Pakistan Institute of Development Economics (PIDE), Islamabad-Pakistan

Heman D. Lohano
Institute of Business Administration, University Road, Karachi-Pakistan

Currently 91 eco-label schemes exist in the international textile market. The most common eco-labels used in the global textile industry are Oeko-Tax Standard, Global Organic Textile Standard, Better Cotton Initiative, Organic Exchange Standard, Organic Content Standard, BMP Certified Cotton, Nature Textile Best, and Blue Sign Standard (Ecolab Index, 2016). Eco-labels in the textile industry promote environment friendly practices, such as sustainable production techniques and minimize the presence of dangerous chemicals in textile products.

The shift in consumer demand from conventional apparel towards environmental friendly apparel has forced firms in the global textile industry to adopt eco-labels (Moore and Wentz 2009). Furthermore, textile firms adopt eco-labels to differentiate their products from competitors and gain a competitive advantage. With this strategy, firms seek to attract customers and build technological, environmental, financial and cultural barriers for entry of new firms in the textile industry (Koszewska 2011).

The demand for eco-labeled textile in the global market is increasing rapidly. In the year 2014, global sales of organic cotton products reached $15.7 billion. In the same year, sales of organic fiber reached $1.1 billion in the United States. Similarly, from the year 2014 to 2015 the global market for organic textile grew from 15% to 25% OrganicTradeAssociation (2015). Asian textile firms are continuously innovating to meet the demand for eco-friendly fabrics. The world's top textile producers, China, Bangladesh, India, South Korea, and Taiwan, have adopted various eco-label schemes OrganicTradeAssociation (2015).

The textile sector is the largest manufacturing sector of Pakistan. It is a major source of foreign exchange earnings for Pakistan and accounts for 60 percent of national exports GovernmentofPakistan (2018). However, the textile industry of Pakistan is one of the most polluting industries of the economy, which directly affects the natural environment and human and animal health.

To compete in the global market, textile firms in Pakistan must adopt eco-labels. The main objective of this paper is to determine the factors that drive a textile firm's decision to adopt an eco-label. We accomplish this objective using firm-level data from the textile industry in Pakistan. The findings of this study will help policy makers in examining existing eco-labeling schemes and in introducing and implementing policy measures to promote the adoption of eco-labels by the textile industry of the country.

2 Literature review

In this section, we review the existing literature on factors that affect the firm's decision to adopt eco-labels or other voluntary environmental schemes. In this regard, Grolleau et al (2007) empirically examined the factors determining the voluntary adoption of Environmental Management System (EMS) by agri-food industries in France. They found that both, management related factors and economic incentives affect the decision of the firm to adopt EMS. However, the study did not identify the path to EMS certification followed by the French firms.

On the other hand, Berghoef and Dodds (2013) explored the interest of Ontario wine industry members in an eco-labeling scheme. The study found that all industry members were willing to participate in the eco-labeling scheme. The motivation behind the adoption of the scheme included environmental improvement, increased visibility, and improved public perception.

Shen and Qin (2011) also analyzed the factors that led Chinese firms to implement ISO 14001 and the Chinese eco-label. They found that firm ownership, firm size, target market, and the number of rivals had an impact on the certification decision of Chinese firms.

Triguero et al (2013) extended the issue to eco-innovation and investigated empirically the effect of supply-side, demand side and regulatory factors on the decision of small-manufacturing enterprises (SMEs) to adopt an eco-innovation. The study found that market share and cost-savings had a significant positive impact on eco-product innovations. On the other hand, existing environmental regulations, expected environmental regulations and access to subsidies and fiscal incentives did not have any significant effect on the firm's decision to eco-innovate. The study did not provide any information on the intensity of eco-innovation.

De Medeiros et al (2014) carried out a literature review on environmentally sustainable product innovation and identified four sets of important factors for environmentally sustainable product innovation namely, market, law and regulation knowledge, inter-functional collaboration, innovation-oriented learning, and R&D investments. The factors recognized in this research provided a base for empirical researchers to conduct studies on the underlying issue.

Few researchers extended the analysis and tried to identify the determinants of sustainable practices of firms. In this regard, Tsireme et al (2012) explored the reasons that affect the decisions of managers of firms to adopt management practices in order to green their supply chain management (G-SCM). The results of the study showed that environmental legislation by public authorities, market-based instruments, and self-regulated motivations affect the managers' decisions to adopt G-SCM practices.

Similarly, Abbasi (2012) in his study analyzed the factors which affect the firm's decision to adopt and implement green/sustainable practices and identified the important gains the firm attained from green/sustainable practices. The study found environmental pressures, globalization, international demand and competitive pressures as the main factors, which influence the firm's decision to adopt green/sustainable practices in the manufacturing industry of Pakistan. Moreover, the study identified scrap reduction, production optimization, reduction in the use of packaging material, noticeable improvement in on-time deliveries and fundamental structural and technical changes as major gains attained from green/sustainable practices. However, the study used qualitative data and did not incorporate any econometric model for empirical estimations.

Samad et al (2015) also identified the factors influencing textile firms to adopt environmental friendly management practices. They found that firm size, international pressure, and penalty are the main factors that affect the decision of firms regarding adoption of environmental friendly management practices.

In the past, researchers have paid little attention to the motives behind adop-

tion of eco-labels at the firm level. Furthermore, their analyses are restricted to environmental friendly management practices. In this study, we identify the factors influencing a textile firm's decision to adopt an eco-label.

3 Data

In order to determine the factors influencing a textile firm's decision to adopt an eco-label, we used panel data of 128 firms from the textile industry listed on the Pakistan Stock Exchange from the years 2009 to 2015. We collected the required data from annual reports of textile firms listed on the Pakistan Stock Exchange (PSX) and Financial Statements Analysis (FSA) of non-financial companies listed on the PSX for the year 2015,[1] published by the Statistics Department of the State Bank of Pakistan.

Additional information has been collected from personal communication with the firms[2] and from various published sources.[3] The annual reports of the textile firms, provided information on the firms' financial performance and competitiveness, including net profit margin, return on capital employed, return on equity, and market share. Besides, these reports also provided information on the firms' output, tax expenses, sales, size, and the textile segment to which they belonged. We took the information about the firms' export status from FSA. The information on the eco-label status of the firms and their age are taken from personal communication with the firms.

For the construction of the environmental performance index, we used the data on water consumption per liter of textile output, the waste water discharge per unit of textile output and the number of water effluents per unit of textile output from various published sources.[4]

[1] This report provides information on 14 major industries listed on the PSX; however, we used only the textile industry information. We selected this sector because of three reasons; the first reason being that this sector is closely linked with the environment. A large number of mechanical and chemical processes are used in the textile industry and each process has a unique impact on the environment. This impact starts with the use of pesticides during the cultivation of natural fibres, the corrosion caused by sheep farming or the emissions during the production of synthetic fibres. A number of processes are applied, using a diverse range of different chemicals, to process the fibres and to reach the final stage of the textile end product (Shaikh 2009). Secondly the products of the textile sector face a huge number of eco-labels in the international market. Lastly this is the largest exporting sector of Pakistan.

[2] We collected information regarding the eco-label adoption status of the firm, and the type of eco-label adopted by directly visiting the website of the firm or through email/phone. Most of the firms under consideration display the information about eco-labels on their official websites and in their annual reports. However, we found a number of firms that did not display this information. We contacted these firms through mail and phone and asked two questions from their representatives: Have you adopted an eco-label? What is the name of this eco-label?

[3] As the data on the textile firms' water consumption, waste water discharge and water effluents per unit product is not available in a specific dataset, therefore, we took this data from various published sources.

[4] See these sources and the information collected from these sources in table A1, table A2, and table A3 in appendix A.

4 Model and estimation methods

This section presents a model that allows empirical examination of the factors that affect a textile firm's decision to adopt an eco-label. It is assumed that a textile firm's objective is to maximize the expected value of long term profits, and the firm will adopt an eco-label if the expected value of long-term profits with eco-label adoption (V^A) is greater than that without eco-label adoption (V^{NA}).

The expected value of long-term profits is called the latent variable since it is not observed in the data by the researchers, and it is assumed to be a linear function of a number of explanatory variables (X):

$$V^A = X\beta^A + \varepsilon^A \tag{1}$$

$$V^{NA} = X\beta^{NA} + \varepsilon^{NA} \tag{2}$$

where X represents the explanatory variables that may affect the eco-label adoption decision of the firm, β^A and β^{NA} are the coefficients matrix of X, and ε^A ε^{NA} are the random error terms.

The textile firm's decision of adopting an eco-label (Y = 1) or not adopting an eco-label (Y = 0) is based on the following criteria:

$$Y = \begin{cases} 1 & \text{if } \mathrm{V}^A > V^{NA} \\ 0 & \text{if } \mathrm{V}^A \leq V^{NA} \end{cases}$$

The outcome of eco-label adoption is driven by random elements in the expected value of long-term profits. Following Greene (2012), the outcome probability is given as:

$$Prob[Y = 1|X] = Prob[V^A > V^{NA}] \tag{4}$$

$$Prob[Y = 1|X] = Prob[X\beta^A + \varepsilon^A > X\beta^{NA} + \varepsilon^{NA}] \tag{5}$$

$$Prob[Y = 1|X] = Prob[X\beta + \varepsilon > 0] \tag{6}$$

where $\beta \equiv \beta^A - \beta^{NA}$ and $\varepsilon \equiv \varepsilon^A - \varepsilon^{NA}$. If the distribution of ε is symmetric, equation 6 can be written as:

$$Prob[Y = 1|X] = Prob[\varepsilon < X\beta] \tag{7}$$

$$Prob[Y = 1|X] = F(X\beta) \tag{8}$$

where $F(.)$ is the cumulative distribution function (CDF) of ε. We assume the logistic CDF to represent the outcome probability. Thus, equation (8) can be written as the logit regression model:

$$Prob[Y = 1|X] = (exp(X\beta))/(1 + exp(X\beta)) \tag{9}$$

To analyze the factors affecting the adoption of eco-labels by textile firms, we estimate the above model using pooled logit regression by maximum likelihood estimation method with STATA. We follow Shen and Qin (2011) to specify the empirical model. In our model, the dependent variable (Y) is a binary variable, which is equal to 1 if the firm adopts an eco-label and 0 otherwise, as defined above. The explanatory variables include indicators of environmental performance, financial performance, competitiveness, firm-specific factors, regulatory pressure, textile product segment, and export status of the firm, which are described below.

(1) Environmental performance

We construct the firm's environmental performance index (EPI) following the approach given in Tyteca et al (2002) and Wagner et al (2002). This index is based on three water pollutants released by textile firms including Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Suspended Solids (TSS).

For obtaining the information on a firm's BOD, COD and TSS, we first collect data on waste water discharge in liters per kg of output for each textile product of the firm from various published sources (see table A1 in appendix A). Next, we multiply it by the output to compute the waste water discharge for each textile product. Then, we compute the total waste water of the firm by summing up waste water discharge from all products of the firm. Finally, we compute BOD, COD and TSS of each firm by multiplying the total waste water discharge with BOD, COD and TSS per liter of waste water, respectively. For the firms without an eco-label, the data on BOD, COD and TSS per liter of wastewater is reported in table A2 in appendix A.

Firms with an eco-label, are forced to reduce the effluent levels to national or international standards, depending on the type of eco-label. For these firms, we use BOD, COD and TSS per liter of waste water as reported in table A3 in appendix A.

We compute the index of BOD for each of the firms as follows:

$$IBOD_i = BOD_{min}/BOD_i \tag{10}$$

where BOD_{min} is the minimum value of BOD observed in the firm level data. This index is between 0 and 1, and the highest value of 1 is assigned to the firm with minimum BOD among all the firms. Similarly, we compute the indices of COD and TSS for each of the firms as follows:

$$ICOD_i = COD_{min}/COD_i \tag{11}$$

$$ITSS_i = TSS_{min}/TSS_i \tag{12}$$

where COD_{min} is the minimum value of COD and TSS_{min} is the minimum value of TSS observed in the firm level data.

Finally, we compute the environmental performance index of the firm as the average value of these three indices:

$$EPI_i = (IBOD_i + ICOD_i + ITSS_i)/3 \tag{13}$$

(2) Financial performance

To evaluate the impact of financial performance on the firm's decision to adopt an eco-label scheme, three alternative financial performance indicators namely, return on equity, return on capital employed, and net profit margin are used (Grolleau et al 2007).

(3) Competitiveness

In order to evaluate the impact of competitiveness on the firm's decision to adopt an eco-label, we use market share, measured as a ratio of the firm's sales to the total industry sales (Grolleau et al 2007).

(4) Firm-specific factors

We use two firm-specific factors, namely, the size of the firm and the age of firm (Iraldo et al 2009). For the size of firm, we use the total number of employees in the firm (Grolleau et al 2007; Hanim Mohamad Zailani et al 2012; Horbach 2008; Rehfeld et al 2007; Shen and Qin 2011). For the age of firm, we use the number of years the firm has been in operation (Horbach 2008; Rehfeld et al 2007; Tsireme et al 2012). For exploring the quadratic relationship between the dependent variable and age, we use the age and square of the age as the explanatory variables.

(5) Regulatory pressure

Basically, there are two sets of regulatory measures through which the public authorities can pressurize textile firms to improve their environmental performance. The first set comprises of laws, regulation, and policies, which have a direct or indirect impact on the firm's environmental performance. The second set consists of environmental taxes.

The government of Pakistan has formulated several environmental protection laws, regulation and policies for the textile industry under the guideline of the Pakistan Environmental Protection Ordinance of 1983 and the Pakistan Environmental Protection Act 1997 (Aftab et al 2000). As environmental regulations exist for all firms in the textile industry of Pakistan, there is no variation in this variable in the firm-level data. Thus, we use taxes to determine regulatory pressure (De Medeiros et al 2014; Horbach 2008; Shen and Qin 2011; Triguero et al 2013; Tsireme et al 2012). However, the data set we employ does not provide information on environmental taxation. Therefore, we use tax to sales ratio of the firm as a proxy for environmental taxation.

(6) Textile product segment

For analyzing the textile product segment fixed effects, we introduce a dummy variable. There are two textile product segments in our sample namely, yarn segment, and textile composites & fabric segment. We define a dummy variable, which is equal to 1 if the textile firm is a yarn manufacturing firm, and 0 if the textile firm is a fabric or textile composite manufacturing firm (Grolleau et al 2007; Shen and Qin 2011).

(7) Export status of the firm

Pressure from the firm's foreign consumers and foreign environmental regulations and standards may force the firm to adopt an eco-label scheme (Grolleau et al 2007). For this purpose, we introduce a dummy variable, which is equal to 1 if the firm exports its commodities and 0 otherwise (Horbach 2008; Shen and Qin 2011).

5 Results and discussion

5.1 Descriptive statistics

The current state of eco-labeling in the textile industry of Pakistan is given in figure 1. It is observed that out of 128 textile firms in the sample, only 32% have eco-labeled products. Of these, 21% are exporting firms and 11% are non-exporting firms. Moreover, 32% of firms that acquired eco-labels include 22% firms that are the yarn manufacturing while 10% are fabric or and textile composite manufacturing firms.

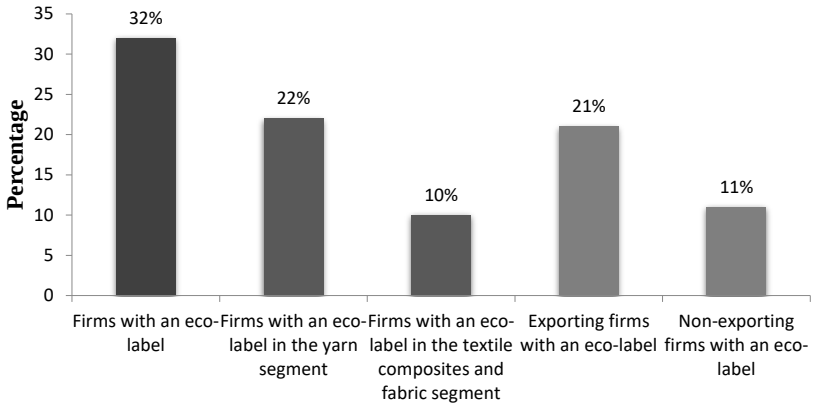

Fig. 1: Firms with and without an eco-label
Source: Based on data obtained through personal communication with firms in the year 2016.

Table 1 presents the descriptive statistics and definitions of the important variables used in this study. It is observed that the mean value of environmental

Table 1: Descriptive statistics

Variables	Definition	With an eco-label	W/O an eco-label	Overall mean
		Mean & SD	Mean & SD	Mean & SD
Dependent				
Eco-label adopted	1 if the firm adopted an eco-label, 0 otherwise	1	0	0.320
		(0)	(0)	(0.467)
Explanatory				
Environmental performance:				
Environmental performance index	This Index measures the firm's environmental performance	0.201	0.041	0.099
		(0.368)	(0.107)	(0.118)
Financial performance:				
Return on equity	Ratio of the firm's net income to average shareholders' equity	0.226	0.206	0.212
		(0.194)	(0.266)	(0.231)
Return on capital employed	Ratio of the firm's earnings before interest and tax to capital employed	0.164	0.134	0.143
		(0.158)	(0.135)	(0.144)
Net profit margin	Ratio of profit earned by the firm from its sales	0.975	0.093	0.095
		(1.503)	(0.154)	(0.153)
Competitiveness:				
Market share	Ratio of firm sales to total industry sales	0.179	0.076	0.109
		(0.190)	(0.118)	(0.153)
Firm-specific factors:				
Firm size	Total number of employees in the firm (thousand)	1.920	1.349	1.532
		(3.301)	(2.131)	(2.458)
Firm age	Number of years the firm has been in operation	34.502	33.172	33.598
		(18.220)	(13.491)	(15.169)
Regulatory pressure:				
Tax to sales ratio	Ratio of the firm's total income tax expenses (million Rs) to its total sales	0.009	0.020	0.016
		(0.008)	(0.013)	(0.109)
Textile segment:				
Yarn segment	1 if the firm operates in the yarn segment, 0 otherwise	0.683	0.621	0.641
		(0.466)	(0.486)	(0.480)
Textile composites & fabric segment	1 if the firm operates in textile & fabric segment, 0 otherwise	0.317	0.379	0.359
		(0.466)	(0.486)	(0.480)
Export status:				
Export	1 if the firm exports its commodities, 0 otherwise	0.669	0.617	0.634
		(0.471)	(0.486)	(0.482)

Source: Estimated by authors based on firm-level data from the textile industry listed on the PSX.
Note: SD represents Standard Deviation given in parentheses.

performance of textile firms with an eco-label (0.20) is much higher than that of firms without an eco-label (0.04).

We also find that the mean value of financial performance (i.e., return on equity, return on capital employed, and net profit margin) of the firms with an eco-label is also higher than that of the firms without an eco-label. We find that the mean market share of the firms with an eco-label (17.9%) is much higher than that of the firms without an eco-label (7.5%).

Comparing firm-specific variables, it is observed that the mean size of the firms with an eco-label is 1920 employees while that of the firms without an eco-label is 1349 employees. Mean age of the firms with and without an eco-label is 34.5 and 33.2, respectively. We find that the average tax to sales ratio of the textile firms with an eco-label is lower than that of the firms without an eco-label.

5.2 Regression results

This section, presents the results of logit regression to examine factors that drive a firm to adopt an eco-label. Table 2 presents the coefficient estimates of logit regression while table 3 presents the corresponding marginal effects.[5]

Three alternative financial performance indicators return on equity (model 1), return on capital employed (model 2), and net profit margin (model 3) are used. The logit model for each of these three measures is estimated and the results are presented in tables 2 and 3.

The results of diagnostic tests of the three models are reported in the last panel of table 2. In our three logit regression models, the Pseudo R squared is in the range of 0.54 to 0.56. Results of Wald chi-squared test show that the regression model is overall statistically significant at 1 percent level for each of the three regressions.

We conduct Hosmer-Lemeshow goodness-of-fit test, which examines the goodness of fit of the model. As the test is statistically significant at 1 percent, the test rejects the null hypothesis that the models are not good fit with the data. On the basis of the model classification tests, we observe that the overall accuracy rate of the firm's decision to adopt or not to adopt an eco-label is around 97% in the three models.

Results of model (1) in table 3 show that environmental performance, profitability, market share, firm size and export status of the firm have significant positive effect on eco-label adoption by a textile firm while the tax burden has significant negative effect.

We find that if the environmental performance index of the firm increases by one percent point, the probability of the firm to adopt an eco-label increases by 4.4 percent points. If the profitability of the firm increases by one percent

[5] For continuous explanatory variables, marginal effects measure the change in the estimated probability, following an increase in the explanatory variable by 1 unit; for discrete variables, however, the marginal effect is calculated as the difference between the probabilities estimated at the sample means when the dummy variable takes the values 1 and 0, respectively (Grolleau et al 2007)

Table 2: Results of logit regression

Model	1	2	3
Dependent variable: Eco-label adopted (Yes=1, No=0)			
Environmental performance:			
Environmental performance index	0.240***	0.299***	0.233***
	(0.0483)	(0.082)	(0.0464)
Financial performance:			
Return on equity	0.00824**		
	(0.00379)		
Return on capital employed		0.0145**	
		(0.0059)	
Net profit margin			0.00861**
			(0.00379)
Competitiveness:			
Market share	0.0296***	0.0434***	0.0208**
	(0.0102)	(0.0161)	(0.00811)
Firm-specific factors:			
Firm size	0.106***	0.186***	0.0983***
	(0.0299)	(0.0586)	(0.0287)
Firm age	-0.0466***	-0.130**	-0.0552***
	(0.0107)	(0.0558)	(0.016)
Square of firm age	0.000413***	0.00125*	0.000619***
	(0.0001)	(0.000663)	(0.000201)
Regulatory pressure:			
Tax to sales ratio	-0.0721	-0.258*	-0.220*
	(0.0454)	(0.134)	(0.12)
Textile segment:			
Textile composites & fabrics segment			
Yarn segment (Yes=1, No=0)	0.684***	0.980**	0.707***
	(0.249)	(0.466)	(0.229)
Export status of the firm:			
Export (Yes=1, No=0)	0.296**	0.720***	0.248*
	(0.146)	(0.258)	(0.144)
Constant	-3.503***	-3.342***	-3.117***
	(0.649)	(0.776)	(0.598)
Diagnostic check:			
Observations	896	896	896
Pseudo R squared	0.5408	0.5635	0.5369
Wald χ^2 statistics	123.34***	40.74***	111.19***
Diagnostic test:			
Hosmer-Lemeshow goodness-of-fit test	78.79***	138.74***	87.44***
Model classification test	0.9754	0.9732	0.9766

Source: Estimated by authors based on firm-level data from the textile industry listed on the PSX. Note: Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

point, the probability of the firm to adopt an eco-label increases by 0.153 percent points. If the market share of the firm increases by one percent point, the probability of the firm to adopt an eco-label increases by 0.55 percent points. If the firm size increases by one thousand employees, the probability of adoption of an eco-label increases by 1.96 percent points.

Moreover, we find that the impact of age on the eco-label adoption decision of the firm is quadratic, i.e. age has a significant negative effect on the eco-label adoption decision of the firm up to a level of age beyond which it has a signifi-

Table 3: Marginal effect of logit regression

Model	1	2	3
Dependent variable: Eco-label adopted (Yes=1, No=0)			
Environmental performance:			
Environmental performance index	0.044***	0.042***	0.0401***
	(0.00751)	(0.0052)	(0.0065)
Financial performance:			
Return on equity	0.00153**		
	(0.00071)		
Return on capital employed		0.00202**	
		(0.0009)	
Net profit margin			0.00148**
			(0.00066)
Competitiveness:			
Market share	0.0055***	0.0060***	0.0036**
	(0.00204)	(0.0029)	(0.0015)
Firm-specific factors:			
Firm size	0.0196***	0.0259***	0.0169***
	(0.00504)	(0.0006)	(0.0045)
Firm age	-0.0086***	-0.0181**	-0.0095***
	(0.00201)	(0.0059)	(0.0027)
Square of firm age	0.000077***	0.000174*	0.000106***
	(0.00002)	(0.00008)	(0.00003)
Regulatory pressure:			
Tax to sale ratio	-0.013	-0.036*	-0.038*
	(0.008)	(0.016)	(0.019)
Textile product segment:			
Textile composites & fabrics segment			
Yarn segment (Yes=1, No=0)	0.1203***	0.125**	0.115***
	(0.0366)	(0.0344)	(0.0305)
Export status of the firm:			
Export (Yes=1, No=0)	0.054**	0.094***	0.042*
	(0.027)	(0.026)	(0.025)

Source: Estimated by authors based on firm-level data from the textile industry listed on the PSX. Note: Robust standard errors are in the parentheses. *** p<0.01, ** p<0.05, * p<0.1.

cant positive effect. This result indicates that relatively new and old textile firms are more likely to adopt an eco-label. This is reasonable, because to maintain a good name in the market an old textile firm is more likely to adopt advanced environmental certifications and schemes such as eco-labels. On the other hand, a new textile firm faces strict competition. To compete effectively with other firms, it is more likely to adopt an eco-label. We find that one percent point increase in the tax burden on a textile firm reduces the probability of eco-label adoption by 3.6 percent points.[6]

Furthermore, we find that, among the textile firms, a yarn manufacturing firm is more likely to adopt an eco-label relative to a fabric or textile composite manufacturing firm. The presence of a firm in the yarn segment increases the

[6] In the first model, we find a negative and insignificant marginal effect for tax to sale ratio; however, in the second model we observe a negative and significant marginal effect of the tax to sale ratio. Therefore, we interpret the marginal effect of the second model for this variable.

probability of eco-label adoption by 12.03 percent points. Finally, an exporting textile firm is more likely to adopt an eco-label than the others. The probability of eco-label adoption by an exporting firm is higher by 5.4 percent points relative to the other firms. We find almost similar results for model (2) and model (3) in table 3.

5.3 Regression results for textile product segments and export status of the firm

For robustness checks, we separately present the results of logit regression for textile product segments and for exporting and non-exporting firms in this section. Table 4 presents the coefficient estimates of logit regressions while table 5 presents the corresponding marginal effects.[7]

The results of the diagnostic tests of the four models are reported in the last section of table 4. In our four logit regression models, the Pseudo R squared is between the range of 0.45 to 0.81. Results of Wald chi-squared test show that the regression model is statistically significant overall at 1 percent level for each of the four regressions.

We conduct Hosmer-Lemeshow goodness-of-fit test, which examines the goodness of fit of the model. As the test is statistically significant at 1 percent, the test rejects the null hypothesis that the models are not good fit with the data. On the basis of the model classification tests, we observe that the overall accuracy rate of the firm's decision to adopt or not to adopt an eco-label is around 98% in the four models.

Results of model (1) and model (2) in table 5, show that if the environmental performance of the firm increases by one percent point, the probability of adopting an eco label increases by 3.9 percent points for a firm operating in the yarn segment and by 1.7 percent points for a firm operating in the textile composites & fabrics segment. If the profitability of the firm increases by one percent point, the probability of adopting an eco label increases by 0.14 percent points for a firm operating in the yarn segment and by 0.119 percent points for a firm operating in the textile composites & fabrics segment. If the market share of the firm operating in the yarn segment increases by one percent point, the probability of the firm to adopt an eco-label increases by 121.4 percent points. If the size of the firm increases by one thousand employees, the probability of adoption of an eco-label of a firm operating in the yarn segment decreases by 11.3 percent points and increases by 0.53 percent points for a firm operating in the textile composites & fabrics segment.

Moreover, we find that the impact of age on the eco-label adoption decision of a firm operating in the textile composites & fabrics segment is quadratic. Finally, if the firm operating in the yarn and textile composites & fabrics segment exports its products, then the probability of eco-label adoption increases by 13 percent points and 4.91 percent points, respectively.

Results of model (3) and model (4) in table 5 show that if the environmen-

[7] The results of the models included return on capital employed and net profit margin and its corresponding marginal effect are given in appendix table B1 and table B2, respectively.

Table 4: Results of logit regression for textile product segments and export status of the firm

	Yarn	Composites	Exporting	Non-exporting
Model	4	5	6	7
Dependent variable: Eco-label adoption (Yes=1, No=0)				
Environmental performance:				
Environmental performance index	0.201***	0.352***	0.449***	0.115***
	(0.0565)	(0.0612)	(0.0529)	(0.0264)
Financial performance:				
Return on equity	0.00717**	0.0245**	0.00818***	0.0194***
	(0.00335)	(0.0106)	(0.00304)	(0.00681)
Competitiveness:				
Market share	6.143***	-0.886	0.723	10.23***
	(1.245)	(1.036)	(0.668)	(2.475)
Firm-specific factors:				
Firm size	-0.570***	0.109***	0.186***	-2.765***
	(0.189)	(0.0356)	(0.0267)	(0.62)
Firm age	-0.0284	-0.153***	-0.0931***	-0.0714
	(0.0334)	(0.05)	(0.0294)	(0.0506)
Square of firm age	0.00014	0.00137**	0.000869**	0.00044
	(0.00049)	(0.00066)	(0.00039)	(0.00068)
Regulatory pressure:				
Tax to sales ratio	-0.126	-0.411	-0.206**	-0.407
	(0.088)	(0.335)	(0.0921)	(0.265)
Textile segment:				
Textile composites & fabric segment				
Yarn segment (Yes=1, No=0)			1.638***	1.290***
			(0.196)	(0.337)
Export status of the firm:				
Export (Yes=1, No=0)	0.682***	1.191**		
	(0.2)	(0.537)		
Constant	-2.613***	-3.268***	-5.359***	-1.492*
	(0.825)	(1.089)	(0.86)	(0.868)
Diagnostic check:				
Observations	574	322	568	328
Pseudo R squared	0.4996	0.6841	0.8075	0.4512
Wald chi2 statistics	121.54***	89.55***	261.43***	93.28***
Diagnostic test:				
Hosmer-Lemeshow goodness-of-fit test	67.07***	48.73***	84.01***	22.82**
Model classification test	0.9791	0.9752	0.9877	0.8689

Source: Estimated by authors based on firm-level data from the textile industry listed on the PSX. Note: Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

tal performance of the firm increases by one percent point, the probability of an exporting firm to adopt an eco-label increases by 4.3 percent points and by 1.5 percent points for a non-exporting firm. If the profitability of the firm increases by one percent point, the probability of an exporting firm to adopt an eco-label increases by 0.079 percent points and by 0.245 percent points for a non-exporting firm. If the market share of the firm increases by one percent point, the probability of a non-exporting firm to adopt an eco-label increases by

Table 5: Marginal effect of logit regression for textile product segments and export status of the firm

	Yarn	Composites	Exporting	Non-exporting
Model	4	5	6	7
Dependent variable: Eco-label adoption (Yes=1, No=0)				
Environmental performance:				
Environmental performance index	0.039***	0.017***	0.043***	0.015***
	(0.0111)	(0.007)	(0.004)	(0.004)
Financial performance:				
Return on equity	0.0014**	0.00119**	0.00079***	0.00245***
	(0.00066)	(0.00068)	(0.00031)	(0.00088)
Competitiveness:				
Market share	1.214***	-0.043	0.069	1.292***
	(0.25555)	(0.05118)	(0.06997)	(0.3674)
Firm-specific factors:				
Firm size	-0.113***	0.0053***	0.0179***	-0.3492***
	(0.03521)	(0.0026)	(0.00298)	(0.05683)
Firm age	-0.0056	-0.0074***	-0.0089***	-0.00901
	(0.0066)	(0.00418)	(0.00349)	(0.00594)
Square of firm age	0.000027	0.00007**	0.00008**	0.00006
	(0.0001)	(0.00005)	(0.00004)	(0.00008)
Regulatory pressure:				
Tax to sales ratio	-0.0249	-0.0201	-0.0198**	-0.0514
	(0.01694)	(0.01068)	(0.00749)	(0.03141)
Textile segment:				
Textile composites & fabric segment				
Yarn segment (Yes=1, No=0)			0.145***	0.138***
			(0.022)	(0.038)
Export status of the firm:				
Export (Yes=1, No=0)	0.130***	0.0491**		
	(0.0357)	(0.02771)		

Source: Estimated by authors based on firm-level data from the textile industry listed on the PSX. Note: Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

129.2 percent points. If the size of the firm increases by one thousand employees, the probability of adoption of an eco-label for an exporting firm increases by 1.79 percent points and decreases by 34.92 percent points for a non-exporting firm.

Moreover, we find that the impact of age on the eco-label adoption decision of an exporting firm is quadratic. One percent point increase in the tax burden on an exporting textile firm reduces the probability of eco-label adoption by 1.98 percent points. Finally, the presence of an exporting and non-exporting firm in the yarn segment increases the probability of eco-label adoption by 14.5 percent points and 13.8 percent points, respectively. We find almost similar results for the regression including return on capital employed and net profit margin.

6 Conclusion

In this study, we identify the factors that affect a textile firm's decision to adopt an eco-label. Results from logit regression show that environmental performance, profitability, market share and firm size have significant positive impact on the adoption of eco-labels by a textile firm while the tax burden has significant negative effect. Furthermore, we find that an exporting textile firm is more likely to adopt an eco-label than the others. In addition, among the textile firms, a yarn manufacturing firm is more likely to adopt an eco-label relative to a fabric or textile composite manufacturing firm.

Age has a significant negative effect on the eco-label adoption decision of the firm up to an optimal level beyond which it has a significant positive effect on the eco-label adoption decision of the firm. Findings of this study can help the policy makers in examining the existing eco-labeling schemes and taking some serious policy measures to promote the use of eco-labels in the textile industry of the country.

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Appendix

Table A1: Water consumption and waste water discharge per unit of textile product

Category	Water consumption (l/kg)	Waste water discharge (l/kg)
Yarn manufacturing	198.416	182.984
Fabric manufacturing	160	154.324
Dyeing and finishing	184.086	184.086
Printing	68.895	68.894
Sizing	3.9	3
Natural fiber manufacturing	120	115
Garments manufacturing	201.723	201.723
Knitting fabrics	120	115
Manmade fiber	33.841	30.203
Textile processing	166	160

Source: Visvanathan et al (2001), and Alanya et al (2006).

Table A2: Effluent discharge level of BOD, COD, and TSS

Province	Effluents (mg/l)		
	BOD	COD	TSS
Punjab	391.26	598.68	475
Sindh	273.80	400.10	1261
KP	475	160	2100
Baluchistan	475	160	2100

Source: Sial et al (2006), Nasir et al (2012), Nosheen et al (2000), and Imtiazuddin et al (2012).

Table A3: Pakistan and World Bank effluent discharge standard

Country/Int org	Effluent (mg/l)		
	BOD	COD	TSS
Pakistan	80	150	150
World Bank (WB)	30	160	50

Source: Dey and Islam (2015) and Shamas (2015)

Table A4: Deceptive of amount of effluent from Pakistani textile firms

	Effluent (Million mg/l)		
	BOD	COD	TSS
Firm with eco-label	249844.6 (749981.4)	1249223 (3749907)	416407.6 (1249969)
Firm without eco-label	5774696 (50500000)	3022091 (17100000)	23200000 (223000000)
Total	4284440 (43200000)	2543883 (14800000)	17000000 (191000000)

Source: Estimated by authors based on firm-level data from the textile industry listed on the PSX.

Table A5: Results of logit regression with return on capital employed and net profit margin

	Yarn segment		Composites		Exporting firm		Non-exporting firm	
Model	8	9	10	11	12	13	14	15
Dependent variable: Eco-label adoption (Yes=1, No=0)								
Environmental performance:								
Environmental performance index	0.199***	0.202***	0.347***	0.346***	0.446***	0.447***	0.113***	0.110***
	(0.0572)	(0.0566)	(0.0611)	(0.0611)	(0.0527)	(0.0525)	(0.0259)	(0.0258)
Financial performance:								
Return on capital employed	0.0181***		0.0176		0.01		0.0362***	
	(0.00631)		(0.015)		(0.0113)		(0.00921)	
Net profit margin		0.0134***		0.0295**		0.0111*		0.0449***
		(0.00445)		(0.0127)		(0.00577)		(0.011)
Competitiveness:								
Market share	6.067***	6.211***	-1.039	-1.04	0.649	0.663	10.32***	10.91***
	(1.37)	(1.284)	(1.012)	(1.024)	(0.651)	(0.667)	(2.468)	(2.74)
Firm-specific factors:								
Firm size	-0.568***	-0.610***	0.0753**	0.0775***	0.172***	0.176***	-2.735***	-2.671***
	(0.187)	(0.195)	(0.0302)	(0.03)	(0.0271)	(0.0273)	(0.611)	(0.599)
Firm age	-0.043	-0.0342	-0.204***	-0.202***	-0.104***	-0.105***	-0.0808	-0.0741
	(0.0335)	(0.0337)	(0.0511)	(0.0518)	(0.0379)	(0.0394)	(0.0515)	(0.0506)
Square of firm age	0.000367	0.000231	0.00215***	0.00215***	0.00105**	0.00108**	0.000574	0.000388
	(0.000491)	(0.000498)	(0.000655)	(0.000666)	(0.000512)	(0.000535)	(0.000694)	(0.000691)
Regulatory pressure:								
Tax to sales ratio	-0.154*	-0.151	-0.530*	-0.492*	-0.239**	-0.212**	-0.456	-0.342
	(0.0813)	(0.0929)	(0.31)	(0.29)	(0.105)	(0.0871)	(0.3)	(0.241)
Textile segment:								
Textile composites &fabrics segment (Reference)								
Yarn Segment (Yes=1, No=0)					1.584***	1.610***	1.347***	1.286***
					(0.19)	(0.192)	(0.344)	(0.332)
Export status of the firm:								
Export (Yes=1, No=0)	0.679***	0.704***	1.398***	1.332***				
	(0.204)	(0.204)	(0.518)	(0.512)				
Constant	-2.484***	-2.462***	-2.204**	-2.203**	-5.063***	-5.077***	-1.504*	-1.365
	(0.809)	(0.843)	(0.958)	(0.945)	(0.959)	(0.957)	(0.866)	(0.843)
Diagnostic check:								
Observations	574	574	322	322	568	568	328	328
Pseudo R squared	0.5022	0.499	0.6798	0.6811	0.8066	0.8066	0.4636	0.4578
Wald χ^2 statistics	114.80***	116.64***	90.68***	106.45***	260.37***	266.47***	100.88***	98.69**
Diagnostic test:								
Hosmer-Lemeshow goodness-of-fit	64.32***	67.70***	57.10***	57.05***	82.54***	85.25***	12.4	26.64***
Model classification test	0.9739	0.9791	0.9783	0.9783	0.9877	0.9877	0.872	0.8689

Source: Estimated by authors based on firm-level data from the textile industry listed on the PSX. Note: Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A6: Marginal effect of logit regression with return on capital employed and net profit margin

	Yarn segment		Composites		Exporting firm		Non-exporting firm	
Model	8	9	10	11	12	13	13	15
Dependent variable: Eco-label adoption (Yes=1, No=0)								
Environmental performance:								
Environmental performance index	0.039***	0.039***	.0177***	0.019***	0.043***	.045***	0.014***	0.015***
	(0.0111)	(0.0111)	(0.0066)	(0.0065)	(0.0047)	(0.00399)	(0.00346)	(0.00372)
Financial performance:								
Return on capital employed	0.0036***		0.00089		0.00097		0.0044***	
	(0.00125)		(0.00077)		(0.00105)		(0.00118)	
Net profit margin		0.0026***		0.00165**		0.00111*		0.00597***
		(0.00087)		(0.00108)		(0.00061)		(0.00155)
Competitiveness:								
Market share	1.190***	1.230***	-0.005	-0.058	0.063	0.066	1.261***	1.450***
	(0.27706)	(0.26236)	(0.05114)	(0.05461)	(0.0678)	(0.07199)	(0.36109)	(0.43101)
Firm-specific factors:								
Firm size	-0.111***	-0.121***	0.0038**	0.0043***	0.0166***	0.0176***	-0.3343***	-0.3551***
	(0.03462)	(0.03636)	(0.0021)	(0.00234)	(0.00297)	(0.00297)	(0.05679)	(0.06021)
Firm age	-0.0084	-0.0067	-0.0104***	-0.01128***	-0.0099***	-0.0105***	-0.0099	-0.0099
	(0.00658)	(0.00667)	(0.00486)	(0.0051)	(0.00444)	(0.00468)	(0.00579)	(0.00634)
Square of firm age	0.000072	0.000057	0.00011***	0.000120***	0.00010**	0.00011**	0.00007	0.00006
	(0.0001)	(0.0001)	(0.00006)	(0.000666)	(0.00006)	(0.00006)	(0.00008)	(0.00009)
Regulatory pressure:								
Tax to sales ratio	-0.0303*	-0.0298	-.02703*	-0.0275*	-0.0231**	-0.0212**	-0.0558	-0.0455
	(0.01547)	(0.01784)	(0.00954)	(0.01025)	(0.00819)	(0.007461)	(0.03363)	(0.03036)
Textile segment:								
Textile composites &fabrics segment (Reference)								
Yarn segment (Yes=1, No=0)					0.141***	0.148***	0.138***	0.145***
					(0.02306)	(0.02237)	(0.03788)	(0.0381)
Export status of the firm:								
Export (Yes=1, No=0)	0.129***	0.135***	0.0589***	0.0619***				
	(0.03617)	(0.03631)	(0.02768)	(0.02768)				

Source: Estimated by authors based on firm-level data from the textile industry listed on the PSX. Note: Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.