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Certification to compensate gender prejudice–Analysis on impact of management system certification on export

Riillo, Cesare A.F.; Mijatovic, Ivana; de Vries, Henk J.

DOI
10.1080/00036846.2021.1990842

Publication date
2022

Document Version
Final published version

Published in
Applied Economics

Citation (APA)
Riillo, C. A. F., Mijatovic, I., & de Vries, H. J. (2022). Certification to compensate gender prejudice–Analysis on impact of management system certification on export. *Applied Economics*, *54*(33), 3777-3794. https://doi.org/10.1080/00036846.2021.1990842

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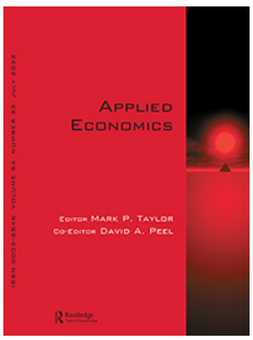

Routledge
Taylor & Francis Group

Applied Economics

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/raec20

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To cite this article: Cesare A.F. Riillo, Ivana Mijatovic & Henk J. de Vries (2022) Certification to compensate gender prejudice – Analysis on impact of management system certification on export, Applied Economics, 54:33, 3777-3794, DOI: 10.1080/00036846.2021.1990842

To link to this article: https://doi.org/10.1080/00036846.2021.1990842

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APPLIED ECONOMICS
2022, VOL. 54, NO. 33, 3777–3794
https://doi.org/10.1080/00036846.2021.1990842

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Certification to compensate gender prejudice – Analysis on impact of management system certification on export

Cesare A.F. Riillo [a], Ivana Mijatovic [b] and Henk J. de Vries [c,d]

[a]Statec Research a.s.b.l., (National Institute for Statistics and Economic Studies of the Grand Duchy of Luxembourg), Luxembourg Ville, Luxembourg; [b]Faculty of Organizational Sciences, Department of Quality Management and Standardization, University of Belgrade, Belgrade, Serbia; [c]Department of Technology and Operations Management, Rotterdam School of Management, Erasmus University, Rotterdam, The Netherlands; [d]Faculty of Technology, Policy and Management, Department of Values, Technology and Innovation, Delft University of Technology, Delft, The Netherlands

ABSTRACT

Management system certification signals that the organization meets international standards, which provides a certain confidence in the company. This confidence is in particular needed for exporting companies in developing countries. Because the business world is dominated by men, female leadership might be another reason to have less confidence in a company. Women-led companies may therefore benefit more from certification. Therefore, this study empirically tests the impact of certification on export, and the moderating effect of female leadership. We use data from enterprise surveys conducted by the World Bank in 2013 that include 4111 firms from 25 Central and Eastern European countries in transition. We implement a recursive bivariate probit model and an extensive sensitivity analysis to account for endogeneity issues. Results confirm that certification and export are positively correlated. Firms managed by females benefit more from certification based on international standards than firms managed by men, especially in the service sector. This suggests that certification compensates for the possibly negative connotations of female leadership. Female managers may consider implementing a management system and get it certified, resulting in a competitive advantage in export markets. Our findings provide food for thought for purchase managers – are they free from prejudice?

KEYWORDS
Management system certification; export; World Bank enterprise survey; gender prejudice

JEL CLASSIFICATION
J16; L15; F10

I. Introduction

Standards are essential for the effective functioning of the global trading system (World Trade Organization 2005). Standards provide solutions to market failures such as imperfect information, and negative externalities such as environmental degradation. They facilitate technical compatibility, which may allow network externalities. However, many companies from developing and transitional countries have problems to comply with globally accepted standards due to substantial cost (Keiichiro et al., 2015). This hinders export but also their share at the domestic market is at stake due to foreign competitors, many local producers are losing the game even on their own market. These standards may be related to products, services, software, processed materials, processes, people or management systems (De Vries 1998). In this study, we focus on management system standards.

The voluntary adoption of management system standards in the areas of quality (ISO 9001), environment (ISO 14001), occupational health and safety (ISO 45001), information security (ISO/IEC 27001) or energy (ISO 50001) is often followed by third-party audits following the same standards and consequently by certifications. Certification bodies verify the correct application of the standards (see Blind, Mangelsdorf, and Pohlisch 2018; De Vries et al. 2010). The certification signals that the company indeed meets these standards and this should provide confidence to the customer. This confidence is in particular needed in cases customers perceive uncertainty. As we will show, this does not only depend on the trust in a country's institutions, it may also depend on company-specific characteristics. In several markets dominated by men, female company leadership may be such an issue: she may have to prove herself more than men in the same position. Women suffer

CONTACT Cesare A.F. Riillo cesare.riillo@statec.etat.lu Statec Research A.s.b.l, (National Institute for Statistics and Economic Studies of the Grand Duchy of Luxembourg), Luxembourg Ville, Luxembourg

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some disadvantages from prejudicial evaluations of their leadership competences, particularly in a masculine environment (Eagly and Carli 2003). Additionally, women-owned firms are disadvantaged in accessing financial markets because of gender discrimination (e.g. Chaudhuri, Sasidharan, and Raj 2018). Therefore, we argue that if certification increases confidence needed for exporting and women-led firms face higher prejudices than men-led firms, then we expect that women-led firms benefit more from management system certification – MS certification – than men-led firms.

This paper explores influence of management system certification (MSC) on export as well as the effect of female management on this relationship. Empirical data stem from the World Bank's Enterprise Survey data of 25 transitional Eastern European Countries (EEC). Other studies on these data consider export as driver of certification (Hudson and Orviska 2013; Fikru 2014a, 2014b), or focus on productivity without explicitly modelling the possible endogeneity issue (Ferro 2011) or look at the role of gender on the export activity without considering the certification (Marquis, 2015). Our study combines some features from all previous studies and expands the work of Goedhuys and Sleuwaegen (2016) to investigate how gender of the top management moderates the impact of certification on export propensity in both service and manufacturing firms.

The paper is divided into five sections. Section II reviews literature on MS certification and its impact on export, and the impacts of female management on exporting propensity, leading to a conceptual framework and hypotheses. The third section deals with the methodology while the fourth section reports results and the sensitivity analysis. Finally, the fifth section discusses the findings and provides conclusions.

II. Backgrounds and hypotheses

Impact of MS certification on export

Certification signals along the supply chain that the supplier complies with certain requirements (Dankers 2003). Certification is 'the provision by an independent body of written assurance (a certificate) that the product, service or system in question meets specific requirements' (ISO 2009). In most cases, these specific requirements are laid down in standards. A report from the World Trade Organization (WTO) meeting in 2013 underlines that developing countries face many difficulties to meet standards and then providing confidence for trade (WTO, 2013). We focus not on the goods and services themselves but on the management systems (MSs) applied by the companies that produce these.

Export performances are positively correlated with MS certification (Blind, 2002; Clougherty and Grajek 2014; Goedhuys and Sleuwaegen 2013; Ferro 2011; Masakure, Cranfield, and Henson 2009a; Masakure, Henson, and Cranfield 2009b; Regis and Jiaotong 2018; Kapri 2019). Explanations include transaction cost reduction (Goedhuys and Sleuwaegen 2016) and overcoming reputation problems (Blind, Mangelsdorf, and Pohlisch 2018). Blind, Mangelsdorf, and Wilson (2013) found quality management certifications to be positively correlated with bilateral trade; mutual recognition of certification has a positive and significant effect on trade and mutual recognition is in particular beneficial for markets access in high-income countries. In Argentina, for instance, MS certification has effectively helped firms expand their exports and the effects of certification are larger on exports to developed countries (Martincus, Castresana, and Castagnino 2010). The same applies to Ethiopia: companies which export a large percentage of their sales have higher chances of being certified, profitable and efficient, leading to better business performance (Fikru 2014a). Experienced exporters already have a reputation which shapes their position on the market, while newcomers on the market need to 'get up to speed' more quickly – in this context, certification to the international standard for quality management ISO 9001 plays a key role in establishing their credibility (Masakure, Cranfield, and Henson 2009a; Masakure, Henson, and Cranfield 2009b).

The effects of the management system itself have to be separated from the signalling effect of the certificate (e.g. Manders 2014). Certification signals a certain level of proficiency and thus may help making a difference between good and bad quality

(Akerlof 1970). Certification provides the external stakeholders a justified confidence that the MS meets the applicable standards. Frondel, Krätschell, and Zwick (2018) indicate that application of MS standards without certification does not influence companies' business performance at the same level as in the case of certified companies, confirming the findings of Siougle, Dimelis, and Economidou (2018), based on a sample of Greek listed companies and Riillo (2017) for Italian firms.

Firms from less developed countries have a higher interest in certification than those from the more developed countries because concerns related to the reputation of the country itself influence market positions of producers and providers from these countries (Fura and Wang, 2017; Ferro 2011; Masakure, Cranfield, and Henson 2009a; Masakure, Henson, and Cranfield 2009b). Lack of institutional support (e.g. efficient market institutions and supportive specialized intermediaries) in developing and transitional countries makes companies operating domestically perceive certification as a surrogate institutional mechanism which helps them to export (Goedhuys and Sleuwaegen 2016). Developing countries increasingly use MS certifications granted by recognized certification bodies to overcome reputation problems to enter international markets (Blind, Mangelsdorf, and Pohlisch 2018). Oya, Schaefer, and Skalidou (2018) reviewed 179 studies on effects of certification in agriculture in low-income countries and found that certification positively impacts sales. However, companies in less developed countries also face the barrier of the level of the requirements so these countries still lag behind in terms of adoption (Clougherty and Grajek 2014). Exporting companies from developing countries may need multiple certifications whereas foreign imports to developing countries are far less conditioned by certification (Xie, Tingyou, and Yi 2011). However, certification can be important for any firm – in a study on foreign companies operating in China, Zhang, Jiang, and Noorderhaven (2019) found that certification is effective in increasing legitimacy of foreign firms. To conclude:

Hypothesis 1. *Management system certification (MSC) based on international standards positively increases the chances of firms to engage in direct exporting.*

Impact of female management on export and certification

Do companies led by women perform better or worse than companies led by men in terms of export propensity? A literature review of the determinants of export performance (Chen, Sousa, and Xinming (2016) shows that evidence on the link between gender and export is rather limited and mixed. While investigating political instability in South Asia, Kapri (2019) uses the gender of the owner and of the management as control variables. He reports some results where female ownership is always associated with export activities while female management is generally not statistically significant. Other empirical studies show that female-led firms (owned or managed) have lower propensity to export than firms led by men (e.g. Orser et al. 2010; Marques 2015) or no statistical significant correlation (Ramón-Llorens, García-Meca, and Duréndez 2017). Using World Bank's Enterprise Surveys, Marques (2015) notes that the gender negatively influences exports propensity essentially through other drivers of export propensity such as firm's size and industry. According to social and liberal feminist theory, female owners are less encouraged to enter foreign markets (Orser et al. 2010). Therefore, we expect:

Hypothesis 2. *Female-managed firm are not more likely to engage in export activities than male-managed firms.*

Female-led firms may face higher barriers to seek and obtain international certification than male lead firms, even if they can potentially benefit from certification: On average, female managers may lack resources (e.g. access to credit and funding) or face cultural pressure preventing them to invest in the certification. To the best of our knowledge, no study specifically investigated whether female managers are more likely to get management system certification. The only two studies use gender (as control variable) while investigating other drivers of certification. These studies use World Bank's Enterprise Surveys and show that female ownership is not statistically associated with certification (Fikru 2014b), or firms owned by women are less likely to adopt certification (Fikru 2014a). Hence, we expect:

Hypothesis 3. *Female-managed firms are not more likely to be certified than male-managed firms.*

Certification signals that the system meets international standards, which provides confidence in the company. In the business world dominated by men, female leadership may be another reason for purchase managers to have less confidence in a company. As international certification alleviates reputation gap, women-led companies that suffer from the prejudices, may therefore benefit more from certification. In other words, if female-led firms achieve certification then they have higher exporting propensity than male-led certified firms. This brings us to the fourth hypothesis:[1]

Hypothesis 4. *Certified female managed firm that are certified have higher chances to engage in export activities than certified male managed firms.*

Figure 1 below offers a graphical representation of our hypotheses.

III. Methodology – Data collection and analysis

To answer our research questions, we need company level data about MS certification, CEO gender and direct export from less developed countries. We investigate firms in transition economies in Central and Eastern Europe and the former Soviet Union because these countries have a relatively high share of female leadership, data are available and the second author is familiar with these countries.

Country characteristics

The transition economies and countries studied in this paper have a common experience with state socialism. Since the 1917, socialist societies were based on a high degree of ideology and a dominant role of communist parties. Fundamental features of state socialism, as opposed to marked economies, were central or state planning and bureaucratic control (Peng 2000, 17). Company decisions had to meet political legitimating criteria prior to economic logic (Mijatovic, Miladinovic, and Stokic 2015). In the 1980s, socialist countries including China had almost one third of the world population but accounted for only 10% of global export and 3% of global innovations (Peng 2000, 21). In the late 1980s and early 1990s, transition of socialistic political and economic systems started. Elements of these transitions included stimulating the private sector and financial market, privatization and restructuring of state-owned enterprises, and liberalization of international trade (Hillman 1994). Export to western countries was hindered by low product quality (Acharyya 2005; Hillman 1994), however, in general, the literature is not consistent if high quality is a prerequisite for export (Racine 2011, 16), cheap products of an acceptable level of quality may be successful as well.

Mandatory standardization was an essential element of the standardization system of any socialist country, in contrast to voluntary standardization in European Union (EU) member states and OECD countries (Organization for Economic Co-operation and Development) (Racine 2011). Trade between socialist countries was based on (mostly) bilateral state agreements. Enterprises

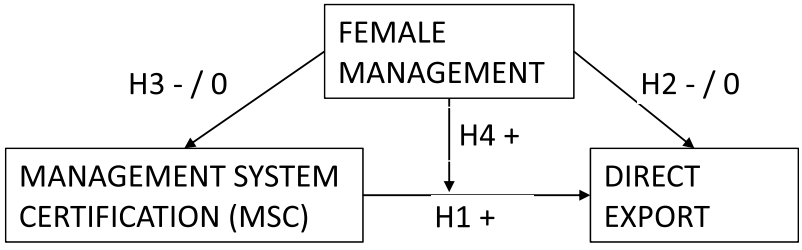

Figure 1. Conceptual framework.

[1]A sport analogy can help to better understand our conceptual model: Sport is good for health (H1); being overweighed is not good for health (H2). Overweighed people are less likely to do sport (H3), but overweighed people that actually do sports, benefit more than others in terms of heath (H4).

were quite isolated from international markets, so they did not need the protectionist instruments common at those markets such as tariffs, quantitative restrictions, and technical-standards discrimination (Hillman 1994). Meanwhile all Central and Eastern Europe countries and the former Soviet Union countries have adopted the system of voluntary standards and standardization that is common in EU and EFTA member states.

Socialist countries put emphasis on female equality in the labour market. As a result, participation of females in the overall workforce was and still is higher than in other countries. The echo of socialist experiences is still visible today in business and management. Reynaud et al. (2007) confirmed some differences between managers from founding EU countries and Eastern European EU member states and indicate that economic development is crucial for convergence in values. Labour market deregulation enlarges gender inequality (Perugini and Selezneva 2015), and further liberalization of the markets will challenge capacities of institutions (e.g. trade unions, see Pulignano 2017) who might deal with gender gap.

Dataset

The empirical analysis is based on the Enterprise Survey Data of the World Bank, the main source for firm-level data in less-developed countries. This dataset is highly reputable and used in literature (Ferro 2011; Goedhuys and Sleuwaegen 2013). The surveys collect cross-sectional information about firms' characteristics and its markets, including internationally recognized quality certification and exports activities. The surveys address a representative sample of non-agricultural firms. The uniform sampling and methodology allow comparability across countries. The target population is consistently defined in all countries and includes the entire manufacturing sector, the services sector, and the transportation and construction sectors. Public utilities, government services, health care, and financial services sectors are excluded.

The data we use are all from the same year, 2013 and include 4947 small, medium-sized and large manufacturing and service firms of 16 Central and Eastern European and nine former Soviet Union countries.

The dependent variable is the export behaviour: does the firm have direct exports (sales of goods or services abroad without an intermediary company)? Engaging in export activities (also known as extensive margin) is the first and difficult step for a firm to access international markets (Helpman et al., 2008). Our independent variable is certification. The wording of the question is: *'Does this establishment have an internationally-recognized quality certification? (Interviewer: if there is need for clarification, some examples are: ISO 9000 or 14,000, or HAPC)'* Enterprise Surveys (2014, pag.103).[2] This fits with our concept of Management System Certification (MSC). An earlier paper based on the same data set used the term International Standards Certification (ISC) (Goedhuys and Sleuwaegen 2013) but that term would suggest that the standard instead of the management system gets certified. The other main variable of interest is top manager gender.

Additional to the common control variables, Number of employees and Age of the firm, we use other variables that may be related to the confidence customers have in the company, see Table 1. In this choice, we follow Goedhuys and

B.8	Does this establishment have an internationally-recognized quality certification? **(INTERVIEWER: if there is need for clarification, some examples are: ISO 9000 or 14000, or HAPC)**

Yes	1
No	2
Still in process	**-6**
Don't know (spontaneous)	**-9**

b8

Figure 2. Wording of the certification question (Enterprise Surveys 2014. pag. 103).

[2]Strictly speaking, the sentence should read 'Interviewer: if there is need for clarification, some examples are: ISO 9001 or 14,001, or HACCP'. We faithfully report the wording in Figure 2.

Sleuwaegen (2016): Being part of a company in foreign ownership is another way to reduce the reputation gap in the perception of customers, especially in low-income countries (i.e. Skoda being part of Volkswagen group) and provides knowledge that can facilitate export and possibly decrease the costs of certification. International certification matters more for the export participation of domestic firms than for plants of foreign firms (Goedhuys and Sleuwaegen 2016). Following previous studies (Goedhuys and Sleuwaegen 2013), we use also two instrumental variables associated with MSC and not systematically with export: the use of licenced foreign technologies and tax controls (number of times per year the firm is inspected by tax authorities). The economic explanation is that strong scrutiny by external stakeholders is associated with MSC. Indeed, licensors often impose technology licensees to acquire a certification and firms subject to greater controls from tax authorities can benefit from higher transparency and well-codified procedures embedded in MSC (Goedhuys and Sleuwaegen 2013, 92).

Table 1. Variables' definition.

Variables of Interest	
Certification	= 1 if a firm has an internationally recognized quality certification
Female Manager	= 1 if a firm's top manager is female
Dependent variable	
Direct Exports	= 1 if a firm registers some direct exports (meaning that firm sells goods and services abroad with no intermediary company)
Firm characteristics	
Ln Employees	Natural logarithm of the total number of full-time equivalent employees
Ln Age	Natural logarithm of the number of years since firm began operations
Website communication	= 1 if firms use their website for business-related activities, i.e. sales, product promotion etc.
Industries	2 digits of International Standard Industrial Classification of All Economic Activities (ISIC). The sample includes the entire manufacturing sector, the services sector, and the transportation and construction sectors.
Reputation variable	
Foreign Ownership	= 1 if ≥ 10% of a firm is owned by foreign individuals, companies or organizations (World Bank threshold)
Financial Auditors	= 1 if an external auditor reviewed its annual financial statement
Instrumental Variables	
Foreign Technology	= 1 if a firm uses technology licenced from a foreign-owned company, excluding office software
Number of tax controls	Number of controls by tax authorities during the last 12 months

IV. Results

Descriptive statistics

Table 2 presents the distribution of variables. The first column reports the distribution of the variables among firms that have an international certification, the second columns among non-certified firms and the third column the distribution of variables in the whole sample.

First, we note that 25.6% of our sample has MSC and direct export is more common among MSC (29.2%) than among the non-MSC (11%). Looking at the other characteristics of the firms, the certified firms are larger, older, more likely to use web communication, to be international (foreign ownership and use of foreign technology) and more supervised (both by financial auditors and by tax authorities). Interestingly, the proportion of female management is lower among non-MSC (11%) than among MSC (29.2%).

The distributions of certification by country and industry are reported in Table 3 and Table 4. The proportion of certification in the available data,

Table 2. Descriptive statistics by MSC (Management system certification).

	(1)	(2)	(3)
	MSC	Non-MSC	Total
	Mean or proportion	Mean or proportion	Mean or proportion
Variables of Interest			
Management System Certification (MSC)			0.256
Female top manager	0.155	0.217	0.201
Dependent variable			
Direct Exports	0.292	0.110	0.156
Firm characteristics			
Ln Employees	3.618	2.860	3.054
	(1.366)	(1.136)	(1.244)
Ln Age	2.658	2.501	2.542
	(0.627)	(0.615)	(0.622)
Website communication	0.768	0.507	0.574
Reputation variables			
Foreign Ownership	0.129	0.051	0.071
Financial Auditors	0.523	0.363	0.404
Instrumental Variables			
Foreign Technology	0.263	0.110	0.149
Number of tax controls	2.618	2.395	2.451
	(2.637)	(2.303)	(2.395)

Notes: Standard deviations of continuous variables are reported in parenthesis.

Table 3. Proportion of MSC firms by countries.

	Unweighted MSC	Weighted MSC
Albania	22.4	16.1
Armenia	26.0	24.0
Azerbaijan	11.4	11.4
Belarus	17.7	15.7
Bosnia and Herzegovina	34.9	36.7
Bulgaria	28.3	27.6
Croatia	23.9	21.3
Estonia	25.6	33.1
North Macedonia	32.1	33.4
Georgia	20.5	10.5
Hungary	60.3	59.2
Kazakhstan	24.2	25.8
Kosovo[§]	32.2	30.2
Kirgyz Republic	23.9	26.4
Latvia	15.8	14.5
Lithuania	20.5	14.9
Moldova	13.3	10.8
Montenegro	22.2	19.2
Poland	38.3	37.5
Romania	34.8	35.7
Serbia	35.6	19.4
Slovak Republic	48.8	45.3
Slovenia	23.3	22.6
Ukraine	16.3	13.9
Uzbekistan	10.1	2.3
Total	25.6	29.7
Unweighted Observations	4111	

Table 4. Proportion of MSC firms by industries.

	Unweighted	Weighted
Textiles	26.3	20.5
Leather	11.6	10.7
Garments	21.9	31.8
Food	36.1	46.5
Metals and machinery	40.3	49.6
Electronics	42.6	41.0
Chemicals and pharmaceuticals	44.7	34.8
Wood and furniture	21.2	21.1
Non-metallic and plastic materials	30.8	43.7
Other manufacturing	32.6	37.2
Retail and wholesale trade	19.2	20.3
Hotels and restaurants	17.8	23.3
Other Services	27.5	32.3
Other: construction, transportation, etc.	31.6	36.2
Total	25.6	29.7
Unweighted Observations	4111	

both weighted and unweighted, turns out to be considerably higher than in register data in countries with a longer tradition of certification such as Italy (e.g. Franceschini et al. 2008; Riillo 2014). We suspect that certified firms have been more likely to participate in the survey limiting capacity of the survey sample to represent certification behaviour of associated firms' population. For example, according to the survey nearly 60% of sampled Hungarian firms (both weighted and unweighted) have an internationally recognized quality certification, i.e. ISO 9001 or ISO 14001. This proportion is much higher than nearly 3% estimates computed combining data from the ISO survey data 2013 and Eurostat data.[3] The enterprise survey methodology assures that survey results, when calculated with sampling weights, are representative of the associated populations only in terms of business sector, location, and firm size. However, the intended level of precision is not guaranteed for indicator values, since the global sampling methodology does not stratify by other features such as gender of the top manager, exporter status, or ownership (World Bank 2014, pag.9). For this reason, in the rest of the analysis we use unweighted data and interpret the results as valid only *within* the context of our analysis without necessarily claiming that the results can be generalized to the whole firms' population.

Econometric model

The econometric analysis allows investigating the relationship between MSC and exports considering all features simultaneously. In particular, we are interested to estimate whether MSC increases the likelihood of exporting and then decompose the effect by gender. We implement a recursive bivariate model with instrumental variables to account for endogeneity of MSC and export. Other studies on these data do not explicitly model the possible endogeneity of certification and export while focusing on productivity in the manufacturing sector (Ferro 2011).

We proceed in two steps. First, export and certification are investigated as separated events in the frame of the probit model (e.g. Greene 2003). This model is appropriate because both export and MSC are both dichotomous. Second, suspecting that the MSC and exports are related activities and unobserved factors (e.g. management culture) could affect the results of the first step, MSC and export

[3]The ISO Survey 2013 reports that 7186 Hungarian firms were ISO-9001-certified, 1955 had a certified environmental management system based on the international standard ISO 14001, and 472 a certificate based on the standard for information security management ISO/IEC 27001 (see https://isotc.iso.org/livelink/livelink?func=ll&objId=20719433&objAction=browse&viewType=1)

In 2013, 349,587 firms were active in Hungary (see Eurostat table bd_9fh_sz_cl_r2. Employer business demography by size class (from 2004 onwards, NACE Rev. 2) available http://appsso.eurostat.ec.europa.eu/nui/show.do?wai=true&dataset=bd_9fh_sz_cl_r2

are jointly investigated in the frame of the recursive bivariate probit model (Greene 2003). In this model, the errors of the equation explaining the MSC are correlated with the errors of the equation explaining the export. The MSC is included in the right–hand side of export equation.

In formula:

$$y_1^* = x_1\beta_1 + \ \gamma y_2 \#\#\mathrm{FM}\beta_{\mathrm{fm1}} + \varepsilon_1,$$
$$y_1 = 1 \text{ if } y_1^* > 0, \qquad 0 \text{ otherwise}$$

$$y_2^* = x_2\beta_2 + \mathrm{FM}\beta_{\mathrm{fm2}} + \varepsilon_2,$$
$$y_2 = 1 \text{ if } y_2^* > 0, \qquad 0 \text{ otherwise}$$

$$E[\varepsilon_1|\boldsymbol{x}_1, \boldsymbol{x}_2, FM] = E[\varepsilon_2|\boldsymbol{x}_1, \boldsymbol{x}_2, FM] = 0$$

$$\mathrm{Var}[\varepsilon_1|\boldsymbol{x}_1, \boldsymbol{x}_2, FM] = \mathrm{Var}[\varepsilon_2|\boldsymbol{x}_1, \boldsymbol{x}_2, FM] = 1$$

$$\mathrm{Cov}[\varepsilon_1, \varepsilon_2|x_1, x_2] = \rho$$

Where $y_1 = 1$ if the firm directly exports, $y_2 = 1$ if the firm is certified and FM = 1 if the firm is led by top female managers. x_2 is the vector of the control variables of equation explaining certification (employment, age, web communication) and includes the instrumental variables (foreign technology and tax controls). x_1 is the vector of the control variables of the equation explaining export (employment, age, web communication). In the final equations we augment both x_1 *and* x_2, including the variables that are associated with the reputation of the firm (foreign ownership and external financial auditors).

Propensity of management system certification

Coefficients of a nonlinear model are not easily interpretable in terms of probability. Therefore, Table 5, Tables 6 and Table 7 report the Average Marginal Effects (AME) that is the *average* change in probability of exporting or certification when a particular explanatory variable increases by one unit. The complete regressions' coefficients are reported in Table 8.

As we are simultaneously modelling certification and export, first we shortly discuss the propensity to be certified (Table 5), then we move to the impact of certification on export (Table 6). Before commenting the results, we look at the appropriateness of the model and note that the correlation coefficient of the error terms of certification and export equations is negative and statistically significant at 10%. This means that the bivariate Probit that simultaneously models certification and export is more appropriate than two separated probit

Table 5. Propensity of management system certification APE.

	(1)	(2)	(3)
	Probit	Biprobit	Biprobit with reputation variable
Female Management	−0.00804	−0.00840	−0.00776
	(0.017)	(0.017)	(0.017)
Firm characteristics			
Ln Employees	0.0598***	0.0595***	0.0522***
	(0.005)	(0.005)	(0.005)
Ln Age	0.0169	0.0171	0.0191*
	(0.010)	(0.010)	(0.010)
Web communication	0.103***	0.102***	0.0983***
	(0.014)	(0.014)	(0.014)
IV			
Foreign Technology	0.141***	0.146***	0.132***
	(0.020)	(0.019)	(0.020)
Tax controls	0.00556**	0.00635**	0.00555**
	(0.003)	(0.002)	(0.002)
Reputation			
Foreign Ownership			0.0734***
			(0.026)
External Auditors			0.0488***
			(0.014)
Industry dummies	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes
RHO		−0.410	−0.276
P-value RHO		0.00315	0.0979
observations	4111	4111	4111

Robust Standard errors clustered by size, industry and countries in parentheses.
Notes: * p <.10, ** p <.05, *** p <.01

Table 6. Propensity of direct exports APE.

	(4)	(5)	(6)
	Probit	Biprobit	Biprobit with reputation variable
MCS	0.0606***	0.217***	0.152**
	(0.012)	(0.058)	(0.064)
Female Management	−0.00542	0.000941	0.000936
	(0.013)	(0.013)	(0.013)
Firm characteristics			
Ln Employees	0.0381***	0.0273***	0.0265***
	(0.004)	(0.005)	(0.006)
Ln Age	−0.00415	−0.00540	−0.000249
	(0.008)	(0.008)	(0.008)
Web communication	0.0822***	0.0665***	0.0698***
	(0.012)	(0.012)	(0.013)
Reputation			
Foreign Ownership			0.104***
			(0.022)
External Auditors			0.00269
			(0.011)
Industry dummies	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes
Rho		−0.410	−0.276
P-value athRho		0.00315	0.098
Obs.	4111	4111	4111

Standard errors in parentheses.
Notes: * p <.10, ** p <.05, *** p <.01

Table 7. Influence of MSC certification on export by gender of management.

	(4a)	(5a)	(6a)
	Probit	Biprobit	Biprobit with reputation variable
Non MCS	ref.	ref.	ref.
MCS with Male Manager	0.0503***	0.204***	0.139**
	(0.013)	(0.057)	(0.063)
MCS with Female Manager	0.101***	0.270***	0.203***
	(0.028)	(0.073)	(0.078)
MCS for Female man. – MCS for Male man.	0.0509*	0.0668*	0.0644*
	(0.0302)	(0.0402)	(0.0368)
Obs.	4111	4111	4111

Estimation included other control variables not reported here.
Standard errors in parentheses.
* p <.10, ** p <.05, *** p <.01

models (equation 1 in Table 5 and equation 4 in Table 6). We note also that adding the variables related to reputation of the firm (foreign ownership and external financial auditors) (equation 3 in Table 5 and equation 6 in Table 6) considerably reduces magnitude and statistical significance of the rho. We interpret these results as evidence that, ceteris paribus, unobserved firms' reputation that facilitates export is negatively associated with certification.

Table 5 Equation 1 reports the probit estimation, Equation 2 is the bivariate probit and (3) bivariate probit with reputation variables.

All equations show that firms with female top management are not more likely to be certified (support for Hypothesis 3). Aside country and industry fix effects, in line with previous literature, all models show that certification positively correlates with size (number of employees) and communicating by website. Both instrumental variables, use of technology licenced from a foreign-owned company, and control from the tax authorities are correlated to certification. Equation (3) shows that also reputation variables such as foreign ownership and financial revision by external auditors are positively related to certification.

Propensity of direct exports

Table 6 shows the impact of MSC on export activity. Certification positively affects the exports in all models (support for Hypothesis 1). The magnitude of the impact is 6.06% in equation (4), 21.7% in equation (5) and 15.2% in equation (6). It is interesting to note that the impact is lowest in equation (4) when the model is considering certification as exogenous. When modelling certification as endogenous, its impact on export is much stronger.

In equations, the female management is not statistically associated to the propensity of direct export (support for hypothesis H2).

Looking at equation 6, we note that average marginal effect of foreign ownership on export is considerable (10.4%) and statistically significant. The impact of certification decreases from 21.7% to 15.2% reducing also statistical significance. This result is consistent with the argument that certification is an effective tool to promote export especially in case the firm faces reputation gaps.

Gender, certification and export

We may observe additional indirect evidence of the interplay between reputation and certification analysing the impact of MSC on export engagement by gender of the management. Assuming that female managers suffer from reputation gaps more than male managers because of persisting prejudices, we argue that firms managed by females are suffering higher reputation gaps. Therefore, if a female-led firm obtains certification it should be more likely to export than certified firms that are managed by men.

Table 7 reports the average marginal effects of MSC on export by management gender based on estimates presented in Table 8. Looking at column (6a) we see in the upper panel that certified firms with male managers have more chances (13.9 percentage points) to engage in exports than non-certified firms. Female-managed certified firms have 20.2 percentage points more than non-certified firms. The lower panel at column (3) shows the difference between female- and male-managed firms and the associated statistical significance. Looking at column (6a) we see that female-managed firms export more (20.2%) than male-managed firms (13.8%) and this difference (6.4%) is statistically significant. A similar pattern can be observed for equation 4a and 5a.

As certified female-managed firms have higher chances to direct export than certified man-managed firms, we can conclude that in

Table 8. Models estimates.

	(1)	(2)	(3)		(4)	
Model	Probit -	Probit		Biprobit	Biprobit with reputation	
Dep. variable	MCS	Direct Exports	MCS	Direct Exports	MSC	Direct Exports
MCS		0.267***		0.936***		0.686**
		(3.97)		(4.46)		(2.57)
Female Manager	−0.0304	−0.168*	−0.0318	−0.171*	−0.0296	−0.171*
	(−0.47)	(−1.82)	(−0.49)	(−1.91)	(−0.46)	(−1.87)
MCS with Female Manager		0.337**		0.372**		0.390**
		(2.10)		(2.41)		(2.47)
Firm characteristics						
Ln Employees	0.225***	0.221***	0.224***	0.157***	0.198***	0.156***
	(11.01)	(9.21)	(10.94)	(4.94)	(9.28)	(4.57)
Ln Age	0.0639	−0.0241	0.0643	−0.0312	0.0725*	−0.00146
	(1.62)	(−0.50)	(1.64)	(−0.67)	(1.83)	(−0.03)
Website communication	0.389***	0.477***	0.386***	0.383***	0.373***	0.411***
	(7.49)	(7.09)	(7.43)	(5.22)	(7.16)	(5.38)
IV						
Foreign Technology	0.482***		0.496***		0.455***	
	(7.73)		(8.12)		(7.29)	
Number of tax controls	0.0210**		0.0239**		0.0210**	
	(2.20)		(2.55)		(2.22)	
Reputation						
Foreign Ownership					0.261***	0.524***
					(2.95)	(5.30)
External Auditors					0.182***	0.0158
					(3.56)	(0.24)
Industries: Textile (ref. category)						
Leather	−0.0439	−1.758***	−0.0372	−1.664***	−0.000197	−1.768***
	(−0.13)	(−3.60)	(−0.11)	(−3.49)	(−0.00)	(−3.74)
Garments	0.150	−0.315	0.142	−0.324*	0.151	−0.333*
	(0.69)	(−1.62)	(0.66)	(−1.67)	(0.68)	(−1.69)
Food	0.471**	−0.923***	0.444**	−0.988***	0.464**	−0.972***
	(2.19)	(−4.66)	(2.08)	(−4.95)	(2.08)	(−4.80)
Metals and machinery	0.444**	−0.377*	0.412*	−0.462**	0.427*	−0.443**
	(2.03)	(−1.89)	(1.90)	(−2.29)	(1.88)	(−2.16)
Electronics	0.386	−0.389	0.358	−0.474*	0.370	−0.475*
	(1.39)	(−1.48)	(1.30)	(−1.80)	(1.31)	(−1.81)
Chemicals and pharmaceuticals	0.613**	−0.359	0.581**	−0.488*	0.545**	−0.517*
	(2.26)	(−1.34)	(2.17)	(−1.82)	(1.96)	(−1.94)
Wood and furniture	−0.168	−0.487**	−0.178	−0.432**	−0.158	−0.446**
	(−0.69)	(−2.28)	(−0.75)	(−1.99)	(−0.64)	(−2.02)
Non-metallic and plastic materials	0.364	−0.495**	0.333	−0.557***	0.347	−0.541***
	(1.63)	(−2.42)	(1.50)	(−2.71)	(1.50)	(−2.59)
Other manufacturing	0.225	−0.666***	0.193	−0.687***	0.201	−0.707***
	(0.99)	(−3.20)	(0.86)	(−3.26)	(0.85)	(−3.31)
Retail and wholesale trade	−0.0480	−1.508***	−0.0752	−1.433***	−0.0700	−1.482***
	(−0.23)	(−8.00)	(−0.36)	(−7.29)	(−0.32)	(−7.40)
Hotels and restaurants	−0.0346	−1.871***	−0.0532	−1.773***	−0.0384	−1.842***
	(−0.15)	(−7.47)	(−0.24)	(−6.95)	(−0.16)	(−7.06)
Other Services	0.141	−0.799***	0.108	−0.804***	0.114	−0.818***
	(0.65)	(−4.04)	(0.50)	(−4.00)	(0.51)	(−4.00)
Other: construction, transportation, etc	0.224	−1.939***	0.196	−1.906***	0.221	−1.903***
	(1.04)	(−8.57)	(0.91)	(−8.22)	(0.99)	(−8.11)
Countries: Uzbekistan (ref. category)						
Albania	0.843***	0.577**	0.801***	0.382*	0.867***	0.479*
	(4.37)	(2.49)	(4.16)	(1.66)	(4.44)	(1.93)
Armenia	0.656***	0.512**	0.632***	0.376*	0.688***	0.452**
	(3.63)	(2.32)	(3.51)	(1.76)	(3.77)	(1.96)
Azerbaijan	0.211	−0.433	0.195	−0.457	0.223	−0.364
	(1.13)	(−1.39)	(1.06)	(−1.54)	(1.19)	(−1.18)
Belarus	0.466*	0.493*	0.412	0.399	0.370	0.408
	(1.75)	(1.81)	(1.54)	(1.53)	(1.35)	(1.48)
Bosnia and Herzegovina	1.051***	1.165***	1.030***	0.917***	0.992***	1.028***
	(5.80)	(5.47)	(5.73)	(4.19)	(5.45)	(4.37)
Bulgaria	0.822***	1.090***	0.806***	0.893***	0.817***	0.990***
	(4.32)	(4.91)	(4.28)	(4.03)	(4.28)	(4.14)
Croatia	0.653***	1.199***	0.627***	1.037***	0.637***	1.133***
	(3.11)	(5.03)	(3.00)	(4.40)	(3.02)	(4.53)
Estonia	0.644**	1.477***	0.604**	1.295***	0.605**	1.393***
	(2.42)	(5.01)	(2.28)	(4.38)	(2.25)	(4.49)
North Macedonia	1.130***	1.288***	1.109***	1.023***	1.156***	1.144***
	(6.04)	(5.88)	(5.97)	(4.51)	(6.13)	(4.62)

(*Continued*)

Table 8. (Continued).

	(1)	(2)	(3)		(4)	
Model	Probit -	Probit	Biprobit		Biprobit with reputation	
Georgia	0.534**	0.395	0.515**	0.272	0.531**	0.359
	(2.34)	(1.30)	(2.29)	(0.94)	(2.34)	(1.19)
Hungary	1.774***	0.659***	1.759***	0.279	1.777***	0.462*
	(9.00)	(2.73)	(8.98)	(1.10)	(9.02)	(1.65)
Kazakhstan	0.745***	0.0660	0.730***	−0.0559	0.781***	0.0662
	(3.77)	(0.24)	(3.72)	(−0.21)	(3.94)	(0.23)
Kosovo[§]	0.870***	0.846***	0.837***	0.626***	0.921***	0.795***
	(4.52)	(3.65)	(4.37)	(2.73)	(4.73)	(3.22)
Kirgyz Republic	0.668***	0.391*	0.646***	0.279	0.650***	0.282
	(3.56)	(1.69)	(3.46)	(1.25)	(3.43)	(1.17)
Latvia	0.597***	1.445***	0.592***	1.281***	0.570**	1.354***
	(2.58)	(6.00)	(2.60)	(5.36)	(2.47)	(5.37)
Lithuania	0.420*	1.439***	0.411*	1.288***	0.437**	1.397***
	(1.91)	(5.98)	(1.89)	(5.46)	(1.99)	(5.62)
Moldova	0.329*	0.239	0.297	0.172	0.331*	0.210
	(1.66)	(0.90)	(1.50)	(0.68)	(1.66)	(0.78)
Montenegro	0.795***	0.216	0.760***	0.0423	0.767***	0.119
	(3.53)	(0.60)	(3.37)	(0.12)	(3.39)	(0.31)
Poland	0.948***	0.751***	0.918***	0.544**	0.985***	0.658***
	(4.91)	(3.22)	(4.75)	(2.36)	(5.02)	(2.64)
Romania	1.045***	0.998***	1.017***	0.761***	1.031***	0.849***
	(5.90)	(4.76)	(5.77)	(3.54)	(5.78)	(3.65)
Serbia	1.019***	1.284***	0.995***	1.041***	1.011***	1.172***
	(5.43)	(5.92)	(5.32)	(4.65)	(5.33)	(4.85)
Slovak Republic	1.326***	0.953***	1.291***	0.635**	1.297***	0.786***
	(6.07)	(3.79)	(5.91)	(2.41)	(5.89)	(2.78)
Slovenia	0.512*	1.964***	0.505*	1.792***	0.500*	1.861***
	(1.79)	(6.97)	(1.77)	(6.47)	(1.71)	(6.36)
Ukraine	0.259	0.227	0.249	0.183	0.302*	0.261
	(1.47)	(1.10)	(1.43)	(0.92)	(1.70)	(1.23)
_cons	−2.793***	−1.825***	−2.747***	−1.539***	−2.800***	−1.708***
	(−9.37)	(−6.30)	(−9.21)	(−5.25)	(−9.05)	(−5.46)
Rho			−0.410		−0.276	
athrho p-value			0.003		0.098	
Obs.	4111	4111	4111		4111	

[§]*This designation is without prejudice to positions on status; t* statistics in parentheses
* p < .10, ** p < .05, *** p < .01

terms of export, firms managed by females benefit more from management system certification than firms managed by men (support H4).

Supplementary analyses

We conduct an extensive supplementary analyses to assess the validity and stability of our results on gender, certification and export. First, we assess whether the results are confirmed across industries. Then we discuss issue of endogeneity implementing a matching technique and a sensitivity analysis.

Industry heterogeneity

Possible unobserved heterogeneity may bias estimates of the gender-certification association with direct exports. Unobserved characteristics of the industry such as export-orientation and sectorial structure of female employment may influence the results of the analysis. For example, service-based organizations (where there is often a higher share of female workers) may be more likely to focus on export activities. At the same time, industries like Metals and Machinery and Electronics where there are likely to be fewer female workers, and especially managers (and have the highest proportion of certified firms), may experience a gender – certification association. Previous estimates shown in Table 7 include a set of 2 digits ISIC industry dummies to account for industries specificities. More technically, the association certification-gender-export can shift across industries (different intercept coefficients) but it is implicitly assumed the same across the industry (same slope coefficient). In this section, we distinguish three industries (Metals, Machinery and Electronics; Services and, Other industries)

Table 9. Proportion of exporting firms by MSC and gender (descriptive).

		Metals, Machinery and Electronics	Services	Other industries
Male manager	MCS	0.59	0.15	0.35
	No MCS	0.23	0.08	0.15
	MCS – No MCS	*0,36*	*0,07*	*0,20*
Female manager	MCS	0.45	0.14	0.39
	No MCS	0.20	0.05	0.17
	MCS – No MCS	*0,25*	*0,09*	*0,22*
	Observations	300	2246	1565

Table 10. Propensity of direct exports AME by industries.

	(1)	(2)	(3)
	Metals, Machinery and Electronics	Services	Other industries
No MCS	ref.	ref.	ref.
MCS with Male manager	0.442***	0.214***	0.349***
	(0.065)	(0.050)	(0.054)
MCS with Female manager	0.435***	0.317***	0.442***
	(0.165)	(0.078)	(0.079)
MCS for Female manager – MCS for Male mananager	−0.00785	0.103*	0.0932
	(0.165)	(0.0605)	(0.0634)
Observations.	300	2246	1573

Notes: Results of biprobit with reputation variables are reported; the model includes a three-way interaction between certification, gender and industries. Standard errors in parentheses.
* p <.10, ** p <.05, *** p <.01

looking at the proportion of exporting firms by MSC and gender (Table 9) and then we repeat our analysis by industries to investigate whether the certification-gender-export association differs per industry (Table 10). Table 9 documents that the proportion of exporting firms changes considerably across industries but certified firms are more export oriented regardless of the gender. It is important to note that the difference between certified and uncertified firms is higher for female managers in all industries with the exception of Metals, Machinery and Electronics (that it is the less numerous one in our sample). A similar pattern can be observed in Table 10 that reports the Bivarite probit estimates with reputation variables and three-ways interaction between certification, gender and industries. Ceteris paribus, female-managed certified firms export more than male-managed certified in all industries with the exception of Metals, Machinery and Electronics. This effect achieves 10% statistically significance only in the service sector. A possible explanation for this pattern can be related to the fact that manufactured items are first produced and then consumed, while most services are produced and consumed at the same time and in the same place. To the extent that inspection of products (before consumption) reduces gender prejudice and the inspection is more feasible in the manufacturing than in the services industries, then it is reasonable that certification benefits female-led firms more in services than in manufacturing industries. Other industry-related specificities such as labour force composition and prevalence of female leadership may still play a role. Further research is advisable.

We can conclude that management system certification is associated with higher export propensity in all industries. On average, female-managed firms benefit more than male managed firm and this effect is most prominent in the service sector.

Endogeneity

Since the present study relies on observational cross-sectional data, endogeneity and simultaneity between gender, certification and export can be an issue. It may well be that firms with female managers are more competitive than companies with male managers, and therefore more keen to engage in export-oriented activities regardless of certification, or that certified export-oriented firms are more concerned with gender issues and then they may retain more female managers. Unfortunately, given data restriction there is no variable that is correlated with gender management and not with export. For this reason, in this section, we attempt to mitigate causal inference concerns by implementing a Coarsened Exact Matching (CEM) procedure. CEM is a matching method (Iacus, King, and Porro 2011, 2012; Blackwell et al. 2009) that approximates randomized experiments by reducing dissimilarities between the 'treated' group (female–led firms) and the 'control' group (male–led firms).[4] CEM temporally coarsens auxiliary variables into meaningful groups, creates strata on the basis of these coarsened variables, and then only retains observations from strata that contain at least one

[4]CEM is successfully implemented in many research fields including innovation studies (Aggarwal and Hsu 2014; Huwei and Zhao (2020), environmental research (Riillo, 2017), and survey methodology (Sarracino, Riillo, and Mikucka 2017; Schork, Riillo, and Neumayr 2021).

observation from both samples (see Iacus, King, and Porro 2011, 2012 for a more detailed explanation of the CEM procedure).

Here, we coarsen employment (<20 employees, 20–99, 100 and over), age (0–5 years, 6–10; 11–50; 51 and over) and industries (metals, etc.; services and other industries). All other variables that are in the export equation are exactly matched. As we are focusing on the impact of gender on export among certified firms, we exclude CEM firms that are not certified. This has the advantage of increasing comparability between male- and female-managed firms.

Table 11 shows the distribution of firm characteristics before and after the CEM procedure. Second and fourth columns report the averages of variables in the women group, while the third and fifth columns report the averages of variables in the men group. The stars indicate that the differences between the averages of the web and telephone samples are statistically significant. Table 11 suggests that before CEM, the two group have different characteristics. After CEM, with the exception of age, the differences between woman and man managed firms are not statistically significant.

Table 12 reports the average marginal effect of female management on export with different specifications of a probit model implemented on post CEM data. Certified firms with female managers have more chances (6.6 percentage points) to engage in exports than comparable firm with male managers.

Table 11. Characteristics of certified firms before and after CEM procedure.

	Pre-CEM		Post-CEM	
Variable	Women	Men	Women	Men
Ln Employees	3.16	3.70***	3.18	3.19
	(0.11)	(0.045)	(0.11)	(0.061)
Ln Age	2.56	2.68**	2.57	2.52
	(0.049)	(0.021)	(0.048)	(0.037)
Web communication	0.67	0.79***	0.68	0.68
Foreign Ownership	0.11	0.13	0.096	0.096
External Auditors	0.45	0.54**	0.45	0.45
Industries				
Metals, Machinery and Electronics	0.067	0.12**	0.057	0.057
Services	0.54	0.42***	0.55	0.55
Other industries	0.39	0.46	0.39	0.39
Observations	163	890	157	664

Means (or proportions) are reported. Robust standard errors of continuous variables are in parentheses. Stars indicate that the difference between women and men sample is statistically significant.
* p < .10 ** p < .05 *** p < .01

Sensitivity to unobservable confounders

A general issue of matching methods such as CEM is the potential existence of unobserved confounders, that is, the used data set lacks important auxiliary variables that affect treatment and outcome variables (Rosenbaum 2005). Not accounting for unobserved confounders might lead to insufficient matching and therefore to flawed results. Sensitivity analyses measure how important unobserved confounders need to be in order to sufficiently change the group effect estimate. As suggested by VanderWeele and Ding (2017) and Linden, Mathur, and VanderWeele (2020), we measure sensitivity based on the E-value. The E-value is defined as the minimum association on the risk ratio scale of an unobserved variable with both the group assignment (i.e. gender) and the outcome in order to explain away an observed association between group assignment and outcome, conditional on the observed variables. The E-value has a range from 1 to infinity. The higher an E-value, the less sensitive an analysis is to unobserved confounders.

Based on results of the equation 3 of Table 12, we first compute the risk ratio of women (1.28 with 95% CI (1.02, 1.61)) and then the E-value: 1,87 (lowest 95% CI of E-value 1.15). This means that an unmeasured confounder that is associated with gender and with export by risk ratios of 1.87-fold each could nullify the observed association, but weaker confounding could not. Figure 3 reports the sensitivity

Table 12. Propensity of direct exports for MSC firms after CEM procedure (AME).

	(1)	(2)	(3)
	Direct Exports	Direct Exports	Direct Exports
Women	0.0634*	0.0599*	0.0656**
	(0.036)	(0.034)	(0.032)
Firm characteristics			
Ln Employees		0.0726***	0.0502***
		(0.011)	(0.011)
Ln Age		0.0341	0.0405
		(0.027)	(0.025)
Web Communication			0.109***
			(0.030)
Reputation			
Foreign Ownership			0.239***
			(0.065)
External Auditors			0.0401
			(0.027)
Industry dummies	Yes	Yes	Yes
Countries dummies	Yes	Yes	Yes
Observations	805	805	805

Robust standard errors in parentheses.
Notes: Average marginal effect of a probit model on prost CEM data. Industry dummies are 2 digits ISIC code, leather and Montenegro are dropped because they predict failure perfectly.
* p <.10, ** p <.05, *** p <.01

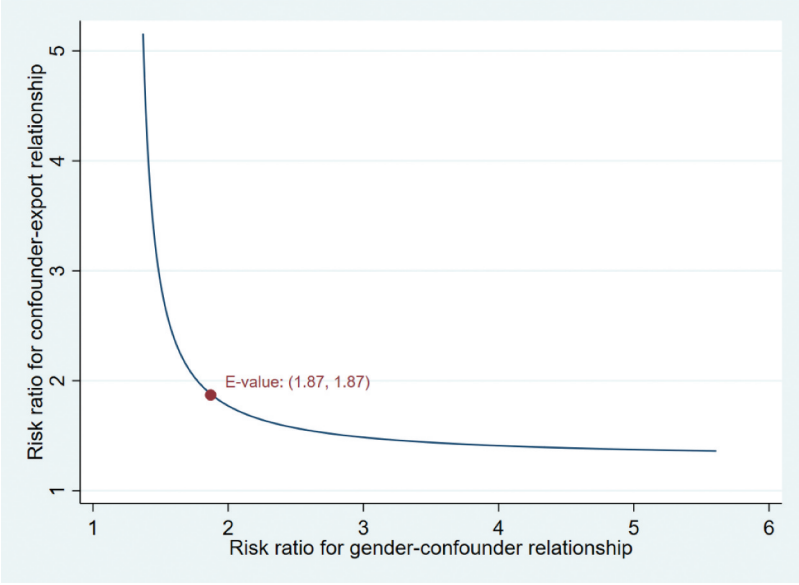

Figure 3. Value of the joint minimum strength of association on the risk ratio scale that an unmeasured confounder must have to fully explain away an observed gender-export risk ratio of 1.28.

analysis, showing all possible combinations of risk ratios needed to explain away the observed association. How plausible is it that there is an unobserved confounder with a risk ratio higher than 1.87? Is the observed E-value, 1,87 low or high? Literature does not suggest a minimum critical E-value. As rough reference point, we take the risk ratio of employment, one of the strongest and well-known drivers of export. As the Risk ratio for one standard deviation of employment is 1.34, we conclude that our analysis is overall robust to possible endogeneity issues.

V. Discussion and conclusions

This paper aims to explore whether international management system certification may help to compensate the gender prejudice and therefore increase the likelihood of female-managed firms to engage in exporting activities. We argue that international certification signals that the management system meets international standards, which provides confidence in the company. This confidence is in particular needed for firms based in developing and in transition countries lacking alternative sources of credibility. In the business world dominated by men, female leadership may be another reason to have less confidence in a company.

This study empirically tests whether certification increases exporting propensity and under which conditions. In particular, we look at the mediating effect of female management on the relationship between certification and export.

The empirical analysis is based on data from Enterprise Surveys, conducted by the World Bank in 2013 that includes 4111 medium-sized and large manufacturing and service firms from 25 Central- and Eastern-European countries in transition. We implement a recursive bivariate model with instrumental variables to mitigate endogeneity of certification and export.

In line with previous literature, we document that Management System certification – MS certification – is positively associated with export propensity (e.g. Goedhuys and Sleuwaegen 2013). Our findings show that the impact of certification on export propensity decreases in magnitude when other sources of reputation are available such as foreign ownership. The most innovative outcome of our research is that certified female-managed firms have higher export potential than certified man-managed firms. We can conclude that in terms of export, firms managed by females benefit more from MS certification based on international standards than firms managed by men. This result is consistent with the view that certification is an

effective tool to increase legitimacy of firms in transition economies (Zhang, Jiang, and Noorderhaven 2019; Xie, Tingyou, and Yi 2011). Credible certifications not only alleviate reputation gap due to absence of institutional support (Goedhuys and Sleuwaegen 2016; Perugini and Selezneva 2015) but also compensate gender prejudice.

This research opens many venues of research. Even if shown that MS certification increases the chances of export, because of data limitation we are not able to disentangle the effects of the management system itself from the signalling effect of the certificate.

The econometric model hinges on the external validity of the instruments and on an extensive sensitivity analysis to mitigate concerns of endogeneity. Future research may use panel (or experimental) data to better assess this issue. Ideally, future data should assure external validity of the results and include both developing and developed countries. Future work may investigate the relationship between gender, MS certification and export explicitly incorporating also the productivity of firms. From an econometric point of view, our model considers the certification as endogenous but the female management is taken as an exogenous variable. That means that the drivers and the conditions that influence the female leadership are not considered. Further investigation is needed to deepen our understanding on the drivers and the conditions that conduct women to lead a company. It would be interesting to also investigate the purchase side: how do purchase managers weigh the different factors when choosing suppliers, including the gender of the top manager? Replication of our study in other parts of the world is recommended as well. The countries in our sample have a tradition of acceptance of women whereas this is apparently less the case in the countries they export to. How would figures be if export would be in the opposite direction, so purchase in these countries? Gender equality being one of the United Nations' Sustainable Development Goals, better insights in these issues could be a starting point for unmasking and combatting conscious or unconscious discrimination.

Our study on female-managed firms could be enhanced by looking at female-owned firms. Even if in most small business the manager and the owner are the same, we expect that the gender prejudice is more severe in the case of the female managers rather than the case when the owner is a woman and the manager is a man because the manager is more visible to the outside world. Additionally, our research focused on the propensity to engage in export activities (also known as extensive margin) neglecting the share of export (also known intensive margin) because reputation gap and female prejudice should be stronger when a firm starts exporting. However, future research should investigate whether and how gender prejudice and certification effect change after starting to export. In other words, building on the work of Kapri (2019), future research could investigate whether after starting to export, certified female-led firm have higher export share than male-managed firms. All these interesting questions are left for the future.

Acknowledgments

Authors appreciate the feedbacks of the participants at the EURAS 2016 Annual Standardisation Conference in Montpellier, France, 29 June – 1 July 2016 and at the EURAS 2021 (virtual) Annual Standardisation Conference 6–9 September 2021, Aachen, Germany. Authors would also like to thank anonymous referees and editors for their careful and constructive reviews. Cesare A.F. Riillo gratefully acknowledges the support of the Observatoire de la Compétitivité, Ministère de l'Economie, DG Compétitivité, Luxembourg, and STATEC, the National Statistical Institute of Luxembourg. Views and opinions expressed in this article are those of the author and do not reflect those of STATEC or STATEC Research and funding partners.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Cesare A.F. Riillo http://orcid.org/0000-0002-4006-5242
Ivana Mijatovic http://orcid.org/0000-0002-7624-0356
Henk J. de Vries http://orcid.org/0000-0003-4535-2715

Authors' Contributions

CR was responsible for econometric analysis, figures, study design, literature search, data collection and writing; IM for study design, literature search, data collection, and writing; HdV for literature search, study design, and writing.

References

Acharyya, R. 2005. *Product Standards, Exports and Employment – An Analytical Study*. Heidelberg, Germany: Physica – Verlag, A Springer Company. doi:10.1007/b137327.

Aggarwal, V. A., and D. H. Hsu. 2014. "Entrepreneurial Exits and Innovation." *Management Science* 60 (4): 867–887. doi:10.1287/mnsc.2013.1801.

Akerlof, G. A. 1970. "The Market for "Lemons": Quality Uncertainty and the Market Mechanism." *The Quarterly Journal of Economics* 84 (3): 488–500. doi:10.2307/1879431.

Blackwell, M., S. Iacus, G. King, and G. Porro. 2009. "CEM: Coarsened Exact Matching in Stata." *Stata Journal* 9 (4): 524–546. doi:10.1177/1536867X0900900402.

Blind, K. 2002. "Driving Forces for Standardization at Standardization Development Organizations." *Applied Economics* 34 (16): 1985–1998. doi:10.1080/00036840110111158.

Blind, K., A. Mangelsdorf, and J. Wilson. 2013. "Mutual Recognition of Accreditation: Does It Matter to Trade? Evidence from the Food, Beverage, and Tobacco Industry." In *Nontariff Measures with Market Imperfections: Trade and Welfare Implications*, edited by J. Beghin, 291–310. Frontiers of Economics and Globalization, Bingley UK: Emerald Group Publishing Limited.

Blind, K., A. Mangelsdorf, and J. Pohlisch. 2018. "The Effects of Cooperation in Accreditation on International Trade: Empirical Evidence on ISO 9000 Certifications." *International Journal of Production Economics* 198: 50–59. doi:10.1016/j.ijpe.2018.01.033.

Chaudhuri, K., S. Sasidharan, and R. S. N. Raj. 2018. "Gender, Small Firm Ownership, and Credit Access: Some Insights from India." *Small Business Economics* 54 (4): 1165–1181. doi:10.1007/s11187-018-0124-3.

Chen, J., C. M. P. Sousa, and H. Xinming. 2016. "The Determinants of Export Performance: A Review of the Literature 2006-2014." *International Marketing Review* 33 (5): 626–670. doi:10.1108/IMR-10-2015-0212.

Clougherty, J. A., and M. Grajek. 2014. "International Standards and International Trade: Empirical Evidence from ISO 9000 Diffusion." *International Journal of Industrial Organization* 36 (C): 70–82. doi:10.1016/j.ijindorg.2013.07.005.

Dankers, C. 2003. *Environmental and Social Standards, Certification and Labelling for Cash Crops*. Rome, Italy: Food and Agriculture Organization of the United Nations.

De Vries, H. J. 1998. "The Classification of Standards." *Knowledge Organization* 25 (3): 79–89.

De Vries, H. J., A. J. Feilzer, H. C. W. Gundlach, and C. A. J. Simons. 2010. "Conformity Assessment." In *Standardisation in Companies and Markets*. 3rd ed., edited by W. Hesser, A. J. Feilzer, and H. J. De Vries, 871–904. Hamburg, Germany: Helmut Schmidt University.

Eagly, A. H., and L. L. Carli. 2003. "The Female Leadership Advantage: An Evaluation of the Evidence." *Leadership Quarterly* 14 (6): 807–834. doi:10.1016/j.leaqua.2003.09.004.

Enterprise Surveys (2014). Indicator Descriptions -Nov 24th, 2014-, The World Bank. http://www.enterprisesurveys.org

Ferro, E. (2011). Signaling and Technological Marketing Tools for Exporters. In World Bank Policy Research Working Paper 5547. 10.1596/1813-9450-5547.

Fikru, M. G. 2014a. "Firm Level Determinants of International Certification: Evidence from Ethiopia." *World Development* 64: 286–297. doi:10.1016/j.worlddev.2014.06.016.

Fikru, M. G. 2014b. "International Certification in Developing Countries: The Role of Internal and External Institutional Pressure." *Journal of Environmental Management* 144: 286–296. doi:10.1016/j.jenvman.2014.05.030.

Franceschini, F., M. Galetto, L. Mastrogiacomo, and L. Viticchiè. 2008. "Diffusion of ISO 9000 and ISO 14000 Certification in Italian Commodity Sectors." *International Journal of Quality & Reliability Management* 25 (5): 452–465. doi:10.1108/02656710810873862.

Frondel, M., K. Krätschell, and L. Zwick. 2018. "Environmental Management Systems: Does Certification Pay?" *Economic Analysis and Policy* 59: 14–24. doi:10.1016/j.eap.2018.02.006.

Fura, B., Q. Wang. 2017. "The level of socioeconomic development of EU countries and the state of ISO 14001 certification." *Quality Quantity* 51 (1): 103–119. doi:10.1007/s11135-015-0297-7

Goedhuys, M., and L. Sleuwaegen. 2013. "The Impact of International Standards Certification on the Performance of Firms in Less Developed Countries." *World Development* 47: 87–101. doi:10.1016/j.worlddev.2013.02.014.

Goedhuys, M., and L. Sleuwaegen. 2016. "International Standards Certification, Institutional Voids and Exports from Developing Country Firms." *International Business Review* 25 (6): 1344–1355. doi:10.1016/j.ibusrev.2016.04.006.

Greene, W. H. 2003. *Econometric Analysis*. 5th ed. Hoboken, New Jersey: Prentice-Hall.

Helpman, E., M. Melitz, and Y. Rubinstein. 2008. "Estimating trade flows: Trading partners and trading volumes". *The quarterly journal of economics* 123 (2): 441–487. doi:10.1162/qjec.2008.123.2.441.

Helpman, E., Melitz, M. and Rubinstein, Y., 2008. "Estimating trade flows: Trading partners and trading volumes". *The quarterly journal of economics* 123 (2): 441-487. doi:10.1162/qjec.2008.123.2.441.

Hillman, A. L. 1994. "The Transition from Socialism: An Overview from a Political Economy Perspective." *European Journal of Political Economy* 10 (1): 191–225. doi:10.1016/0176-2680(94)90067-1.

Hudson, J., and M. Orviska. 2013. "Firms' Adoption of International Standards: One Size Fits All?" *Journal of Policy Modeling* 35 (2): 289–306. doi:10.1016/j.jpolmod.2012.04.001.

Huwei, W., and Z. Zhao. 2021. "How Does China's Industrial Policy Affect Firms' R&D Investment? Evidence from 'China Manufacturing 2025." *Applied Economics*. 55 (53): 6333–6347. doi:10.1080/00036846.2020.1717429.

Iacus, S. M., G. King, and G. Porro. 2011. "Multivariate Matching Methods that are Monotonic Imbalance Bounding." *Journal of the American Statistical Association* 106 (493): 345–361. doi:10.1198/jasa.2011.tm09599.

Iacus, S. M., G. King, and G. Porro. 2012. "Causal Inference without Balance Checking: Coarsened Exact Matching." *Political Analysis* 20 (1): 1–24. doi:10.1093/pan/mpr013.

ISO (2009). Certification. http://www.iso.org/iso/home/standards/certification.htm Accessed 16 December 2020.

Kapri, K. 2019. "Impact of Political Instability on Firm-level Export Decisions." *International Review of Economics and Finance* 59: 98–105. doi:10.1016/j.iref.2018.08.008.

Keiichiro, H.,T. Otsuki, J. Wilson. 2015. "Food Safety Standards and International Trade: The Impact on Developing Countries' Export Performance. "In Food Safety, Market Organization, Trade and Development, edited by A. Hammoudi, C. Grazia, Y. Surry and J.B. Traversac. Cham, Switzerland: Springer International Publishing. doi:10.1007/978-3-319-15227-1.

Linden, A., M. B. Mathur, and T. J. VanderWeele. 2020. "Conducting Sensitivity Analysis for Unmeasured Confounding in Observational Studies Using E-values: The Evalue Package." *Stata Journal* 20 (1): 162–175. doi:10.1177/1536867X20909696.

Manders, B. (2014). *Implementation and Impact of ISO 9001* (ERIM PhD Series Research in Management 337). Erasmus Research Institute of Management ERIM.

Marques, H. 2015. "Does the Gender of Top Managers and Owners Matter for Firm Exports?" *Feminist Economics* 21 (4): 89–117. doi:10.1080/13545701.2015.1029958.

Martincus, C. V., S. Castresana, and T. Castagnino. 2010. "ISO Standards: A Certificate to Expand Exports? Firm-Level Evidence from Argentina." *Review of International Economics* 18 (5): 896–912. doi:10.1111/j.1467-9396.2010.00915.x.

Masakure, O., J. Cranfield, and S. Henson. 2009a. "Factors Affecting the Incidence and Intensity of Standards Certification Evidence from Exporting Firms in Pakistan." *Applied Economics* 43 (8): 901–915. doi:10.1080/00036840802600103.

Masakure, O., S. Henson, and J. Cranfield. 2009b. "Standards and Export Performance in Developing Countries: Evidence from Pakistan." *The Journal of International Trade & Economic Development* 18 (3): 395–419. doi:10.1080/09638190902986538.

Mijatovic, I., S. Miladinovic, and D. Stokic. 2015. "Corporate Social Responsibility in Serbia: Between Corporate Philanthropy and Standards." In *Corporate Social Responsibility in Europe: United in Sustainable Diversity*, edited by S. O. Idowu, R. Schmidpeter, and M. S. Fifka, 333–350. Cham, Switzerland: Springer International Publishing. doi:10.1007/978-3-319-13566-3_18.

Orser, B., M. Spence, A. Riding, and C. A. Carrington. 2010. "Gender and Export Propensity." *Entrepreneurship Theory and Practice* 34 (5): 933–958. doi:10.1111/j.1540-6520.2009.00347.x.

Oya, C., F. Schaefer, and D. Skalidou. 2018. "The Effectiveness of Agricultural Certification in Developing Countries: A Systematic Review." *World Development* 112: 282–312. doi:10.1016/j.worlddev.2018.08.001.

Peng, M. W. 2000. *Business Strategies in Transition Economies*. Thousand Oaks, California: Sage Publication, .

Perugini, C., and E. Selezneva. 2015. "Labour Market Institutions, Crisis and Gender Earnings Gap in Eastern Europe." *Economics of Transition* 23 (3): 517–564. doi:10.1111/ecot.12072.

Pulignano, V. 2017. "Workplace Inequality, Trade Unions and the Transnational Regulation of the Employment Relationships: The Case of Europe." *Employee Relations* 39 (3): 351–364. doi:10.1108/ER-07-2016-0144.

Racine, J. L. (2011). Harnessing Quality for Global Competitiveness in Eastern Europe and Central Asia. The World Bank, http://documents.worldbank.org/curated/en/629041468030582964/Harnessing-quality-for-global-competitiveness-in-Eastern-Europe-and-Central-Asia Accessed 21 December 2020.

Ramón-Llorens, M. C., E. García-Meca, and A. Duréndez. 2017. "Influence of CEO Characteristics in Family Firms Internationalization." *International Business Review* 26 (4): 786–799. doi:10.1016/j.ibusrev.2017.01.007.

Regis, P. J., and X. Jiaotong. 2018. "The Extensive and Intensive Margins of Exports of Firms in Developing and Emerging Countries." *International Review of Economics and Finance* 56: 39–49. doi:10.1016/j.iref.2018.03.016.

Reynaud, E., C. P. Egri, D. A. Ralston, W. Danis, A. Starkus, M. Dabic, and A. Wallace. 2007. "The Differences in Values between Managers of the European Founding Countries, the New Members and the Applicant Countries: Societal Orientation or Financial Orientation?" *European Management Journal* 25 (2): 132–145. doi:10.1016/j.emj.2007.02.005.

Riillo, C. A. F. 2014. "Is ISO 9000 Good for Business? - A Review of Large Quantitative Studies-". *Issues of Business and Law* 8: 30–57.

Riillo, C. A. F. 2017. "Beyond the Question "Does It Pay to Be Green?": How Much Green? And When?". *Journal of Cleaner Production* 141: 626–640. doi:10.1016/jclepro.2016.09.039.

Rosenbaum, P. R. 2005. "Sensitivity Analysis in Observational Studies." In *Encyclopedia of Statistics in Behavioral Science*, edited by B. S. Everitt and D. C. Howell, 1451–1462. Chichester: John Wiley & Sons, .

Sarracino, F., C. A. F. Riillo, and M. Mikucka. 2017. "Comparability of Web and Telephone Surveys for the Measurement of Subjective Well-being." *Survey Research Methods* 11 (2): 141–169. doi:10.18148/srm/2017.v11i2.6740

Schork, J., C. A. F. Riillo, and J. Neumayr. 2021. "Survey Mode Effects on Objective and Subjective Questions: Evidence from the Labour Force Survey." *Journal of Official Statistics* 37 (1): 213–237. doi:10.2478/jos-2021-0009.

Siougle, E., S. Dimelis, and C. Economidou. 2018. "Does ISO 9000 Certification Matter for Firm Performance? A Group Analysis of Greek Listed Companies." *International Journal of Production Economics* 209: 2–11. doi:10.1016/j.ijpe.2018.04.028.

VanderWeele, T. J., and P. Ding. 2017. "Sensitivity Analysis in Observational Research: Introducing the E-value."." *Annals of Internal Medicine* 167 (4): 268–274. doi:10.7326/M16-2607.

World Bank (2014). Enterprise Surveys Indicator Descriptions available at https://www.enterprisesurveys.org/content/dam/enterprisesurveys/documents/Indicator-Descriptions.pdf. Accessed February 10, 2018.

World Trade Organization (2005). *World Trade Report 2005*. Geneva: World Trade Organization. Available at https://www.wto.org/english/res_e/booksp_e/anrep_e/world_trade_report05_e.pdf .

World Trade Organization (2013). Members Grapple with Certifying Products, and Certifying the Certifiers, Technical Barriers to Trade: Formal Meeting, 29 and 31 October 2013 https://www.wto.org/english/news_e/news13_e/tbt_29oct13_e.htm .

Xie, B., L. Tingyou, and Q. Yi. 2011. "Organic Certification and the Market: Organic Exports from and Imports to China." *British Food Journal* 113 (10): 1200–1211. doi:10.1108/00070701111177647.

Zhang, J., J. Jiang, and N. Noorderhaven. 2019. "Is Certification an Effective Legitimacy Strategy for Foreign Firms in Emerging Markets?". *International Business Review* 28 (2): 252–267. doi:10.1016/j.ibusrev.2018.09.003.