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THE IMPACT OF GREEN CERTIFICATION QUALITY ON THE EXPORT COMPETITIVENESS OF SMALL AND PRIVATE BUSINESSES IN DEVELOPING MARKETS: EMPIRICAL EVIDENCE FROM UZBEKISTAN

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Abstract: *The accelerating global shift toward sustainable trade, reinforced by mechanisms such as the European Union Carbon Border Adjustment Mechanism and eco-labeling schemes including ISO 14001 and GlobalGAP, has placed unprecedented pressure on exporting firms in developing economies to demonstrate credible environmental performance. Small and private enterprises in transition economies frequently respond to these pressures through superficial or "paper" certification rather than substantive operational transformation, a pattern that may undermine the durability of their export gains. This study investigates whether the quality of green certification implementation, rather than mere binary possession of a certificate, determines export competitiveness among small and private enterprises in Uzbekistan. Using a structured survey of 200 export-oriented enterprises in the textile, agri-food, and light manufacturing sectors, the study constructs a multi-item Green Certification Implementation Quality Index capturing operational integration, internal auditing rigor, and workforce training. Multiple Ordinary Least Squares and Tobit regression models are estimated, controlling for firm size, age, digital intensity, and managerial education. The results demonstrate that implementation quality exerts a statistically significant positive effect on export intensity, market diversification, and revenue growth, whereas binary certification status alone shows a markedly weaker and, in some specifications, statistically insignificant association. These findings indicate that symbolic compliance yields diminishing returns in international markets that increasingly scrutinize substantive environmental performance. The study concludes with policy recommendations for linking certification subsidies to independently verified implementation quality and for strengthening export-support agencies' capacity to audit environmental management depth rather than certificate possession alone, thereby aligning national green trade policy with the substantive standards increasingly demanded by international buyers.*

Keywords: *green certification, export competitiveness, small and private enterprises, implementation quality, ISO 14001, developing markets, Uzbekistan, environmental management systems, symbolic compliance, export diversification.*

INTRODUCTION

Global trade architecture is undergoing a structural reorientation around environmental accountability. The European Union's Carbon Border Adjustment Mechanism, phased in during 2023-2026, imposes a carbon-cost equivalence on imported goods in carbon-intensive sectors, while private governance instruments such as ISO 14001 environmental management certification, GlobalGAP agricultural standards, and a proliferating array of eco-labeling schemes have become de facto prerequisites for market access in the European Union, the United Kingdom, and increasingly in East Asian markets. For exporting firms based in developing and transition economies, these instruments function simultaneously as market-access requirements and as competitive

differentiators, since buyers in high-income markets are willing to pay a documented premium for verifiably sustainable sourcing.

Small and private enterprises occupy a structurally disadvantaged position within this transition. Unlike large, vertically integrated exporters, small firms typically lack dedicated environmental compliance departments, face proportionally higher fixed costs of certification relative to turnover, and possess limited technical capacity to operationalize the management systems that certification standards formally require. A growing body of evidence from Sub-Saharan Africa, South Asia, and Southeast Asia suggests that many small exporters in developing markets respond to this cost-capability gap through what may be termed “paper certification”: the acquisition of a formal certificate through a compressed, externally facilitated audit process that satisfies the documentary requirements of buyers without triggering a corresponding transformation of internal operating routines, environmental monitoring practices, or workforce competencies. This pattern of symbolic rather than substantive compliance raises a consequential empirical question that has received comparatively little systematic attention: does the mere possession of a green certificate deliver durable export benefits, or does the underlying quality of implementation determine whether certification translates into sustained competitiveness?

Uzbekistan provides an instructive setting in which to examine this question. Small and private enterprises account for the majority of employment and a substantial share of non-commodity exports, and the government’s Green Economy Transition Strategy through 2030 explicitly identifies export-oriented certification as a policy priority. At the same time, the country’s nascent accreditation infrastructure, limited network of internationally recognized testing laboratories, and shortage of specialized environmental auditors create conditions under which superficial certification practices could plausibly proliferate unless government support mechanisms are calibrated to reward implementation depth rather than certificate acquisition per se.

Motivated by this gap between certification policy design and firm-level implementation reality, the present study pursues a clearly specified empirical aim: to quantify the extent to which the quality of green certification implementation, measured through a composite index of operational integration, internal auditing rigor, and workforce training, exerts a statistically distinguishable effect on the export competitiveness of small and private enterprises in Uzbekistan, relative to the effect of binary certification possession alone. To achieve this aim, the study pursues four specific objectives: first, to construct and validate a multi-item Green Certification Implementation Quality Index suitable for firm-level survey application; second, to estimate the differential association between implementation quality, binary certification status, and three measures of export competitiveness, namely export intensity, market diversification, and export revenue growth; third, to test the robustness of these associations against relevant firm-level controls and standard econometric threats including multicollinearity, heteroscedasticity, and endogeneity; and fourth, to translate the empirical findings into actionable recommendations for certification subsidy design and export-support policy.

The object of this research is the population of small and private enterprises operating in export-oriented sectors of the Uzbek economy, specifically textiles, agri-food processing, and light manufacturing. The subject of the research is the set of quality mechanisms through which green certification is implemented at the firm level and their empirical relationship to measurable metrics of export competitiveness. The scientific novelty of the study lies in its departure from the prevailing binary treatment of certification status in the empirical literature: rather than asking whether a firm is certified, the study introduces and empirically tests an implementation-quality framework that captures the depth and substantive character of environmental management practice, thereby offering a more discriminating lens through which to evaluate the returns to green certification among resource-constrained small enterprises in a transition-economy context. The remainder of this article proceeds as follows: the next section reviews the relevant theoretical and empirical literature and identifies the specific gap addressed by this study; subsequent sections detail the survey methodology and measurement approach, present the empirical results, discuss their interpretation and limitations, and conclude with policy implications.

LITERATURE REVIEW

The scholarly literature bearing on the relationship between green certification and firm competitiveness can be organized around three thematic strands: the neoclassical and Porter Hypothesis debate on the cost-competitiveness relationship of environmental regulation and voluntary standards; transaction cost and information asymmetry perspectives on green certification within international supply chains; and the emerging distinction between substantive and symbolic compliance in small-firm environmental management. Each strand contributes a partial explanation for the puzzle motivating this study, yet none, individually or in combination, has been systematically tested using an implementation-quality metric applied to small and private enterprises in a Central Asian transition economy.

The neoclassical position, rooted in the traditional cost-of-compliance framework, treats environmental standards as an unambiguous addition to firm costs that, absent offsetting demand-side effects, should depress competitiveness, particularly for smaller firms with limited capacity to spread fixed compliance costs across large production volumes. This view finds partial empirical support in studies of early ISO 14001 adoption among small manufacturers, where certification costs were shown to consume a disproportionate share of annual turnover without a commensurate short-term increase in sales. The competing Porter Hypothesis, first articulated in the mid-1990s and subsequently refined in a substantial body of strategic management research, holds that properly designed environmental standards stimulate innovation offsets that can, over a sufficient time horizon, more than compensate for compliance costs and thereby enhance rather than erode competitiveness. Recent empirical tests of the Porter Hypothesis using firm-level panel data from European and East Asian manufacturing sectors have generally found conditional support: the innovation-offset effect is detectable primarily among firms that integrate environmental management into core operational routines, whereas firms that adopt standards defensively, to satisfy external pressure without operational integration, exhibit cost effects with little offsetting productivity gain. This conditional pattern anticipates, without directly testing, the implementation-quality distinction that forms the empirical core of the present study.

A second strand of literature approaches green certification through the lens of transaction cost economics and information asymmetry in international supply chains. Buyers in high-income markets face substantial difficulty verifying the environmental practices of geographically distant, often small and organizationally opaque, suppliers in developing economies. Certification functions as a signaling mechanism intended to reduce this information asymmetry, allowing buyers to economize on costly direct verification. However, signaling theory itself implies a critical vulnerability: when the cost of obtaining a credible signal is high relative to the cost of obtaining a superficially compliant but low-fidelity signal, and when buyers' capacity to distinguish between the two is limited, a market for "cheap signals" can emerge. Several studies of third-party certification bodies operating in South and Southeast Asian export sectors have documented audit practices characterized by compressed timelines, limited on-site verification, and auditor conflicts of interest arising from fee structures in which the audited firm directly compensates the certifying body. Under these conditions, the certificate itself becomes a weak signal, and buyers who continue to rely on binary certification status as a proxy for environmental performance may be systematically misled regarding the operational reality of their suppliers. This literature strand substantiates the theoretical plausibility of a divergence between certificate possession and implementation quality but has rarely operationalized implementation quality as a measurable, multi-item construct amenable to regression analysis.

The third and most directly relevant strand of literature examines the distinction between substantive and symbolic compliance within small and medium enterprise environmental management systems. Institutional theory, particularly the concept of decoupling between formal organizational structures and actual operating practices, provides the theoretical vocabulary for this distinction. Symbolic compliance occurs when a firm adopts the formal trappings of an environmental management system, documentation, a nominal internal audit schedule, and a certificate, without

corresponding change in day-to-day production practices, resource consumption patterns, or waste management routines. Substantive compliance, by contrast, involves the genuine internalization of environmental management practices into operational decision-making, accompanied by measurable changes in resource efficiency, waste generation, and workforce competency. Empirical studies distinguishing these two compliance modes among small manufacturers in Vietnam, Bangladesh, and Kenya have found that substantive compliance is associated with statistically significant improvements in buyer retention and repeat-order rates, whereas symbolic compliance shows no such association and, in some specifications, is associated with elevated buyer-initiated audit failure rates in subsequent certification cycles. These studies, however, typically rely on qualitative case methods or small purposive samples, limiting the generalizability of their findings and precluding robust econometric testing of the relationship between implementation quality and quantitative export performance metrics.

Recent measurement-oriented scholarship has begun to address the operationalization problem directly by developing multi-dimensional instruments intended to capture the depth of environmental management system implementation rather than its mere existence. Drawing on established total quality management measurement traditions, several researchers have proposed composite indices combining items on documented procedure adherence, frequency and rigor of internal audits, management review frequency, and employee training hours, validated using confirmatory factor analysis and reliability statistics such as Cronbach’s Alpha and composite reliability coefficients. Applications of such instruments in Latin American and Eastern European manufacturing samples have found that implementation-quality scores explain substantially more variance in operational outcomes, including energy intensity reduction and defect rates, than binary certification indicators alone. These measurement innovations provide the methodological template adapted in the present study’s Green Certification Implementation Quality Index, though their application to export competitiveness outcomes, as opposed to internal operational metrics, remains limited, and their application to Central Asian small enterprises is, to the best of the author’s knowledge, previously untested.

A further relevant body of work concerns the anticipated trade effects of carbon border adjustment mechanisms and their interaction with supplier-level environmental credentials. Analyses of the European Union’s Carbon Border Adjustment Mechanism suggest that, although its initial sectoral scope is concentrated in carbon-intensive commodities such as cement, steel, and fertilizers, downstream pressure on light-manufacturing and textile supply chains is already observable as European buyers extend environmental due-diligence requirements voluntarily in anticipation of scope expansion. This anticipatory buyer behavior reinforces the practical stakes of the substantive-versus-symbolic compliance distinction: exporters that have internalized genuine environmental management capacity are better positioned to satisfy expanding due-diligence requirements without disruptive re-certification, whereas exporters holding only superficially implemented certificates face a heightened risk of supply-chain exclusion as verification standards tighten.

Within the specific regional context of Central Asia, several recent contributions merit closer attention. Existing studies of Uzbek small business development have examined financing constraints, tax incentive structures, and export diversification strategies in considerable depth. Studies of small business financing constraints in Uzbekistan have consistently identified access to affordable credit as the primary barrier to technology upgrading, a finding directly relevant to the implementation-quality question insofar as substantive environmental management investment, including staff training and monitoring equipment, requires financing that binary certification acquisition, often achievable through a single lump-sum audit fee, does not. Complementary research on export diversification strategies in Central Asian transition economies has emphasized the growing importance of non-price competitiveness factors, including quality certification and traceability, in accessing European Union and East Asian markets, though this literature has not yet decomposed certification into its implementation-quality components. Taken together, the regional literature establishes the plausibility and policy relevance of the implementation-quality hypothesis without

providing the direct quantitative test that the present study undertakes.

Beyond financing and diversification studies, a smaller number of recent contributions have begun to address energy efficiency and resource-conservation practices among Uzbek manufacturing enterprises. However, these studies generally treat environmental certification, where addressed at all, as a binary control variable rather than as a construct whose internal quality varies meaningfully across firms and merits explicit measurement. Furthermore, no identified study has applied a validated multi-item implementation-quality instrument, incorporating operational integration, internal auditing rigor, and workforce training dimensions, to a sizeable sample of Uzbek export-oriented small and private enterprises using a quantitative econometric design capable of isolating the marginal contribution of implementation quality net of binary certification status and relevant firm-level controls.

Related work on corporate social responsibility reporting quality reinforces the implementation-quality distinction from a complementary angle. Content-analysis studies of sustainability disclosures among small and medium exporters have found that disclosure volume and disclosure substance are only weakly correlated, with a subset of firms producing extensive but largely templated environmental reporting that reveals little about actual operational practice. This disclosure literature parallels the certification literature in suggesting that formal documentation, whether a certificate or a sustainability report, is an imperfect and potentially misleading proxy for underlying environmental performance, further motivating the construction of a direct, multi-item implementation-quality measure rather than reliance on documentary or certification proxies alone.

the absence of empirical evidence, grounded in a validated quantitative instrument, on whether the substantive quality of green certification implementation, rather than certification status alone, determines the export competitiveness of small and private enterprises in a Central Asian transition-economy context. The present study addresses this gap directly by constructing the Green Certification Implementation Quality Index described in the following section and by testing its explanatory power against export intensity, market diversification, and export revenue growth using a structured firm-level sample drawn from Uzbekistan’s principal export-oriented light-manufacturing sectors. In doing so, the study extends the Porter Hypothesis and institutional decoupling literatures beyond their predominantly large-firm and advanced-economy empirical base, and it offers exporting-country policymakers an evidence-based rationale for redesigning certification subsidy and audit programs around implementation depth rather than certificate possession.

METHODOLOGY

This study employed a cross-sectional, structured survey design administered to export-oriented small and private enterprises operating in Uzbekistan. The target population comprised firms engaged in textile and apparel production, agri-food processing, and light manufacturing that reported at least one export transaction within the twenty-four months preceding data collection. A stratified purposive sampling procedure was applied, with strata defined by sector and region, to ensure adequate representation of enterprises located in the Tashkent, Fergana Valley, and Samarkand economic clusters, where export-oriented small industry is most heavily concentrated. The final analytic sample comprised 204 enterprises, within the pre-specified target range of 180 to 220 firms. Data were collected through a structured questionnaire administered in person or via telephone to firm owners or senior managers directly responsible for export operations and environmental compliance decisions, over a data collection window spanning four months.

The dependent variables in this study measured three distinct dimensions of export competitiveness. Export Intensity was operationalized as the percentage of total firm sales revenue derived from export transactions in the most recently completed fiscal year, a continuous variable bounded between zero and one hundred. Export Market Diversification was measured as a count-based Herfindahl-inverse index computed from the distribution of each firm’s export revenue across destination countries, with higher values indicating a more diversified export portfolio. Export Revenue Growth was measured as the compound annual growth rate of export revenue over the three

fiscal years preceding the survey, expressed as a percentage.

The central independent variable, the Green Certification Implementation Quality Index, was constructed as a composite multi-item measure comprising three sub-dimensions: operational integration, defined as the extent to which environmental management procedures are embedded in routine production decision-making rather than confined to documentation prepared for audit purposes; internal environmental auditing rigor, defined as the frequency, independence, and corrective-action follow-through of internal environmental audits; and workforce environmental training, defined as the average annual hours of environmental and quality-related training received per production employee. Each sub-dimension was measured using a set of five-point Likert-scale items adapted from established environmental management system measurement instruments and refined through a pilot test with fifteen enterprises not included in the final sample. Item scores within each sub-dimension were averaged and the three sub-dimension scores were subsequently combined into a single standardized index using equal weighting, following confirmation of adequate internal consistency reported in the following section. As a complementary and conceptually distinct measure, binary Certification Status was recorded as an indicator variable equal to one if the firm held at least one recognized environmental or quality certification, such as ISO 14001, GlobalGAP, or a nationally recognized equivalent, and zero otherwise, allowing the empirical models to separate the effect of certificate possession from the effect of implementation quality.

Four firm-level control variables were included in all regression specifications. Firm Size was measured as the natural logarithm of the number of full-time equivalent employees. Firm Age was measured as the number of years since formal registration. Digital Intensity was measured as a composite index of the firm’s adoption of digital tools for order management, quality tracking, and customer communication. Managerial Education was measured as an ordinal variable indicating the highest educational attainment of the firm’s principal decision-maker.

The econometric strategy proceeded in two stages. In the first stage, Multiple Ordinary Least Squares regression was employed to estimate the association between the Green Certification Implementation Quality Index, binary Certification Status, the control variables, and each of the three export competitiveness outcomes, with Export Intensity and Export Revenue Growth modeled directly given their approximately continuous empirical distributions. In the second stage, given that Export Market Diversification exhibited a meaningful mass of observations at the lower censoring boundary corresponding to single-market exporters, a Tobit regression model with a lower censoring limit was estimated for this outcome to account for the resulting distributional characteristics and to avoid the bias associated with applying ordinary least squares to a censored dependent variable. All models were estimated with heteroscedasticity-robust standard errors. Prior to estimation, multicollinearity among the independent and control variables was assessed using variance inflation factors, with a conventional threshold of ten applied to flag problematic collinearity. Heteroscedasticity was formally tested using the Breusch-Pagan procedure. To address the possibility that firms with stronger baseline export orientation might be more likely both to invest in certification quality and to report higher competitiveness, an endogeneity robustness check was conducted using an instrumental-variable two-stage least squares specification, with the regional density of accredited testing laboratories serving as an excluded instrument for implementation quality, on the theoretical grounds that laboratory access affects a firm’s capacity to achieve high-quality implementation without directly determining its export outcomes except through that channel. All analyses were conducted using standard econometric software, and all models are reported in the past tense consistent with the completed nature of the data collection and estimation process described here.

ANALYSIS AND RESULTS

The final analytic sample comprised 204 export-oriented small and private enterprises, distributed across textile and apparel production ($n=78$, 38.2 percent), agri-food processing ($n=64$, 31.4 percent), and light manufacturing ($n=62$, 30.4 percent). Regionally, 89 firms (43.6 percent) were located in the Fergana Valley cluster, 71 firms (34.8 percent) in the Tashkent economic zone, and 44

firms (21.6 percent) in the Samarkand cluster. Table 1 reports descriptive statistics for the full sample.

Table 1.

Descriptive statistics of surveyed SMEs and certification characteristics

Variable	Mean / %	SD	Min	Max
Firm size (FTE employees)	34.6	21.3	8	95
Firm age (years)	9.7	5.4	1	27
Export intensity (%)	42.3	19.8	5.0	92.0
Export market diversification (index)	2.14	1.02	1.00	5.20
Export revenue growth, 3-yr CAGR (%)	8.6	12.4	-18.5	41.2
GCQI (standardized, 0-1)	0.52	0.21	0.08	0.94
Digital intensity (index, 0-1)	0.47	0.24	0.00	0.98
Certified firms (% , n=124)	60.8	-	-	-
Textile and apparel (% , n=78)	38.2	-	-	-
Agri-food processing (% , n=64)	31.4	-	-	-
Light manufacturing (% , n=62)	30.4	-	-	-

As shown in Table 1, sampled firms employed an average of 34.6 full-time equivalent workers and had operated for an average of 9.7 years since formal registration. Mean export intensity across the sample stood at 42.3 percent of total sales, with substantial dispersion, and mean export revenue growth over the preceding three years was 8.6 percent, though the wide standard deviation indicates considerable heterogeneity in export trajectories across firms. Binary certification status was held by 124 firms, corresponding to 60.8 percent of the sample, a proportion broadly consistent with figures reported by Uzbekistan’s export promotion agency for the light-manufacturing sector. The mean Green Certification Implementation Quality Index score for the full sample was 0.52 on the standardized zero-to-one scale, but a decomposition by certification status revealed a mean GCQI of 0.61 among certified firms compared with 0.34 among non-certified firms, an initial indication that certification and implementation quality, while related, are empirically distinguishable constructs rather than equivalent measures of the same underlying phenomenon. Notably, the standard deviation of GCQI among certified firms alone was 0.19, indicating substantial heterogeneity in implementation quality even conditional on holding a formal certificate, a pattern consistent with the symbolic-versus-substantive compliance distinction developed in the literature review.

A sector-disaggregated inspection of the descriptive statistics revealed further heterogeneity relevant to subsequent interpretation. Agri-food processing firms reported the highest mean export intensity at 47.1 percent, followed by textile and apparel firms at 41.8 percent and light manufacturing firms at 37.4 percent, a pattern broadly consistent with the greater prevalence of GlobalGAP and food-safety certification requirements in agricultural export value chains. Mean GCQI scores likewise varied by sector, with agri-food processors recording the highest mean implementation-quality score at 0.58, compared with 0.51 for textile and apparel firms and 0.47 for light manufacturing firms, suggesting that sector-specific buyer scrutiny may exert an independent influence on the depth of certification implementation observed at the firm level. Among the 124 certified firms, the most commonly held credential was a nationally recognized environmental compliance equivalent (58.9 percent of certified firms), followed by ISO 14001 (31.5 percent) and GlobalGAP or an equivalent food-safety standard, held predominantly by agri-food processors (24.2 percent of certified firms, with overlap reflecting multiple concurrent certifications held by a subset of firms). This distribution indicates that a majority of certified firms in the sample rely on lower-cost national equivalents rather than internationally accredited standards, a pattern with direct relevance to the implementation-quality question, since national equivalents in Uzbekistan’s still-developing accreditation infrastructure are, on average, subject to less rigorous third-party verification than internationally accredited ISO or GlobalGAP audits.

Prior to substantive hypothesis testing, the internal consistency and construct validity of the Green Certification Implementation Quality Index were assessed. Table 2 reports Cronbach’s Alpha, Composite Reliability, and Average Variance Extracted for each of the three constituent sub-dimensions and for the composite index.

Table 2.

Measurement model reliability and validity tests for the GCQI

Construct	Items	Cronbach’s Alpha	Composite Reliability	AVE
Operational integration	5	0.86	0.88	0.61
Internal auditing rigor	4	0.82	0.85	0.58
Workforce training	4	0.79	0.83	0.55
Composite GCQI	13	0.89	0.91	0.59

All three sub-dimensions and the composite GCQI exceeded the conventional threshold of 0.70 for Cronbach’s Alpha and Composite Reliability, and all exceeded the 0.50 threshold for Average Variance Extracted, indicating that the measurement instrument demonstrated adequate internal consistency and convergent validity for subsequent use as a continuous independent variable in the regression analysis. The operational integration sub-dimension exhibited the strongest reliability statistics, consistent with its comparatively concrete and observable item content, while the workforce training sub-dimension, though still acceptable, exhibited marginally lower reliability, plausibly reflecting greater firm-to-firm variation in how training activities are recorded and recalled by respondents. Convergent validity was further supported by the pattern of inter-item correlations within each sub-dimension, which ranged from 0.41 to 0.68, indicating that items within each construct captured a coherent underlying dimension without excessive redundancy. Discriminant validity across the three sub-dimensions was assessed by comparing the square root of each construct’s Average Variance Extracted against its correlations with the other two constructs; in all three cases the square root of Average Variance Extracted exceeded the corresponding inter-construct correlations, satisfying the standard Fornell-Larcker criterion for discriminant validity and supporting the treatment of operational integration, internal auditing rigor, and workforce training as empirically distinct, if correlated, components of the broader implementation-quality construct.

Table 3 presents the pairwise correlation matrix among the three export competitiveness outcomes, the two certification-related independent variables, and the four firm-level control variables.

Table 3.

Correlation matrix of dependent, independent, and control variables

Variable	1	2	3	4	5	6	7	8
1. Export intensity	1.00							
2. Export diversification	0.52***	1.00						
3. Export revenue growth	0.44***	0.38***	1.00					
4. GCQI	0.58***	0.49***	0.41***	1.00				
5. Certification status	0.31***	0.27**	0.14	0.46***	1.00			
6. Firm size (ln)	0.29***	0.33***	0.19**	0.22**	0.18*	1.00		
7. Firm age	0.09	0.12	-0.06	0.11	0.16*	0.24**	1.00	
8. Digital intensity	0.34***	0.30***	0.26**	0.33***	0.21**	0.28***	0.10	1.00

The correlation matrix reveals several patterns of note. The Green Certification Implementation Quality Index exhibited a moderate-to-strong positive correlation with all three export competitiveness outcomes, most notably with export intensity, exceeding the corresponding

correlations for binary certification status by a considerable margin. Binary certification status, while positively correlated with export outcomes, showed a substantially weaker association, particularly with export revenue growth, where the correlation coefficient failed to reach conventional significance thresholds. Firm size and digital intensity were both positively associated with export intensity and market diversification, consistent with expectations regarding the resource requirements of sustained export activity. No pairwise correlation among the independent and control variables exceeded 0.62, and subsequent variance inflation factor diagnostics, discussed below, confirmed the absence of problematic multicollinearity, with all variance inflation factors remaining below 3.1, comfortably under the conventional threshold of 10.

The core econometric results are presented in Table 4, which reports four sequential Ordinary Least Squares specifications with export intensity as the dependent variable, followed by supplementary results for the Tobit and revenue-growth models discussed in the accompanying narrative.

Table 4.

OLS and instrumental-variable regression models (Dependent variable: Export Intensity, %)

Variable	Model 1	Model 2	Model 3	Model 4 (IV)
Firm size (ln employees)	3.42** (1.12)	3.05** (1.10)	2.68* (1.05)	2.61* (1.07)
Firm age	0.18 (0.14)	0.15 (0.14)	0.11 (0.13)	0.10 (0.13)
Digital intensity	4.65*** (1.38)	4.21** (1.35)	3.42** (1.28)	3.35** (1.31)
Managerial education	1.92* (0.87)	1.74* (0.86)	1.35 (0.82)	1.29 (0.84)
Certification status (binary)	-	4.87* (2.31)	1.92 (2.24)	1.68 (2.29)
GCQI (standardized)	-	-	28.60*** (4.92)	31.20*** (7.80)
Constant	18.4*** (4.2)	16.9*** (4.1)	9.7* (4.5)	9.2* (4.6)
R-squared	0.184	0.201	0.352	0.347
F-statistic	11.28***	10.02***	17.44***	15.86***
N	204	204	204	204

Model 1, containing only the firm-level control variables, explained 18.4 percent of the variance in export intensity and confirmed that digital intensity and firm size were significant positive predictors of export intensity, while firm age showed no statistically significant association. Model 2 introduced binary certification status, which entered with a positive and statistically significant coefficient, indicating that certified firms exported, on average, 4.87 percentage points more of their total sales than non-certified firms, holding controls constant. The inclusion of certification status improved model fit modestly, raising the coefficient of determination by 1.7 percentage points. Model 3 introduced the Green Certification Implementation Quality Index alongside binary certification status. The results are striking: the GCQI coefficient was large, positive, and highly statistically significant, indicating that a one-standard-deviation increase in implementation quality was associated with an increase of approximately 28.6 percentage points in export intensity per unit of the standardized index, while the coefficient on binary certification status declined sharply in magnitude and lost statistical significance once implementation quality was controlled for. The inclusion of GCQI increased the coefficient of determination by 15.1 percentage points relative to Model 2, an increment that was itself statistically significant based on the corresponding F-test for the change in explained variance. This pattern constitutes the central empirical finding of the study: once the substantive quality of certification implementation is accounted for, the binary fact of certificate possession carries no additional independent explanatory power for export intensity. In terms of economic magnitude, the Model 3 estimate implies that a firm improving its GCQI score from the sample’s twenty-fifth percentile to its seventy-fifth percentile, holding controls constant, would be expected to experience an increase in export intensity of approximately 13.4 percentage points, a magnitude considerably larger than the corresponding effect associated with moving from

non-certified to certified status alone, and one that translates, at the sample’s mean export revenue level, into an economically meaningful increase in absolute export earnings.

Diagnostic testing supported the reliability of the Model 3 specification. The Breusch-Pagan test for heteroscedasticity yielded a test statistic significant at the 5 percent level, confirming the appropriateness of the heteroscedasticity-robust standard errors reported throughout. Variance inflation factors for all regressors in Model 3 remained below 3.5, indicating that the simultaneous inclusion of binary certification status and GCQI did not introduce problematic collinearity despite their positive pairwise correlation. Model 4 reports the instrumental-variable two-stage least squares robustness check, using regional accredited-laboratory density as an excluded instrument for GCQI. The first-stage F-statistic for the instrument, 24.7, comfortably exceeded the conventional weak-instrument threshold of 10, and the second-stage coefficient on instrumented GCQI remained large, positive, and statistically significant, albeit somewhat larger in magnitude than the corresponding Ordinary Least Squares coefficient, a pattern consistent with attenuation bias in the original measure due to survey-based measurement error rather than with reverse causality inflating the OLS estimate. A Durbin-Wu-Hausman endogeneity test yielded a p-value of 0.041, providing modest evidence of endogeneity and thereby supporting the use of the instrumental-variable specification as a robustness complement to the baseline OLS results rather than as evidence that the OLS estimates should be discarded.

Beyond the export intensity models reported in Table 4, parallel analyses were conducted for the two remaining export competitiveness outcomes. For export market diversification, given the censored distribution of the outcome at its lower bound corresponding to single-destination exporters, a Tobit regression model was estimated. The results closely mirrored the pattern observed for export intensity: the GCQI coefficient was positive and significant, while binary certification status was not significant once GCQI was included, and the pseudo-R-squared for the full Tobit specification reached 0.29, compared with 0.11 for a baseline model containing only binary certification status and controls. For export revenue growth, an Ordinary Least Squares specification analogous to Model 3 in Table 4 again found GCQI to be a significant positive predictor, with a coefficient indicating that a one-standard-deviation increase in implementation quality was associated with an increase of approximately 6.8 percentage points in the three-year compound annual export revenue growth rate, whereas binary certification status alone showed no statistically distinguishable association with revenue growth in any specification. Across all three outcome measures, therefore, the empirical pattern was consistent: implementation quality, rather than certification status, was the variable exhibiting robust and economically meaningful explanatory power for export competitiveness among the sampled small and private enterprises.

To probe the robustness and boundary conditions of this central finding further, two supplementary analyses were conducted. First, an interaction term between GCQI and the natural logarithm of firm size was added to the Model 3 specification for export intensity. The interaction coefficient was negative and marginally significant, indicating that the marginal return to implementation quality was somewhat larger among smaller firms in the sample than among their relatively larger counterparts, a pattern consistent with the interpretation that implementation quality substitutes, in part, for the scale-related advantages that larger firms otherwise enjoy in export markets. Second, the full Model 3 specification was re-estimated separately within each of the three sectoral subsamples. The GCQI coefficient remained positive and statistically significant in all three subsamples, though its magnitude was somewhat larger in the agri-food subsample than in the textile or light-manufacturing subsamples, plausibly reflecting the more codified and externally verifiable nature of food-safety-related environmental practices relative to general manufacturing environmental management. Taken together, these supplementary analyses indicate that the implementation-quality effect identified in the pooled sample is not an artifact of sectoral composition or firm-size distribution, but rather a pattern that replicates, with modest variation in magnitude, across the principal subgroups of the sample.

DISCUSSION

The empirical results reported above provide clear support for the study's central hypothesis: the substantive quality of green certification implementation, rather than the binary fact of certificate possession, is the variable that meaningfully explains export competitiveness among small and private enterprises in Uzbekistan. This finding warrants interpretation on both theoretical and practical grounds, and it merits comparison against the existing empirical literature reviewed earlier in order to situate the contribution of this study within the broader scholarly conversation.

From a theoretical standpoint, the finding that implementation quality dominates certification status once both are entered jointly into the regression specification lends strong empirical support to the conditional variant of the Porter Hypothesis discussed in the literature review, whereby environmental standards enhance competitiveness only when they are integrated into genuine operational routines rather than adopted defensively to satisfy external pressure. The sharp attenuation of the certification-status coefficient in Model 3, alongside its loss of statistical significance, is difficult to reconcile with a pure institutional-legitimacy account in which certification confers competitive benefit primarily through the signal it sends to buyers, independent of its operational substance. If certification functioned purely as a legitimacy-conferring signal, one would expect its coefficient to remain stable, or to decline only modestly, upon the introduction of a correlated but conceptually distinct implementation-quality measure. The observed pattern instead suggests that whatever competitive benefit buyers historically associated with certificate possession is, at least within this sample, substantially explained by the fact that certified firms also tend to exhibit higher implementation quality, and that it is this underlying operational substance, not the certificate as a discrete object, that buyers and markets ultimately reward.

This interpretation aligns closely with the substantive-versus-symbolic compliance literature reviewed above, which similarly found that decoupled, documentation-oriented compliance failed to generate the buyer-retention benefits associated with genuine operational integration among small manufacturers in South and Southeast Asian export sectors. The present study extends that literature by providing, to the author's knowledge, the first quantitative econometric demonstration of this pattern using a validated multi-item implementation-quality instrument applied to a Central Asian transition-economy sample, and by demonstrating that the pattern holds not only for qualitative buyer-retention outcomes but also for quantitative export intensity, diversification, and revenue growth metrics estimated within a rigorous multivariate framework that controls for firm size, age, digital intensity, and managerial education.

The findings also speak directly to the transaction cost and information asymmetry literature on certification as a signaling mechanism. The observation that a majority of certified firms in the sample rely on lower-cost national certification equivalents, and that certification status alone explains comparatively little variance in export outcomes once implementation quality is controlled for, is consistent with the "cheap signal" concern raised in that literature: when the cost of obtaining a certificate is decoupled from the cost of achieving genuine operational quality, certification risks devolving into a weak signal that sophisticated buyers increasingly discount, favoring instead direct or third-party verification of operational practice. This dynamic has particular salience in light of the anticipated expansion of carbon border adjustment and supply-chain due-diligence requirements discussed in the introduction, since buyers facing their own regulatory exposure are likely to intensify scrutiny of supplier environmental claims in ways that a superficially obtained certificate will not withstand.

At the same time, several findings diverge from patterns reported in advanced-economy studies and merit specific comment. Whereas European studies of ISO 14001 adoption among small manufacturers have generally found a comparatively small but positive independent effect of certification status even after controlling for measures of environmental management maturity, the present study found this independent effect to be statistically indistinguishable from zero in the fully specified model. This divergence plausibly reflects differences in accreditation infrastructure maturity: in advanced-economy contexts, certification bodies are subject to stringent oversight that

constrains the prevalence of low-fidelity certificates, whereas in Uzbekistan’s still-developing accreditation ecosystem, as documented in the descriptive results showing heavy reliance on national equivalents, the gap between certificate possession and implementation quality may be considerably wider, producing a correspondingly larger empirical divergence between the two constructs’ explanatory power. A further point of divergence concerns price-premium effects documented in several advanced-economy studies, wherein certified status alone has been shown to command a measurable price premium among environmentally conscious retail buyers; the present study did not directly measure price premia, focusing instead on volume-based export intensity, diversification, and revenue growth, and it is plausible that a price-premium channel operates somewhat independently of the volume-based channels emphasized here, a possibility that future research incorporating transaction-level pricing data could usefully investigate.

The findings also contribute to institutional theory’s decoupling literature by providing a quantitative metric through which the degree of decoupling between formal certification structure and substantive operational practice can be measured and compared across firms, rather than treated as a qualitative, case-specific phenomenon. The considerable variation in GCQI observed even among certified firms, with a standard deviation of 0.19 around a certified-firm mean of 0.61, indicates that decoupling is not a uniform or binary condition but rather a matter of degree that varies continuously across the certified-firm population, a nuance that the prevailing binary treatment of certification status in much of the applied literature has been unable to capture. This continuous conceptualization of decoupling, operationalized through the GCQI instrument, represents a methodological contribution that may prove useful in future institutional-theory research extending beyond the specific export-competitiveness outcomes examined here.

The practical implications of these findings for small and private enterprise managers are direct. Firms seeking to leverage environmental credentials for export competitiveness should treat certification not as a terminal compliance objective but as one component of a broader investment in operational integration, internal auditing capacity, and workforce training, since it is these substantive investments, not the certificate itself, that the empirical evidence identifies as the driver of superior export outcomes. For firms operating under binding financial constraints, the sector-disaggregated and firm-size interaction results suggest that implementation-quality investment may yield disproportionately large returns for smaller firms specifically, offering a partial counter-narrative to the presumption that certification inherently favors larger, better-resourced exporters.

Several limitations of the present study should be acknowledged. First, the cross-sectional research design precludes definitive causal inference regarding the direction of the relationship between implementation quality and export competitiveness, notwithstanding the instrumental-variable robustness check reported in the results section; longitudinal panel data tracking the same firms through certification adoption and subsequent export performance would provide a more conclusive causal test. Second, the sample, while adequately sized and stratified across three major economic clusters, is drawn exclusively from Uzbekistan and from three specific export sectors, limiting the immediate generalizability of the findings to other transition economies or to sectors with different certification regimes, such as heavy industry or extractives. Third, the Green Certification Implementation Quality Index, although demonstrating strong psychometric properties in this sample, relies on self-reported survey items rather than independently verified operational audit data, introducing the possibility of social-desirability bias in firm managers’ responses regarding their own environmental management practices, a limitation partially, but not fully, mitigated by the instrumental-variable specification’s reliance on an external, non-self-reported instrument. Future research extending this framework to additional transition-economy contexts, incorporating independently audited implementation-quality measures, and following firms longitudinally through the certification and export lifecycle would substantially strengthen the evidentiary base underlying the policy recommendations advanced in the following section.

CONCLUSION

This study set out to determine whether the quality of green certification implementation, as distinct from the binary possession of a certificate, explains the export competitiveness of small and private enterprises in Uzbekistan. Using a structured survey of 204 export-oriented enterprises in the textile, agri-food, and light manufacturing sectors and a multi-item Green Certification Implementation Quality Index validated through established reliability and validity criteria, the study found consistent and robust evidence that implementation quality, not certification status, is the empirically dominant predictor of export intensity, market diversification, and export revenue growth. Binary certification status, while positively associated with export outcomes in isolation, lost statistical significance once implementation quality was controlled for, and this pattern held across sectoral subsamples, firm-size strata, and an instrumental-variable robustness specification addressing potential endogeneity concerns. These findings directly answer the research question motivating the study: small and private enterprises that merely acquire a certificate without corresponding investment in operational integration, internal auditing rigor, and workforce training should not expect the durable export benefits that superficial engagement with green certification programs might be assumed to confer.

These empirical results carry direct policy implications for government bodies and export-support agencies. First, certification subsidy programs currently administered on the basis of certificate acquisition alone should be redesigned to condition disbursement, in whole or in part, on independently verified implementation-quality benchmarks, for example through spot audits assessing operational integration and internal auditing practice rather than through documentary review alone. Second, export-support agencies should expand technical assistance programs specifically targeting the workforce training and internal auditing capacity dimensions identified as constituent elements of the Green Certification Implementation Quality Index, since these dimensions, unlike the certificate itself, appear to be the operative channels through which export competitiveness gains materialize. Third, given the evidence that reliance on lower-cost national certification equivalents is associated with lower average implementation quality, policymakers should consider strengthening the accreditation and oversight infrastructure governing domestic certification bodies, potentially through alignment with international accreditation standards, in order to narrow the gap between national and internationally recognized certification credibility. Fourth, given the finding that implementation-quality returns may be disproportionately large for smaller firms, targeted implementation-quality support, rather than certification-acquisition subsidies alone, may offer a more cost-effective mechanism for expanding the population of genuinely export-competitive small enterprises than current subsidy designs premised on certificate acquisition.

Future research should extend this framework longitudinally, tracking firms through certification adoption and subsequent export performance to strengthen causal identification beyond the cross-sectional and instrumental-variable evidence presented here. Comparative studies applying the Green Certification Implementation Quality Index across other Central Asian and transition-economy contexts would help establish the generalizability of the implementation-quality effect beyond the Uzbek case, while extensions incorporating independently audited, rather than self-reported, implementation-quality data would further strengthen the evidentiary foundation for the policy recommendations advanced above.

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