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Customer environmental concerns and profit margin: Evidence from manufacturing firms☆

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ABSTRACT

This study evaluates the impact of customer environmental concerns on manufacturing firms' profit margin. Eco-conscious customers may have a high demand for green products and are willing to pay a price premium for those products. The green effect is subject to the degree of greenness in production processes. In addition, environmental investments reduce the negative impact of production processes on the natural environment, alleviating customers' environmental concerns. However, environmental investments increase product costs, which may subsequently offset economic benefits from eco-conscious customers. As such, we test the impact of customer environmental concerns on profit margin by controlling for the greenness levels (represented by energy consumption) and environmental investments (represented by energy efficiency measures). Based on a sample of 5390 manufacturing firms in 25 Central and Eastern European and Central Asian countries, our empirical results indicate a positive impact of customer environmental concerns on profit margins for low energy-intensity firms and a negative impact for high energy-intensity firms. In addition, high energy-intensity firms with energy efficiency measures are more negatively affected by customer environmental concerns than those with energy efficiency measures.

1. Background

Green supply chain management (GSCM) has received increasing interest from firm managers, customers, policymakers, and other stakeholders since production-related emissions have been found to be a serious contributor to environmental degradation (Khan, Yu, Golpîra, Sharif, & Mardani, 2021; Thongrawd, Pichetsiraprapa, Somthong, & Sudprasert, 2019; Zhu, Sarkis, & Lai, 2013). One purpose of GSCM is to alleviate customer environmental concerns or promote pro-environmental consumption (Green, Zelbst, Meacham, & Bhadauria, 2012; Kushwah, Dhir, & Sagar, 2019), which is thought to be buyer behavior that avoids certain types of products causing pollution (Carrigan, Szmigin, & Wright, 2004). Customer environmental concerns affect manufacturing firms in different ways, such as product decisions and the choice of inputs (Nouira, Frein, & Hadj-Alouane, 2014; Yu, Han, & Hu, 2016), sustainable supply chain collaborations (Liu, Anderson, & Cruz, 2012; Yang, Luo, & Wang, 2017), and the emission intensity and environmental performance (Hammami, Nouira, & Frein, 2018). Customer environmental concerns are therefore recognized as a vital driver for environmental

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management practices (Chen, Chiu, Lin, & Wu, 2019; Yu et al., 2016).

The importance of customer environmental concerns is also related to the fact that firms engaging in environmental activities are largely motivated by economic benefits or social/ethical commitments (Tang & Gekara, 2020). For economic consequences of green practices, customer channels are a promising area of study since environmental activities affect financial performance through satisfied customers and their spending (Feng & Wang, 2016; Gadenne, Kennedy, & McKeiver, 2009). Customers may treat eco-unfriendly firms as having poor reputations, which further damages those firms' financial and market performance (Walsh, Mitchell, Jackson, & Beatty, 2009). This is also because eco-conscious customers directly influence profitability through high demand for green products (Hussain, Khokhar, & Asad, 2014; Suki, 2013) and their willingness to pay more for green products (Hilger, Hallstein, Stevens, & Villas-Boas, 2019; Zhong & Chen, 2019). However, green concerns' effects may vary across firms with different greenness levels. Customer environmental concerns with regard to firms in low greenness industries do not naturally lead to increased demand for greenness or premium pricing. On the other hand, high polluting industries need more investment in pollution prevention measures, which may offset the benefits generated from customers with environmental concerns. Therefore, the greenness of a firm is an essential factor influencing customer environmental concerns and their impact on financial performance.

The purpose of this study is to investigate the impact of customer environmental concerns on profit margin, a measure of financial performance, and how this impact relies on firms' greenness levels. Profit margin refers to the 'net benefit' of customer environmental concerns and the induced environmental practices (Hatakeda, Kokubu, Kajiwara, & Nishitani, 2012). The greenness of a firm is represented by its energy consumption, which is treated as an ecological characteristic of production processes (Aller, Herrerias, & Ordóñez, 2018; Solnørdal & Thyholdt, 2019). Energy consumption may signal a firm's overall environmental impact, which in turn affects the purchasing behavior of eco-conscious customers. For firms with similar levels of energy consumption, consumers may perceive a firm with energy efficiency measures as being environmentally friendly. As such, the impact of customer environmental concerns on financial performance may depend on firms' energy consumption and investment in energy efficiency measures.

The previous literature on customer environmental concerns is generally based on theoretical, mathematical, or conceptual models, accompanied by case studies or quantitative analyses using experimental or survey data (Hammami et al., 2018; Nouira et al., 2014; Suki, 2013; Yang et al., 2017; Yu et al., 2016).[1] Customers' conscious intentions stated in the survey may differ from their actual purchasing behavior (Baden & Prasad, 2016; Carrington, Neville, & Whitwell, 2010). This study hence complements those previous studies and provides empirical evidence of the impact of customer environmental concerns on financial performance. This study contributes to the literature by addressing three main research questions. First, to what extent do customer environmental concerns (requirements) affect profit margin? Second, to what extent does energy consumption moderate the impact of customer environmental concerns on profit margin? Third, to what extent do energy efficiency measures affect the moderating role of energy consumption in the relationship between customer environmental concerns and profit margin. To answer these research questions, we derive a conceptual model, which indicates that the impact of customer environmental concerns on financial performance depends on the gap between price and unit cost inclusive of inputs of environmental improvement, the size of price premiums relative to the marginal cost of the environmental inputs, and the increased demand for the green products. We relate firm environmental inputs (and environmental performance) to energy consumption and energy efficiency measures and conduct the empirical analysis based on a diverse cross-industry sample of 5390 firms in 25 Central and Eastern European and Central Asian countries.

This paper is organized as follows. Section 2 addresses the literature review and hypothesis development. The conceptual framework is presented in Section 3. Section 4 describes the data, measuring, and methodology. Following this, empirical results are presented in Section 5 and empirical findings and their implications are discussed in Section 6. Concluding remarks, limitations, and avenues for future research are provided in Section 7.

2. Related literature

2.1. Customer environmental concerns

In general, environmental concerns refer to the attitude of protecting the environment (Ahmed et al., 2021), which can future lead to pro-environmental consumption or purchasing (Kushwah et al., 2019). For example, a firm's customers may require environmental certifications or adherence to certain environmental standards when they make a procurement decision. From the perspective of individual consumers, the negative emotional responses to corporate environmental irresponsibility may lead to negative word of mouth, consumer dissatisfaction, and boycotting (Walsh et al., 2009; Xie, Bagozzi, & Grønhaug, 2015). Thus, environmentally responsible customers consider both economic interests and social and environmental wellbeing when they make purchasing decisions (Carrington, Chatzidakis, Goworek, & Shaw, 2021; Pawaskar, Raut, & Gardas, 2018). Supply chain partners' concerns motivate firms to invest in the practices of social responsibility (Chen et al., 2019) since green products provided to customers could reduce their environmental concerns and improve their stratification levels (Feng & Wang, 2016).

Customer environmental concerns encourage firms to consider environmental quality in production (Gadenne et al., 2009; Gong, Gao, Koh, Sutcliffe, & Cullen, 2019; Laari, Töyli, Solakivi, & Ojala, 2016). Feng et al. (2018) measured customer-driven green supply chain management with regard to eco-design, mutual understanding of responsibility for environmental performance, and cooperative activities with a direct target to reduce the overall environmental impact of products. As such, Feng et al. (2018) mainly focused on

[1] This is probably due to data unavailability. In the 2019 version of the World Bank Enterprise Surveys used in this study, there is a question directly addressing customer environmental concerns for firms in Central and Eastern European and Central Asian countries.

environmental collaboration with customers, in line with the conceptual typologies in Zhu et al. (2013). While Laari et al. (2016) also measured firms' customer environmental collaboration, they further pointed out that customers may play a monitoring role in firms' environmental activities. For example, customers may require suppliers to ensure environmental practices or implement an environmental management system.

2.2. Environmental concerns and financial performance

Customer environmental concerns may affect the elements of financial performance in different ways. In the literature, the measure of financial performance is generally based on respondents' answers of the economic situation in terms of various dimensions such as turnover, profit, market share, and return on assets, in line with the operations management theory (Feng et al., 2018; Laari et al., 2016; Mengze & Wei, 2015; Ozusaglam, Kesidou, & Wong, 2018; Thongrawd et al., 2019). Researchers further conceptualized the elements of financial performance to a single unidimensional measure. The single unidimensional measure of financial performance may complicate the empirical results and confuses the channels through which environmental practices affect financial performance. Environmental practices affect firm business performance via their impact on sales growth or productivity improvement (Nishitani, 2011; Ozusaglam et al., 2018). The primary inputs of financial ratios, such as sales, costs, capital (or equity) size, and market share, respond to environmental activities in different manners. Environmentally friendly firms may have poor financial performance regarding return on assets, especially in the short run, since pollution abatement investments have lower returns and long payback periods (Horváthová, 2012).

Customers' growing concerns about greenness may change their purchasing behavior and lead to high demand for green products. There may be green income for firms with knowledge of environmental technologies and green business opportunities generated from downstream clients with high environmental concerns (Nishitani, 2011). In the literature, experimental studies confirm that customers with environmental concerns have a stronger preference for green products (Hussain et al., 2014; Suki, 2013).

Another channel through which customers' environmental concerns contribute to profitability is their willingness to pay more for green products. Researchers have confirmed the impact of environmental beliefs on consumer willingness to pay for low-carbon agricultural products (Zhong & Chen, 2019) and seafood products from eco-friendly waters (Hilger et al., 2019). Few studies investigate customers' willingness to pay for environmentally friendly manufacturing products. One exception is Viciunaite and Alfnes (2020), who documented the evidence of consumers' high ranking of apparel items' sustainability attributes over price, indicating the price premiums for these attributes. As such, customers with environmental concerns are more likely to pay more for eco-friendly products and hence enhance green firms' turnover.

In contrast to the benefits of offering green products to environmentally responsible customers, manufacturing costs necessary for improving greenness may offset subsequent benefits, influencing firms' optimal product decisions. High-polluting firms are more likely to conflict with consumer environmental requirements, which pushes them to invest in pollution abatement techniques. This indicates that green concerns for high-polluting firms do not necessarily raise financial performance. In this study, we use energy consumption to represent firms' pollution levels. Energy consumption is a primary environmental concern, with particular regard to the environmental impact of fossil fuels (Aller et al., 2018; Solnørdal & Thyholdt, 2019). Energy-related carbon emission is one of the most important factors impacting environmental performance (Hammami et al., 2018). In other words, energy-related emissions are one of the indicators measuring the overall greenness in production processes (Dangelico & Pontrandolfo, 2010), which further affects customers' purchasing behavior and willingness to pay.

Environmental performance that could alleviate customer environmental concerns is associated with a firm's impact on the natural environment (such as emissions) and activities taken by the firm to reduce the negative outcomes (Doan & Sassen, 2020; Misani & Pogutz, 2015; Zhang, 2021). In response to energy-related emissions, energy efficiency measures increase the ratio of desirable production output to pollution emissions and hence improve environmental performance (Bostian, Färe, Grosskopf, & Lundgren, 2016). Firms with energy-efficiency technologies differentiate themselves from their competitors in terms of resource efficiency and pollution abatement (D'Orazio & Valente, 2019; Ozusaglam et al., 2018). Energy efficiency measures are one of the main environmental practices employed by firms that seek to confront climate change (Solnørdal & Thyholdt, 2019). High energy-intensive firms may reduce production-related emissions by investing in energy efficiency measures. Energy-efficiency technologies reduce the environmental impact of a firm's product, resulting in competitive prices or superior profit margins (Ozusaglam et al., 2018). For firms with similar energy intensity, customers are more likely to pay more for those with environmental protection investments.

3. Conceptual framework

The Study of Nouira et al. (2014) is one of only a few studies that have theoretically explored how customers' environmental concerns affect demand, price, and subsequently financial performance. To study the channels through which customer environmental concerns and the degree of greenness affect financial performance more formally, we follow Nouira et al. (2014) but use fewer assumptions to examine the profit optimization for a firm that sells green products (i.e., a green firm). We also follow Saitone, Sexton, and Sumner (2015) and use the implicit functions, which facilitate the comparative static analysis.

The profit-maximization problem for a green firm is expressed as:

$$\mathrm{Max}\{(S^g - C^g(E)) * X^g(S^g, S^o, E)\} \tag{1}$$

where S^g and S^o are the unit prices of the green and ordinary products provided by the green firm and its competitors (ordinary firms),

respectively; C^g is the per-unit costs of the green product. The demand function for the green product (X^g) depends on its own-price and cross-price (and other demand determinants, which are suppressed in the equation). In addition, E is a continuous variable (for example, costs incurred in energy efficiency improvements) representing the degree of greenness, which is part of the total costs and directly affects the demand for the green product.

The solution to Eq. (1), $\widetilde{S^g}$, is derived from the first-order condition of the maximizing question:

$$X^g + (S^g - C^g)\frac{\partial X^g}{\partial S^g} = 0 \tag{2}$$

Eq. (2) implies that the solutions, $\widetilde{S^g}$, is a function of cost variable, the level of greenness, and the substitute's price. The implicit function $\widetilde{S^g}$ is in the form:

$$\widetilde{S^g} = \widetilde{S^g}(C^g, E, S^o) \tag{3}$$

Replacing the price for the green product in Eq. (1) with $\widetilde{S^g}$ yields the optimized profit:

$$\left(\widetilde{S^g} - C^g(E)\right)X^g\left(\widetilde{S^g}, E, S^o\right) \tag{4}$$

Finally, we evaluate the impact of the greenness on the optimized profit, by differentiating Eq. (4) with respect to E.[2]

$$\left(\frac{\partial \widetilde{S^g}}{\partial E} - \frac{\partial C^g}{\partial E}\right)X^g + \left(\widetilde{S^g} - C^g\right)\left(\frac{\partial X^g}{\partial \widetilde{S^g}}\frac{\partial \widetilde{S^g}}{\partial E} + \frac{\partial X^g}{\partial E} + \frac{\partial X^g}{\partial S^o}\right) \tag{5}$$

Eq. (5) indicates that the impact of greenness on profit is subject to the price premium for greenness, the gap between price and unit cost of the green product, quantity response to greenness, and substitutability between the two goods. All items depend on customer environmental concerns.

After assuming a positive gap between price and unit cost, we question whether there is a positive contribution of greenness to the profit. In other words, whether the sign of Eq. (5) is justified. In the equation, the first term is positive, given that the greenness has a greater marginal impact on price than on unit cost, i.e., $\frac{\partial \widetilde{S^g}}{\partial E} > \frac{\partial C^g}{\partial E}$. The sign of the second term is ambiguous because of $\frac{\partial X^g}{\partial \widetilde{S^g}} < 0$ as indicated by the demand theory, $\frac{\partial X^g}{\partial E} > 0$ given the positive impact of greenness on the demand, and the ambiguous sign of $\frac{\partial X^g}{\partial S^o}$, depending on the substitutability between the green and ordinary products. Overall, the sign of Eq. (5) is indeterminate, indicating that the impact of greenness on profit is uncertain.

The likelihood of a positive sign of Eq. (5) is great in cases of (*i*) a lower marginal cost of the green content relative to the price premium for the green product, (*ii*) a less elastic demand for the green product, and (*iii*) high substitutability between the green and ordinary products.[3] Among them, price premiums for the green product and its demand elasticity depend on customers' environmental concerns. Eco-friendly customers may differentiate green products from ordinary products and more easily tolerate prices increases, resulting in low substitutability between green and ordinary products and hence inelastic demand for green products. This is consistent with microeconomic theory and is empirically tested by Nouira et al. (2014) and Roheim and Zhang (2018). Thus, customers' environmental concerns are probably associated with low elastic demand and increased demand for green products, resulting in better financial performance (i.e., a positive sign of Eq. (5)). Therefore, we derive our first hypothesis:

Hypothesis 1 (H1). Customer environmental concerns improve firms' financial performance.

In Eq. (5), the marginal cost of the green content is directly related to energy use and energy efficiency improvements. Environmental investments that alleviate customer environmental concerns may increase operating costs (Misani & Pogutz, 2015; Ozusaglam et al., 2018; Doan & Sassen, 2020). Additionally, firms may not implement cost-effective energy efficiency technologies due to market failure, indicating the existence of the "efficiency paradox" (DeCanio, 1998). This may further weaken the positive impact of customers' environmental concerns on financial performance. As such, we posit the second hypothesis as follows:

Hypothesis 2a (H2a). The impact of customer environmental concerns on firms' financial performance depends on energy intensity.

Hypothesis 2b (H2b). The impact of customer environmental concerns on firms' financial performance depends on energy efficiency measures.

4. Data, variables, and methodology

4.1. Data

The World Bank Enterprise Surveys collected data on the business environment and firm performances for most low- and medium-

[2] The impact of greenness on the price of the ordinary product is suppressed.

[3] The competing demand is one of the reasons explaining the environmental concerns and the pro-environmental purchasing behavior (Carrington et al., 2010)

income countries and some high-income countries (Enterprise Surveys, 2020). The surveys employ a stratified-sampling methodology to ensure good representativeness of the survey data. In addition, the survey data include a large number of firm characteristics and other factors, which may affect financial performance and need to be controlled in the model to separate the impact of customers' environmental concerns (and energy intensity) on financial performance. The Enterprise Surveys are widely used by researchers to investigate the business environment, investment behavior, and financial performance because of the reliability and trustworthiness of the dataset (e.g., Tian & Lin, 2019; Wellalage, Locke, & Samujh, 2019; Zhang & Xie, 2021; Zhang, 2021).

The 2019 survey includes a module on the green economy for countries in Central and Eastern and Europe and Central Asia, which are sample countries used in this study. For comparison, the surveys also provide firm-level data from developed countries, namely the European Union (EU) member states. Totally, there are 5390 manufacturing firms covering 25 countries. (See Appendix A1 for the sample distribution by country and industry).

4.2. Measurement

Customers show their environmental concerns by focusing on a firm's production processes, the greenness of its products, its claim, and environmental certifications. Customer environmental concerns can be reflected by their requirement for environmental certifications, which facility customers evaluating firms' environmental performance. In this study, the measure of customer environmental concerns ('*Customer*') is based on the survey question, "…did any of the establishment's customers require environmental certifications or adherence to certain environmental standards as a condition to do business with this establishment?"[4] The Enterprise Surveys leave the contents of environmental certifications and environmental standards to the respondents. Implementing an environmental management system, such as the ISO 1400 or Eco-Management and Audit Scheme (EMAS), may satisfy the requirements of these eco-friendly customers.

This study uses profit margin as a measure of firm financial performance ('*Profit-Margin*'), which is defined as gross profit (= total sales – total cost of sales) divided by total sales. As discussed above, green-conscious customers may pay more for green products and buy more of those products over ordinary products, influencing firms' sales. This may further cover the environmental cost occurred in the production of the green products and consequently raise profit margin.

In the survey, firms answered questions about their consumption of electricity, fuels, natural gas, and coal. For each energy input, we group firms into four quantiles on the basis of energy consumption, resulting in four quantile variables.[5] For each quantile variable, we set ranks from 1 (for the 1st quantile) to 4 (for the 4th quantile). The sum of the four quantile variables represents energy intensity. The values of the summarized ranks by firms are further set to four quantile dummy variables, representing the overall energy intensity, namely, from *Energy-Intensity-*q_1, the lowest quantile, to *Energy-Intensity-*q_4, the highest quantile. For firms in the four energy-intensity quantiles, the average profit margin ranges between 37.1% and 52.6%, with the upper bound for the 1st quantile and the lower bound for the 4th quantile. For the 1st, 2nd, and 3rd quantiles, the share of firms with environmentally conscious customers in the individual quantile does not differ greatly, at a value of about 16%, which is much lower than the counterpart for the 4th quantile (about 21.9%).

We used the following survey question to measure investment in greenness, "Over the last three years, did this establishment adopt any measures to enhance energy efficiency?" Firms investing in energy efficiency measures seek to enhance energy efficiency and reduce emissions, which leads to positive disclosure statements and may alleviate customer environmental concerns and further promote the demand for greenness.

4.3. Methodology

The baseline specification tests the impact of customer concerns for green products on profit margin for the whole sample, after controlling for the degree of energy intensity and other determinants. This is:

$$ProfitMargin_i = a_0 + a_1 Customer_i + \sum_{k=2}^{4} b_k Energy\_q_{k,i} + \sum_{k=1}^{m} c_k X_{k,i} + \sum_{k=1}^{o} e_k Sector_{k,i} + U_i \quad (\textbf{Model A}) \tag{6}$$

where X represents control variables and U_i is the residual. The dummy variables for manufacturing subsectors (*Sector*) control for industry heterogeneity. The lowest energy intensity (the 1st quantile) is the base in regression.

Replacing the individual dummy variables for energy consumption with the interaction between these variables and *Customer* yields the specification to test how the impact of customer environment concerns on profit margin varies across firms with various levels of energy consumption.

$$ProfitMargin_i = a_0 + a_1 Customer_i + \sum_{k=2}^{4} b_k Energy\_q_{k,i} * Customer_i + \sum_{k=1}^{m} c_k X_{k,i} + \sum_{k=1}^{o} e_k Sector_{k,i} + U_i \ (\textbf{Model B}) \tag{7}$$

Since the base is *Energy-q1*, the coefficient of the stand-alone variable, *Customer*, measures the impact of customers' environmental concerns on financial performance for firms in the 1st quantile of energy intensity. Using the interaction terms, we derive the impact of

[4] Gong et al. (2019) measured customer concerns using the revenue/loyalty score from the Thomson Reuters ASSET4.

[5] We measure energy intensity based on quantile dummies due to the presence of outliers in the data and the possible non-linear relationship between energy consumption and financial performance.

customers' environmental concerns on financial performance for firms in high quantiles of energy intensity. For example, we keep only the 2nd quantile and its interaction with *Customer* and rewrite Eq. (7) as:

$$ProfitMargin_i = a_0 + \left(a_1 + b_2 Energy\_q_{2,i}\right) * Customer_i \quad (8)$$

In Eq. (8), a significant coefficient of the interaction terms (b_2) indicates the differential impact of *Customer* on profit margin for firms in the 2nd quantile, compared to firms in the 1st quantile, the base. In particular, the sum of a_1 and b_2 represents the impact of *Customer* on profit margin for firms in the 2nd quantile.

We named the baseline specification as Model A and its modified version Model B. The two models are applied to the whole sample. In addition, we are to estimate Model B for the subsamples of green firms and ordinary firms in order to test whether customer environmental concerns and energy intensity jointly impact financial performance and whether this joint impact depends on energy efficiency improvements.

4.4. Control variables

The survey data include variables about firm characteristics and market conditions, which likely affect firms' financial performance and need to be controlled in the model.

The degree of competition in the market affects both profit margin and purchasing of environmentally concerned customers. In the survey questionnaire, firms reported the number of competitors their primary products faced in their primary markets. The number of competitors reflects competitive pressures in the market and the competing demand for green products. For firms that stated, "too many competitors to count," we created an individual dummy for them. For other firms, we grouped them into four quantiles (dummies) according to the number of competitors. The demand condition further differs between domestic and foreign markets. Accordingly, we created a dummy variable for exporters. Profit persistence is well documented in the literature. Due to data availability, we used the growth rate of sales to create four quantiles to catch the impact of profit persistence. Firms facing restrained capacity utilization may lose market share and suffer financial loss (Zhang, 2022).

Some basic firm features such as firm size, firm age, the number of educated employees, managerial experience, and firm location may explain the different financial performance between firms. In terms of firm legal status, shareholding companies probably own more financial resources and are less risk-averse, resulting in better financial performance. Firms partly owned by foreign investors have more financial resources and better technologies than firms owned by domestic investors. In the end, a dummy variable for firms located in non-EU countries is incorporated in the model specification to capture the different levels of profitability between the EU state members and non-EU countries.

The list of variables used in the analysis and descriptive statistics are presented in Table 1. For the whole sample, the average profit margin is about 44%. For dummy variables, the mean is the share of firms with the characteristics in the whole sample. For example, the share of firms with environmentally- aware customers is about 18% (i.e., the mean of *Customer*).

Table 2 demonstrates the correlation matrix for all variables. Profit margin is negatively correlated with energy efficiency measures, customer environmental concerns, and high energy-intensity variables, indicating the necessity to explore whether the impact of customer environmental concerns on profit margin depends on the greenness and environmental investments. The correlation matrix also shows that older or large firms are more oriented towards greenness regarding their low level of energy intensity and the adoption of energy efficiency measures.

5. Empirical results

This section begins by describing a simple comparison of mean differences of variables for green firms and ordinary firms. Next, we discussed the estimation results from the ordinary least squares (OLS) regressions for Model A and Model B. For each regression, the robust standard errors are estimated for statistical tests. Finally, we reported the results of additional tests and robustness checks.

5.1. Univariate T-test results

Table 3 presents the descriptive statistics for the whole sample and the T-test results for the difference in the means of variables for green firms and ordinary firms. The average profit margin is 40.7% for green firms and 46.3% for ordinary firms. For the two firm groups, the share of firms with eco-conscious customers is significantly different. While the share of firms with environmentally concerned customers is 29.6% for green firms, the counterpart is only 10.3% for ordinary firms, indicating that green concerns motivate firms to invest in environmental activities. Regarding the 1st energy-intensity quantile, the green firm group has a greater share of firms with eco-conscious customers than the ordinary firm group (18.3% versus 29.2%); the opposite is true for the 4th energy-intensity quantile (32.4% versus 20.5%). Thus, green firms have a greater energy intensity than ordinary firms. High-polluting firms may trigger customers' concerns for greenness, which further forces firms to implement environmental activities.

5.2. Estimation results

Table 4 presents the estimation results for Model A. The coefficient of *Customer* is significant and negative, at the value of − 0.023. On average, firms with environmentally concerned customers have a 2.3% lower profit margin than firms without this type of

Table 1
Variable definitions and descriptive statistics.

Variable	Definition	Mean	SD
Profit-Margin	Profit margin = (total sales − total cost of sales)/total sales.	0.442	0.268
Customer	Dummy variable (= 1 for firms whose customers required environmental certifications)	0.176	0.381
Energy-q_1~q_4	Dummy variable (= 1 for firms with energy intensity in a particular quantile and 0 otherwise)	0.250	
Competition-q_1~q_4	Dummy variable (= 1 for firms with number of competitors in a particular quantile and 0 otherwise)	0.155	
Competition-q_9	Dummy variable (= 1 for firms with competitors: "too many to count" and 0 otherwise)	0.378	
Non-exporter*	Dummy variable (= 0 for exporters and 1 otherwise)	0.555	0.497
Exporter	Dummy variable (= 1 for exporters and 0 otherwise)	0.445	0.497
Growth-q_1~q_4	Dummy variable (= 1 for firms with sales growth rate in a particular quantile and 0 otherwise)	0.250	
Capacity-Utilization	Capacity utilization	0.706	0.292
Firm-Size: Small*	Dummy variable (= 1 for firms with employees $\geq$ 5 and $\leq$ 19 and 0 otherwise)	0.374	0.484
Firm-Size: Medium	Dummy variable (= 1 for firms with employees $\geq$ 20 and $<$ 100 and 0 otherwise)	0.363	0.481
Firm-Size: Large	Dummy variable (= 1 for firms with employees $\geq$ 100 and 0 otherwise)	0.263	0.440
Firm-Age	Firm age in number of years, in logarithm	2.888	0.606
Employee-Education	Percentage of workers with a university degree	0.139	0.231
Manager-Experience	Top manager's numbers of years working in the sector, in logarithm	2.755	0.783
Legal-Status: Other*	Dummy variable (= 0 for corporations and 1 otherwise)	0.279	0.449
Legal-Status: Corporation	Dummy variable (= 1 for corporations and 1 otherwise)	0.721	0.449
Domestic-Owner*	Dummy variable (= 0 for firms with foreign ownership and 1 otherwise)	0.889	0.314
Foreign-Owner	Dummy variable (= 1 for firms with foreign ownership and 0 otherwise)	0.111	0.314
Location: Big-City*	Dummy variable (= 1 for firms in the city with population over 1 million and 0 otherwise)	0.487	0.500
Location: Medium-City	Dummy variable (= 1 for firms in the city with population over 250,000–1 million and 0 otherwise)	0.240	0.427
Location: Small-City	Dummy variable (= 1 for city with population below 250,000 and 0 otherwise)	0.273	0.445
Region: non-EU	Dummy variable (= 0 for EU member states and 1 otherwise)	0.762	0.426
Region: EU	Dummy variable (= 1 for EU member states and 0 otherwise)	0.238	0.426

Dummy variables with star and the 1st quantile dummy for each type of quantile dummies (q1–q4) are the base in regressions.

customer. The negative impact of customer concerns is present across all sample firms, regardless of their energy consumption. Thus, we rejected the first hypothesis (H1). All coefficients of the three variables for energy intensity are significant and negative. In addition, the absolute magnitudes of those quantile variables gradually increase from the low quantile to the high quantile. The profit margin is 6.3%, 8.9%, and 12.3% smaller for firms in the 2nd, 3rd, and 4th quantile, respectively, than for firms in the 1st energy-intensity quantile. Poor environmental behavior, as measured by energy intensity, undermines financial performance. Another possible explanation for the estimated difference of the energy intensity quantiles is that high energy-intensive firms may have high pollution control costs, which reduce profit margins.

Table 5 reports the estimation results of Model B for the whole sample, green firms, and ordinary firms. Since we included the interaction terms between *Customer* and each of the high quantiles of energy intensity, the stand-alone *Customer* measures the green effect for firms in the 1st quantile of energy intensity. The significant and positive coefficient of the stand-alone *Customer* for the three regressions, in the range of 4.9% and 7.0%, suggests a contribution of environmentally sensitive customers to profit margin in the lowest energy-intensive firms, regardless of energy efficiency improvements. For the whole sample, the sum of the coefficients of *Customer* and the interaction terms is 0.7%, − 4.9%, and − 7.9% for the 2nd, 3rd, and 4th quantiles, respectively. The impact of customers' environmental concerns becomes negative for firms in the 3rd and 4th energy-intensity quantiles. As such, we failed to reject Hypothesis 2a (H2a).

The regression results in Table 5 suggest that, for green firms, customer environmental concerns raise the profit margin by 5.5% for firms in the 1st and 2nd energy intensity quantile groups,[6] and reduce the profit margin for firms in the 3rd and 4th energy intensity quantile groups. For ordinary firms, except for firms in the 1st energy intensity quantile group, customer environmental concerns reduce profit margins for firms in all other high quantile groups. In general, the reduction in profit margin for high energy-intensive firms is smaller for those with energy efficiency measures than for those without energy efficiency measures, supportive evidence for Hypothesis 2b (H2b).

We turned to the estimates of control variables. For the regressions for Models A and B, most of the control variables are significant, indicating that they, together with the environmental variables, adequately explain the variance in profit margins. For the quantile variables for the level of competition, the estimation results indicate that, compared to the profit margins of firms in the 1st quantile, firms' profit margins decline monotonically as the competition increases from a moderate to a strong level (i.e., from the 2nd quantile to the 4th quantile). The size of *Competition-q9* (corresponding to firms with "too many competitors to count") is less negative than the other three quantiles. Firms might either exaggerate or did not wish to reveal their actual level of competition and instead reported: "too many competitors to count." In this region, the non-EU nations have a higher profit margin than the EU member states. The difference is smaller for green firms than ordinary firms. The stringent environmental regulations in the EU member states may lead to high pollution abatement costs, resulting in smaller profit margins.

[6] The interaction between the 2nd quantile and *Customer* is insignificant, indicating the same impacts of customer environmental concerns on profit margins for firms in the 1st and 2nd energy intensity quantile groups.

Table 2
Correlation matrix.

Variable	No.	1	2	3	4	5	6	7	8	9	10	11	12
Profit-Margin	1												
Measures	2	-0.1016***											
Customer	3	-0.0466***	0.2461***										
Energy-Intensity-q2	4	0.0255	-0.0109	-0.0266									
Energy-Intensity-q3	5	-0.0546***	-0.0003	-0.0232	-0.3332***								
Energy-Intensity-q4	6	-0.1525***	0.1335***	0.0642***	-0.3333***	-0.3333***							
Competition-q2	7	-0.0306*	0.0186	-0.0213	-0.0111	0.0941***	0.0466***						
Competition-q3	8	-0.0702***	0.0665***	0.0703***	-0.0002	0.0341*	0.1167***	-0.1840***					
Competition-q4	9	-0.0855***	0.1061***	0.0459***	0.0078	-0.0182	0.1530***	-0.1841***	-0.1840***				
Competition-q9	10	0.0974***	-0.1245***	-0.0479***	-0.0208	-0.0765***	-0.2720***	-0.3347***	-0.3345***	-0.3347***			
Exporter	11	0.008	0.1434***	0.1597***	0.0284*	-0.0535***	0.0961***	-0.0131	0.0379**	0.0251	-0.0984***		
Growth-q2	12	0.0036	-0.002	0.0049	0.0024	-0.0135	-0.0078	0.0019	-0.0061	-0.0005	0.0198	0.0000	
Growth-q3	13	0.0549***	-0.0073	0.0184	0.0400**	-0.0145	-0.0147	-0.0005	0.0033	0.0208	-0.0129	0.0612***	-0.3332***
Growth-q4	14	-0.0832***	0.0047	-0.0189	-0.0256	0.013	0.0068	0.0111	-0.0039	-0.0101	0.0009	0.0005	-0.3333***
Capacity-Utilization	15	-0.0905***	0.0671***	0.0163	-0.0034	0.0395**	0.0524***	0.0283*	0.0089	0.0217	-0.0214	0.0865***	0.0348*
Firm-Size: Medium	16	-0.0111	0.0242	-0.0098	-0.0424**	0.0039	0.0678***	0.0122	0.0275*	-0.0038	-0.0017	0.0123	-0.0308*
Firm-Size: Large	17	0.0408**	0.1318***	0.1453***	-0.024	-0.0551***	0.0819***	0.0198	-0.0043	-0.0128	-0.0507***	0.2993***	0.0004
Firm-Age	18	0.0262	0.1287***	0.1187***	-0.0012	-0.0461***	0.0731***	0.0277*	0.0334*	0.0565***	-0.0785***	0.1942***	0.0422**
Employee-Education	19	-0.011	-0.0217	0.0682***	-0.0695***	0.0691***	0.0085	0.0450***	0.0093	-0.0585***	0.0324*	-0.0722***	-0.0184
Manager-Experience	20	0.0380**	0.0413**	0.0036	0.0527***	-0.0084	-0.0087	-0.0104	0.0046	0.0611***	-0.0058	0.0889***	0.0410**
Legal-Status: Corporation	21	-0.1000***	0.0876***	0.0669***	0.0319*	0.0519***	0.0722***	0.0504***	0.0763***	0.0549***	-0.0804***	0.0156	-0.0044
Foreign-Owner	22	-0.0212	0.0937***	0.0944***	-0.0259	-0.0286*	0.0778***	0.0022	0.0318*	0.0006	-0.0652***	0.2583***	-0.0177
Location: Medium-City	23	0.0211	-0.1039***	-0.0437**	-0.0636***	0.0016	0.0044	-0.0314*	-0.0191	-0.0578***	0.0685***	-0.0764***	0.0127
Location: Big-City	24	0.2076***	-0.0605***	-0.0399**	0.0437**	0.0042	-0.1528***	-0.0284*	-0.0672***	-0.0387**	0.1413***	-0.0848***	-0.0035
Region: non-EU	25	0.1380***	-0.1059***	-0.0396**	-0.0547***	0.0751***	-0.0726***	0.003	-0.0779***	-0.1557***	0.1943***	-0.2537***	-0.0316*

		13	14	15	16	17	18	19	20	21	22	23	24
Growth-q4	14	-0.3333***											
Capacity-Utilization	15	0.0831***	-0.1111***										
Firm-Size: Medium	16	-0.0192	0.0063	0.0198									
Firm-Size: Large	17	0.1231***	-0.0291*	0.0562***	-0.4508***								
Firm-Age	18	0.0894***	0.0472***	0.0085	-0.0154	0.2309***							
Employee-Education	19	-0.0082	0.0206	0.0148	0.0243	0.0679***	-0.0629***						
Manager-Experience	20	0.0536***	-0.0144	0.0291*	0.0032	0.0135	0.2916***	-0.1178***					
Legal-Status: Corporation	21	0.0319*	-0.0490***	0.1027***	0.0347*	0.0652***	-0.0271*	0.1404***	0.0195				
Foreign-Owner	22	0.0233	-0.0014	0.0224	-0.018	0.2360***	0.0436**	-0.0038	-0.0590***	0.0126			
Location: Medium-City	23	-0.0405**	-0.0016	-0.0598***	-0.0048	-0.0303*	-0.0418**	0.0888***	-0.0680***	-0.0992***	-0.0444**		
Location: Big-City	24	0.0639***	-0.0528***	-0.0025	-0.0508***	0.0330*	-0.0466***	0.0849***	0.0461***	0.0910***	-0.0699***	-0.3444***	
Region: non-EU	25	-0.0285*	-0.0263	-0.1437***	-0.016	0.0325*	-0.1865***	0.2244***	-0.1545***	-0.0665***	-0.1196***	0.1734***	0.2808***

***, **, and * indicate significance at the 0.01, 0.05, and 0.1 level, respectively.

Table 3
Mean difference tests for *Profit-Margin*, *Customer*, and *Energy*, for firms with/without energy efficiency measures.

Variable	Whole sample	Green firms	Ordinary firms	Mean difference	
Profit-Margin	0.442	0.407	0.463	-0.056	***
Customer	0.176	0.296	0.103	0.193	***
Energy-q_1	0.250	0.183	0.292	-0.109	***
Energy-q_2	0.250	0.244	0.254	-0.010	
Energy-q_3	0.250	0.250	0.250	0.000	
Energy-q_4	0.250	0.324	0.205	0.119	***

***, **, and * indicate significance at the 0.01, 0.05, and 0.1 level, respectively.

Table 4
Estimation results of Model A.

Variable	Estimate	SE	
Intercept	0.476	0.027	***
Customer	-0.023	0.009	***
Energy-q_2	-0.063	0.011	***
Energy-q_3	-0.089	0.011	***
Energy-q_4	-0.123	0.011	***
Competition-q_2	-0.042	0.013	***
Competition-q_3	-0.056	0.013	***
Competition-q_4	-0.064	0.013	***
Competition-q_9	-0.043	0.011	***
Exporter	0.025	0.008	***
Growth-q_2	-0.016	0.010	*
Growth-q_3	0.002	0.010	
Growth-q_4	-0.055	0.010	***
Capacity-Utilization	-0.062	0.013	***
Firm-Size: Medium	0.020	0.008	**
Firm-Size: Large	0.027	0.010	***
Firm-Age	0.016	0.006	***
Employee-Education	-0.036	0.017	**
Manager-Experience	0.011	0.005	**
Legal-Status: Corporation	-0.049	0.008	***
Foreign-Owner	-0.006	0.012	
Location: Medium-City	0.039	0.009	***
Location: Big-City	0.112	0.009	***
Region: non-EU	0.045	0.010	***
Sector dummies	Yes		
Observations	5390		
Adj. R-squared	0.121		

***, **, and * indicate significance at the 0.01, 0.05, and 0.1 level, respectively.

5.3. Additional tests and robustness checks

We estimated the impact of customers' environmental concerns and energy intensity on profit margin. Like other ratio variables, the distribution of profit margin is asymmetric and right-skewed, which may bias the estimation results of the OLS regressions. As a robustness check, we applied Ferrari and Cribari-Neto (2004) beta regression approach to estimate Model B, the primary focus of this study. The beta regression approach controls for the asymmetries of the ratio variable by using the maximum likelihood estimation method, which is based on the beta distribution (Cribari-Neto & Zeileis, 2010). Table 6 reports the estimated marginal effects of the beta regressions. The results are generally consistent with the relevant OLS estimations, including, for example, the following: (a) that the green concerns positively affect the profitability of the lowest energy-intensity firms; (b) that for high energy-intensive firms, the green concerns effect is negative; (c) that low energy-intensive firms with energy efficiency measures are less positively affected by customer green concerns than those without energy efficiency measures; and (d) that the reduction in profit margins are higher for high energy-intensive firms with energy efficiency measures than for those without energy efficiency measures.

The estimation results in the previous section (and the robustness checks above) indicate that the effects of green concerns depend strongly on energy intensity, an indicator of environmental performance. As a robustness test, we further estimated Model B for heavy industry and light industry, using both the OLS approach and the beta regression.[7] Green practices vary across industries due to their unique contextual differences (Zhu, Sarkis, & Lai, 2008). Heavy industries are more reliant on energy inputs than light industries,

[7] The two types of industries have a similar profit margin, as shown in Appendix A2. The share of firms with eco-conscious customers is higher for heavy industries than light industries. In addition, heavy industries have a smaller share of firms with lower energy intensity and a higher share of firms with higher energy-intensity firms than light industries.

Table 5
Estimation results of Model B.

	Whole sample			Green firms			Ordinary firms		
Variable	Estimate	SE		Estimate	SE		Estimate	SE	
Intercept	0.434	0.027	***	0.449	0.045	***	0.404	0.035	***
Customer	0.049	0.018	***	0.055	0.024	**	0.070	0.028	**
Customer* Energy-q_2	-0.042	0.024	*	-0.024	0.031		-0.086	0.039	**
Customer* Energy-q_3	-0.098	0.025	***	-0.091	0.031	***	-0.103	0.040	***
Customer* Energy-q_4	-0.128	0.022	***	-0.122	0.029	***	-0.151	0.036	***
Competition-q_2	-0.045	0.013	***	-0.037	0.020	*	-0.049	0.017	***
Competition-q_3	-0.060	0.013	***	-0.037	0.019	**	-0.077	0.017	***
Competition-q_4	-0.070	0.013	***	-0.047	0.019	**	-0.085	0.017	***
Competition-q_9	-0.017	0.011		-0.041	0.018	**	-0.009	0.014	
Exporter	0.022	0.008	***	0.025	0.013	**	0.023	0.011	**
Growth-q_2	-0.014	0.010		-0.036	0.015	**	-0.003	0.013	
Growth-q_3	0.004	0.010		-0.024	0.016		0.019	0.013	
Growth-q_4	-0.056	0.010	***	-0.078	0.015	***	-0.042	0.013	***
Capacity-Utilization	-0.073	0.013	***	-0.089	0.022	***	-0.062	0.015	***
Firm-Size: Medium	0.017	0.008	**	-0.002	0.013		0.031	0.010	***
Firm-Size: Large	0.025	0.010	**	0.013	0.016		0.037	0.014	***
Firm-Age	0.014	0.006	**	0.012	0.010		0.022	0.009	**
Employee-Education	-0.036	0.017	**	-0.072	0.027	***	-0.017	0.022	
Manager-Experience	0.010	0.005	**	0.014	0.007	**	0.007	0.006	
Legal-Status: Corporation	-0.060	0.008	***	-0.040	0.013	***	-0.069	0.011	***
Foreign-Owner	-0.007	0.012		-0.006	0.016		-0.004	0.018	
Location: Medium-City	0.044	0.009	***	0.023	0.015		0.047	0.012	***
Location: Big-City	0.123	0.009	***	0.121	0.015	***	0.120	0.012	***
Region: non-EU	0.033	0.010	***	0.027	0.014	**	0.037	0.013	***
Sector dummies	Yes			Yes			Yes		
Observations	5390			2054			3336		
Adj. R-squared	0.1050			0.0975			0.1059		

***, **, and * indicate significance at the 0.01, 0.05, and 0.1 level, respectively.

Table 6
Robustness checks: estimation results of Model B, using beta regression.

	Whole sample			Green firms			Ordinary firms		
Variable	Estimate	SE		Estimate	SE		Estimate	SE	
Customer	0.040	0.017	**	0.043	0.022	**	0.066	0.027	**
Customer* Energy-q_2	-0.035	0.024		-0.019	0.030		-0.074	0.038	**
Customer* Energy-q_3	-0.087	0.023	***	-0.076	0.027	***	-0.101	0.038	***
Customer* Energy-q_4	-0.118	0.021	***	-0.110	0.025	***	-0.142	0.035	***
Competition-q_2	-0.038	0.012	***	-0.032	0.019	*	-0.041	0.016	**
Competition-q_3	-0.054	0.012	***	-0.034	0.018	**	-0.068	0.016	***
Competition-q_4	-0.064	0.012	***	-0.044	0.018	**	-0.077	0.017	***
Competition-q_9	-0.011	0.010		-0.036	0.017	**	-0.002	0.013	
Exporter	0.027	0.008	***	0.026	0.012	**	0.028	0.01	***
Growth-q_2	-0.010	0.010		-0.031	0.015	**	0.000	0.013	
Growth-q_3	0.014	0.010		-0.018	0.015		0.029	0.013	**
Growth-q_4	-0.049	0.010	***	-0.075	0.015	***	-0.034	0.013	***
Capacity-Utilization	-0.068	0.012	***	-0.081	0.021	***	-0.059	0.015	***
Firm-Size: Medium	0.019	0.008	**	0.006	0.014		0.029	0.01	***
Firm-Size: Large	0.027	0.010	***	0.017	0.016		0.037	0.013	***
Firm-Age	0.014	0.006	**	0.010	0.009		0.022	0.008	***
Employee-Education	-0.046	0.016	***	-0.080	0.026	***	-0.030	0.020	
Manager-Experience	0.009	0.005	**	0.015	0.007	**	0.005	0.006	
Legal-Status: Corporation	-0.055	0.008	***	-0.042	0.013	***	-0.059	0.01	***
Foreign-Owner	-0.003	0.012		-0.003	0.016		0.002	0.017	
Location: Medium-City	0.044	0.009	***	0.026	0.015	*	0.046	0.012	***
Location: Big-City	0.115	0.009	***	0.117	0.015	***	0.111	0.012	***
Region: non-EU	0.034	0.010	***	0.027	0.014	**	0.039	0.013	***
Sector dummies	Yes			Yes			Yes		
Observations	5390			2054			3336		
R-squared	0.1060			0.1078			0.1124		

***, **, and * indicate significance at the 0.01, 0.05, and 0.1 level, respectively.

which subsequently entail different energy intensities and environmental activities (Li & Lin, 2016). Nevertheless, light industries are more consumer-oriented than heavy industries, which may lead to different impacts of customers' environmental concerns on firm environmental behavior and purchasing patterns in response to producers' greenness. Table 7 presents the estimation results. In terms of the significant level of the interaction terms, the estimated coefficients from the OLS and beta regressions are not substantially different. Therefore, we briefly discussed the estimation results from the OLS regressions. For heavy industries, environmentally concerned customers raise profit margins for firms in the 1st and 2nd energy-intensity quantiles and lower profit margins for firms in the 3rd and 4th quantiles. This indicates that consumers relate firms' energy consumption to the greenness levels and reward firms that demonstrate good environmental performance. For light industries, while there is no green concerns effect for the low energy-intensive firms, green concerns reduce the profit margins of high energy-intensive firms. High energy-intensive firms in heavy industries are more affected by green concerns than those in light industries, relative to their respective base, which is likely attributed to the differences in their production processes and their target markets. Energy intensity may not sufficiently represent the greenness of firms in light industries. Additionally, light industries operate in a more consumer-oriented market, where customer concerns are less likely reflected in the price and demand, compared to the equipment and facilities markets for firms in heavy industries.

6. Discussion

In the literature, researchers have evaluated the impact of green practices along the supply chain on financial performance using multidimensional measures of green practices and firm performance. This study differs from the existing literature by focusing on customer environmental concerns and their impact on profit margin. The importance of customer environmental concerns is well recognized by policymakers, industries, and researchers, specifically regarding its initiative role in green practices (Larri et al., 2016) and its mediating role in the GSCM–financial performance linkage (Gong et al., 2019; Nouira et al., 2014). A firm's environmental activities beyond the commitment to regulatory pressure is a proactive strategy to improve eco-conscious customers' satisfaction (Tang & Gekara, 2020). Theoretically, green products differentiate themselves from conventional products, resulting in a less elastic demand, which, accompanied by consumers' willingness to pay more for green products, may enhance firms' profit margins.

However, the impacts of customer environmental concerns on financial performance may depend on firms' environmental impacts. High-polluting firms trigger consumers' concerns over environmental factors, which may not lead to increased demand and price premiums. We used energy consumption as a proxy for the level of greenness, based on the correlation between energy consumption and pollution emissions (Aller et al., 2018). In addition, high-polluting firms require higher environmental investments, resulting in a reduction in profit margins and low efficiency of environmental activities. Accordingly, we estimated the model for firms with energy efficiency measures (green firms) and firms without energy efficiency measures (ordinary firms) to test the correlation between green concerns effects and firms' greenness.

The key findings of this study are as follows. First, for the whole sample, the impact of customer environmental concerns is significant and negative, likely due to the increased environmental costs that offset the positive impact of the demand for greenness or the gap between ethical intentions and ethical consumption (Carrington et al., 2010). The estimation results for variables of energy intensity show that high energy-intensive firms have a relatively small profit margin, indicating the impact of environmental costs and/or the lack of pro-environmental consumption of their products.

Second, after adding the interaction terms to the model for the whole sample, the estimation results confirm a monotonic inverse relationship between the degree of energy intensity and the green concerns' effects. As documented by Ajamieh, Benitez, Braojos, and Gelhard (2016), green practices may reduce operational costs such as the consumption of raw materials through improved cross-functional cooperation for environmental improvement. While customer environmental concerns raise profitability for firms with the lowest energy consumption, it undermines profitability for high energy-intensive firms. The impact of eco-conscious customers depends on the level of energy intensity, possibly reflecting differences in both benefits and costs of green practices for firms with different levels of energy intensity.

Third, customer environmental concerns reduce the profit margins of ordinary firms more than that of green firms, for the group of firms with high energy intensity, although customer environmental concerns have a higher positive impact on low energy-intensive firms for the ordinary firm group than for the green firm group. As such, we provided an alternative reason to explain why some firms do not implement cost-efficiency energy efficiency technologies, i.e., the "efficiency paradox" (DeCanio, 1998). In this study, customer environmental concerns are based on whether a firm's customers require environmental certifications or adherence to certain environmental standards before they decide to purchase. Therefore, customers' environmental requirements may indicate poor environmental performance, which motivates firms to invest in environmental activities. Increased income due to additional demand and price premiums is probably not sufficient to cover environmental costs, resulting in a smaller profit margin and hence a lower efficiency of environmental activities.

In general, our empirical findings indicate that the direction and size of the green effects depend on the level of greenness in production processes, a perspective that contributes to the literature's ambiguous impact of GSCM on financial performance. Although researchers controlled for environmental performance when evaluating the impact of GSCM on firm performance (Feng et al., 2018; Laari et al., 2016; Ozusaglam et al., 2018), they did not consider the various impacts of GSCM across firms with different levels of pollution and environmental performance. The negative impact of the green concerns on high energy-intensive firms may undermine the contribution of green practices to profitability for those firms. The different impacts of green concerns on firms with different levels of greenness further render the evaluation of green practices in all types of firms indeterminate.

Finally, the estimation results indicate that, for either green firms or ordinary firms, customer environmental concerns reduce profit margins for firms with high energy intensity, reflecting a low efficiency of environmental investments for these firms. This also

Table 7
Robustness checks: estimation results of Model B for heavy and light industries.

	Heavy industry						Light industry					
	OLS			Beta regression			OLS			Beta regression		
Variable	Estimate	SE		Estimate	SE		Estimate	SE		Estimate	SE	
Intercept	0.440	0.044	***				0.454	0.037	***			
Customer	0.087	0.029	***	0.067	0.029	**	0.029	0.023		0.028	0.022	
Customer* Energy-q_2	-0.068	0.035	**	-0.052	0.035		-0.044	0.036		-0.036	0.036	
Customer* Energy-q_3	-0.137	0.036	***	-0.113	0.035	***	-0.075	0.034	**	-0.072	0.031	**
Customer* Energy-q_4	-0.176	0.033	***	-0.152	0.031	***	-0.092	0.031	***	-0.090	0.030	***
Competition-q_2	-0.044	0.017	***	-0.036	0.017	**	-0.044	0.019	**	-0.040	0.018	**
Competition-q_3	-0.063	0.017	***	-0.058	0.017	***	-0.056	0.019	***	-0.049	0.018	***
Competition-q_4	-0.071	0.017	***	-0.063	0.017	***	-0.069	0.018	***	-0.066	0.017	***
Competition-q_9	-0.035	0.016	**	-0.022	0.015		-0.003	0.016		-0.001	0.014	
Exporter	0.040	0.012	***	0.046	0.012	***	0.008	0.011		0.012	0.011	
Growth-q_2	0.004	0.014		0.009	0.014		-0.031	0.014	**	-0.025	0.014	*
Growth-q_3	0.031	0.015	**	0.048	0.014	***	-0.019	0.014		-0.016	0.014	
Growth-q_4	-0.050	0.014	***	-0.041	0.014	***	-0.060	0.014	***	-0.055	0.014	***
Capacity-Utilization	-0.041	0.018	**	-0.038	0.018	**	-0.099	0.017	***	-0.091	0.016	***
Firm-Size: Medium	0.002	0.011		0.005	0.012		0.031	0.012	***	0.033	0.012	***
Firm-Size: Large	0.013	0.015		0.021	0.015		0.040	0.014	***	0.036	0.014	**
Firm-Age	0.000	0.009		-0.003	0.009		0.026	0.009	***	0.026	0.009	***
Employee-Education	-0.025	0.023		-0.036	0.022	*	-0.051	0.025	**	-0.062	0.023	***
Manager-Experience	0.019	0.007	***	0.021	0.007	***	0.004	0.007		0.002	0.006	
Legal-Status: Corporation	-0.052	0.013	***	-0.047	0.013	***	-0.066	0.011	***	-0.061	0.011	***
Foreign-Owner	-0.015	0.016		-0.013	0.016		-0.002	0.018		0.005	0.017	
Location: Medium-City	0.023	0.014	*	0.024	0.014	*	0.057	0.012	***	0.055	0.012	***
Location: Big-City	0.108	0.014	***	0.099	0.013	***	0.132	0.013	***	0.123	0.013	***
Region: non-EU	0.062	0.015	***	0.066	0.014	***	0.010	0.014		0.011	0.014	
Sector dummies	Yes			Yes			Yes			Yes		
Observations	2544			2544			2846			2846		
R-squared	0.1189			0.1184			0.1089			0.109		

***, **, and * indicate significance at the 0.01, 0.05, and 0.1 level, respectively.

confirms that firms need a long time to realize returns on environmental investments, as observed by Horváthová (2012). Promoting customer environmental concerns can be a successful strategy to promote the demand for greenness and hence accelerate returns on environmental investments. Demand-driven incentives of green practices are recommended by the researchers (Hammami et al., 2018; Nouira et al., 2014; Yang et al., 2017). Environmental information provides exchange channels with external stakeholders, such as customers, and hence stimulates the green demand. This is particularly important from a practice standpoint for light industries, where the low (high) energy-intensive firm are less rewarded (punished) by eco-conscious customers.

7. Conclusions

Although extant literature has examined the role of customer environmental concerns in firms' green supply chain management, little empirical research has been conducted to evaluate the impact of customer environmental concerns on firm financial performance and how this impact relies on the degree of production greenness. Our empirical findings from a sample of 5390 manufacturing firms in Central and Eastern Europe and Central Asia indicate that green concerns effects vary across firms with different greenness levels (represented by energy consumption). Our findings show an inverse relationship between green concerns effects and greenness levels, providing for firms to improve greenness. Environmental investments, represented by energy efficiency measures, may alleviate consumer environmental concerns. However, green concerns do not benefit firms with high energy intensity, regardless of environmental investments. This implies that the benefits of green concerns are not sufficient to improve environmental efficiency. From the perceptive of firms, marketing tactics with a focus on environmental information and knowledge may help customers form accurate price perceptions of green products. From the perceptive of policymakers, a well-designed subsidy policy targeting firms' greenness levels and environmental investments would help motivate environmental practices and enhance environmental efficiency. Since profit margin is a component of return on assets (Zhang, Xie, & Sikveland, 2021), our study further provides implications for investors when they assess environmental risk or benefits of impact investment.

Although this study contributes to the literature in several ways, it does have some limitations that highlight potential future research directions. First, we focused on one element of GSCM, customer environmental concerns, and evaluated its impact on profit margins. Although we uncovered the channels through which green concerns affect profit margins, other benefits such as market shares may provide insight on how market conditions affect green concerns effects more specifically. In addition, we measured customers' environmental concerns through their environmental requirements. There may be other factors reflecting customers' environmental concerns. Second, we tested how green concerns' effects vary across firms with different levels of greenness (energy intensity) in production processes. A measure of greenness based on product attributes remains an avenue for future research. Third, our empirical results indicate that green concerns do not reward firms that have implemented environmental investments (energy

efficiency measures). In fact, firms with environmental investments are less profitable, indicating a lower efficiency of environmental investments. There is, therefore, an urgent need to better understand the inputs of environmental practices along the supply chain in order to address this low-efficiency issue.

Declaration of interest statement

None.

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Appendix A1. Sample distribution by country and manufacturing subsector

	ISIC:																				
Country	15	17	18	19	20	21	22	24	25	26	27	28	29	31	32	33	34	35	36	37	Sum
Albania	17	0	35	15	0	3	4	3	2	5	0	6	1	0	0	0	0	0	4	0	95
Belarus	82	21	66	2	7	3	7	8	15	6	0	7	11	5	0	5	4	0	15	2	266
Bosnia and Herzegovina	12	1	2	2	9	3	5	1	5	7	1	10	3	1	0	0	0	0	11	0	73
Czech Republic	50	7	1	0	3	0	3	8	21	9	2	68	63	4	4	7	11	0	10	1	272
Estonia	15	8	13	1	13	2	6	1	4	3	0	17	9	4	0	3	1	1	13	1	115
Georgia	54	0	6	0	2	0	4	6	1	11	3	4	0	0	0	1	0	0	9	0	101
Hungary	94	8	7	6	7	5	8	7	16	5	4	111	83	9	1	5	10	2	7	0	395
Kazakhstan	106	11	33	2	6	5	17	15	39	83	3	62	30	9	0	2	2	2	10	0	437
Kyrgyz	26	6	5	2	0	1	11	3	1	22	0	5	1	0	0	1	1	0	2	0	87
Latvia	17	0	5	0	22	2	10	4	4	3	0	8	4	5	0	1	3	0	13	0	101
Moldova	49	1	12	4	3	2	3	3	6	4	0	4	4	2	1	2	0	0	5	0	105
Mongolia	42	9	10	5	12	2	6	2	2	13	2	1	2	0	0	0	0	0	2	0	110
Montenegro	14	1	0	1	7	1	6	1	0	2	0	3	1	0	0	0	0	0	8	0	45
Morocco	86	12	128	8	3	2	12	11	8	16	4	15	7	6	1	1	1	1	10	1	333
North Macedonia	21	5	17	5	2	2	1	2	5	1	1	4	3	2	0	0	1	1	4	0	77
Poland	30	3	29	2	3	1	7	0	30	4	0	28	17	6	0	3	0	2	36	7	208
Republic of Cyprus	27	0	0	0	2	0	4	4	3	5	0	7	1	0	0	0	0	0	7	0	60
Russia	95	3	87	1	10	4	17	21	22	87	3	88	92	15	1	7	7	6	7	9	582
Serbia	23	2	4	4	0	3	4	7	4	4	2	8	2	3	0	0	1	0	3	0	74
Slovenia	12	2	2	1	7	3	7	6	13	8	7	23	18	4	4	6	4	1	3	1	132
Tajikistan	13	6	4	0	3	0	5	0	5	5	0	0	1	0	0	0	1	0	1	0	44
Turkey	130	131	109	4	5	3	6	42	12	52	13	106	102	5	2	9	5	0	20	2	758
Turkish Cypriot Community	8	1	2	0	0	0	1	0	5	3	0	2	2	0	0	0	0	0	5	3	32
Ukraine	87	6	74	4	14	2	8	9	19	66	6	71	84	20	5	8	7	5	15	0	510
Uzbekistan	84	49	40	4	3	6	7	20	47	73	4	14	4	4	0	1	6	3	8	1	378
Sum	1194	293	691	73	143	55	169	184	289	497	55	672	545	104	19	62	65	24	228	28	5390

The categories (codes) of manufacturing sectors are based on ISIC, namely 15: Food, 17: Textiles, 18: Garments, 19: Leather, 20: Wood, 21: Paper, 22: Publishing, printing, and Recorded media, 24: Chemicals, 25: Plastics & rubber, 26: Non-metallic mineral products, 27: Basic metals, 28: Fabricated metal products, 29: Machinery and equipment, 31: Electronics, 32: Communication equipment, 33: Medical instruments, 34: Motor vehicles, 35: Transport equipment, 36: Furniture, and 37: Recycling.

Appendix A2. Mean difference tests for *Profit-Margin*, *Customer*, and *Energy*, for heavy and light industries

Variable	Whole sample	Heavy industry	Light industry	Mean difference	
Profit-Margin	0.442	0.441	0.442	0.000	
Customer	0.176	0.196	0.159	0.037	***
Energy-q_1	0.250	0.178	0.314	-0.136	***
Energy-q_2	0.250	0.294	0.210	0.084	***
Energy-q_3	0.250	0.240	0.259	-0.018	
Energy-q_4	0.250	0.287	0.217	0.071	***

Notes: ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 level, respectively.

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