A CROSS-COUNTRY EMPIRICAL STUDY TOWARDS THE IMPACT OF FOLLOWING ISO MANAGEMENT SYSTEM STANDARDS ON EURO-AREA ECONOMIC CONFIDENCE

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Please cite this article as:	Article History:
Armeanu, S.D., Vintilă, G. and Gherghina, S.C., 2017. A Cross-Country Empirical Study Towards the Impact of Following ISO Management System Standards on Euro-Area Economic Confidence. *Amfiteatru Economic*, 19(44), pp. 144-165	Received: 30 September 2016 Revised: 23 November 2016 Accepted: 21 December 2016

Abstract
This study aims to examine the impact of following ISO management system standards on economic sentiment indicator (ESI) as proxy of economic agents' general view concerning economic activity, for 21 European Union member states over 2005-2014. The empirical research comprises ISO standards with reference to management systems towards quality (ISO 9001, ISO 13485, ISO 16949), food safety (ISO 22000), environment (ISO 14001), and information security (ISO 27001). Panel data fixed effects regression models provide support for a positive impact of the quality management systems related to automotive industry, as well as information security management systems, on the ESI. Further, dynamic panel data approach by way of two-step system generalized method of moments emphasizes a positive influence of quality management systems standard for the medical device industry on Euro-area economic confidence, but a negative effect of food safety management systems. Also, ISO 9001, ISO 22000, and ISO 14001 Granger cause ESI.

Keywords: ISO management systems standards, EU economic sentiment indicator, panel data fixed effects regression model, generalized method of moments, Granger causality

JEL Classification: C33, L15

Introduction

The globalization phenomenon of world economy alongside the extent of international trade has driven to the quick processes of quality internationalization, as a fundamental part of companies' competitiveness (Ruževičius, 2008). Likewise, the development of technology augmented the diversity of the products and services existing on the market (Başaran, 2016). Therefore, the worldwide setting constrains companies towards being more responsive to customers and intensify requirements for higher quality (İşeri-Say,

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Toker and Kantur, 2008). The focus should be on innovation so as to satisfy consumers and to overcome competitors in a competitive circumstance (Martínez-Costa and Martínez-Lorente, 2008). The aim of the International Organization for Standardization (hereinafter 'ISO') is to develop standards on a wide-reaching foundation to let businesses to go beyond national borders without creating trade barriers (Prajogo, Tang and Lai, 2012). Quality Management Systems (hereinafter 'QMS'), Environmental Management Systems (hereinafter 'EMS'), alongside Occupational Health and Safety Management Systems (hereinafter 'OHSMS') are imperative as clients impose high standards of quality, commitment to better environmental practices, as well as tasks that care for workers commencing illegal or unsafe practices (Oliveira, 2013). Moreover, information security is a major concern for businesses, public bodies, their customers, and the public (Gillies, 2011). Thereby, ISO 27000 was established on behalf of protecting organizations' information assets, the 'life-blood' of all companies (Humphreys, 2006) and carries a management approach to information security, supporting companies to set, uphold, and constantly develop an Information Security Management System (hereinafter 'ISMS').

Nevertheless, the market shows information asymmetry since customers frequently do not have broad understanding about features of the products and its suppliers. Standardization can relatively solve the issue of information asymmetry through product quality standards which may allow consumers to differentiate high quality products from low quality ones. Thus, Nicolau and Sellers (2002) provided evidence that the stock market reacts positively to ISO 9000 following, proving that quality certification can be regarded as a useful tool for lessening the information asymmetry between buyers and sellers. Also, Terlaak and King (2006) suggested that certification may give a way of communicating about unobservable firm attributes, so creating a growth effect for certified organizations. Further, quality management standards support to distinguish firms that guarantee a steady product quality from those that might be less trustworthy (Manders, Vries and Blind, 2016). Accordingly, King, Lenox and Terlaak (2005) noticed that companies certify with ISO 14001 to lessen information asymmetries with supply chain partners.

Large-scale organizations require suitably designed formalized procedures and hierarchical structure to circumvent disorder and assure efficiency, quality, and timeliness (Adler, 1999). Gotzamani and Tsiotras (2002) highlighted the positive or optimistic view which claim that standards' implementation may help meliorate internal structure, external and internal connection by means of obvious fixed duties and responsibilities, employees' awareness towards quality, and customer's trust through improved products' compliance. On the other side, the negative or pessimistic view pretends the occurrence of a static quality system, which augment bureaucracy and cut flexibility abreast innovation.

Standards are intended to increase efficiencies in a company and so improve performance (Ochieng, Muturi and Njihia, 2015). There are two approaches which stress how quality management practices influence business performance (Lafuente, Bayo-Moriones and García-Cestona, 2010). According to operational view, the companies that follow quality management schemes enhance their performance due to managing production process failures, guiding workers to discover potential sources of quality gains, and engaging to customer contentment. Further, the strategic approach suggests that the costs caused by quality melioration should be viewed as investments, whilst the related benefits are reflected in firm performance.

This research contributes to the literature by empirically exploring the impact of following ISO management system standards on economic agents' overall view concerning economic

activity as proxied by economic sentiment indicator (hereinafter 'ESI) for the European Union (hereinafter 'EU') member states. The economic sentiment indicator aims to pursue the whole economic activity, being a composite measure made up of five sectoral confidence indicators with different weights, namely Industrial confidence indicator (40%), Services confidence indicator (30%), Consumer confidence indicator (20%), Retail trade confidence indicator (5%), and Construction confidence indicator (5%). Besides, the weights are set according to the representativeness of each considered sector, as well as the tracking performance regarding the gross domestic product growth. ESI, abreast confidence indicators for industry, construction, retail trade, services, consumers, and financial services, are computed by Commission's Directorate General for Economic and Financial Affairs (hereinafter 'DG ECFIN') based on survey-data. According to OECD (2001), the harmonised business survey in industry took place initially in 1962, the harmonised business survey in the construction sector was introduced in 1996, the harmonised survey in retail trade was applied in 1984, the harmonised consumer survey was employed in 1972, whereas the harmonised business survey in the service sector was started in 1996. The surveys undertaken by DG ECFIN allow comparisons regarding the business cycles amongst EU Member States, therewith emphasizing an essential monitoring tool towards the economic evolution of the Eurozone, also examining the progress achieved by the applicant countries. Therefore, the main advantage of these indicators is their ability to properly point out the forthcoming economic change. Likewise, confidence indicators can provide essential facts regarding optimist or pessimist beliefs which are significant drivers of the business cycle. In this context, the financial crisis abreast the sovereign debt period highlighted an overall climate of extremely low confidence

The paper proceeds as follows: previous related studies are discussed in the next section. Data and empirical specifications are presented in Section 2. Empirical results are showed in Section 3. Last section concludes the study.

1. Literature review

ISO 9001 refers to an international standard that establishes requirements for the management of quality (Elmuti and Kathawala, 1997). Based on customer focus principle, firms hinge on their customers and should recognize and meet the needs of current and future consumers and further should attempt to go beyond their expectations, whereas the leadership principle set a clear image of the company future (Manders, Vries and Blind, 2016). As such, Rao, Ragu-Nathan and Solis (1997) examined the association between ISO 9000 and the level of quality management practices and quality results within firms from China, India, Mexico, and the United States and emphasised that ISO 9000 certification had a significant impact on leadership, strategic quality planning, good supplier relationships, and customer satisfaction. Clougherty and Grajek (2008) analysed the influence of ISO implementation on economic affairs between countries, based on panel data disclosed by OECD states over 1995-2002 and find no effect of ISO diffusion in developed nations, but a positive impact on international trades and foreign direct investments in developing nations. Tzelepis et al. (2006) studied a sample of 1,572 firms from three Greek manufacturing industries and notice that ISO 9001 is a managerial item that lessen productive inefficiency. Ullah, Wei and Xie (2014) investigated a sample of companies from 31 Latin American and Caribbean countries and provide evidence that ISO-certified firms show significantly higher labour productivity and lower cost of sales than non-certified firms. Koc (2007) found that ISO 9000 implementation engenders a noteworthy difference on firm performance between certified and non-certified firms. Therewith, Aba,

Badar and Hayden (2016) surveyed the operating performance for a sample of 397 firms that had received ISO 9001 certification over 1991-2002 and reveal that certified firms performed better than those non-certified. Contrariwise, Quazi, Hong and Meng (2002) contradicted Rao, Ragu-Nathan and Solis (1997) and provided evidence for Singaporean firms that ISO 9001 has no influence on quality management practices and quality results. Also, Lima, Resende and Hasenclever (2000) compared the performance of Brazilian firms holding ISO 9000 certificates with a control group of companies without certification and document no performance gap across the two sets. İlkay and Aslan (2012) revealed no statistically significant difference between certified and non-certified companies in terms of performance for 255 small to medium-sized enterprises in Turkey.

Likewise, customer care, healthy and safe food, in conjunction with ecological standards embody merely some of the requisites that modern business call for from manufacturers of food products (Djordjevic, Cockalo and Bogetic, 2011). The food industry is not only accountable for producing safe food, but also for proving in a clear way how food safety has been planned and assured (Fotopoulos, Kafetzopoulos, and Psomas, 2009). Thus, Baş, Yüksel and Çavuşoğlu (2007) seen better customer self-reliance as a benefit of applying a food safety management system (hereinafter 'FSMS'). Beyond greater consumer confidence, Qijun and Batt (2016) mentioned as well the benefits most often associated with the implementation of a third party certified FSMS: 'improved product quality and safety, reduced costs, access to new markets, increased market share, fewer customer complaints, improved productivity, improved profitability, an improved company image or reputation, the need to comply with legislation'.

Certifying to the ISO 14001 standard is an internationally recognized signal that a firm has applied a system to alleviate and constantly improve its environmental impact (McGuire, 2014). The central foundation for the creation of ISO 14001 was that its universal approval should ease international trade by harmonizing other environmental management standards and by giving a transnationally recognized blueprint for sustainable development, pollution prevention, and compliance assurance (Delmas, 2002). Hence, based on a panel study of 108 countries over seven years, Prakash and Potoski (2006) stated that trade relations boost ISO 14001 taking on if states' key export markets have applied this voluntary regulation. Besides, ISO 9001 is customer-driven, whilst ISO 14001 is more driven by stakeholders, the community or regulators (Zeng et al., 2005). Consequently, ISO 14001 may be noticed by the market as a reactive rather than a proactive investment (Cañón-de-Francia and Garcés-Ayerbe, 2009). For a panel data of Japanese manufacturing firms over 1996-2007, Nishitani (2011) documented that EMS implementation increases firm value added via demand increase and productivity improvement. On the contrary, Watson et al. (2004) did not establish any significant difference in financial performance between EMS adopters and non-EMS adopters. Also, He et al. (2015) pointed out that embracing ISO 14001 has insignificant effects on financial performance of Chinese firms. However, Yang, Hong and Modi (2011) exposed positive and significant effect of environmental management on firm performance in developed countries, but such links did not occur in developing states.

Further, since security issues emerge as a vital part of everyday life, organizations should guarantee that they are adequately secured (Saint-Germain, 2005). Thus, Filipek (2007) conveyed that information security come to be a business priority. ISO 27000 certification confirm that the company own the right people, processes, and technology in place, whilst the senior management is devoted to the firm security comprising the protection of private customer facts (Benner, 2007).

2. Research methodology

2.1 Data and variables

The initial sample comprised all EU 28 countries except Ireland (IE), which reported only the consumer confidence indicator. Subsequently, we remarked missing data for Denmark (DK), Estonia (EE), Latvia (LV), Lithuania (LT), Finland (FI), and Sweden (SE). Hence, the estimations will be performed for 21 EU countries for the period of time spanning from 2005 to 2014, as follows: Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Cyprus (CY), Czech Republic (CZ), France (FR), Germany (DE), Greece (EL), Hungary (HU), Italy (IT), Luxembourg (LU), Malta (MT), Netherlands (NL), Poland (PL), Portugal (PT), Romania (RO), Slovak Republic (SK), Slovenia (SI), Spain (ES), and United Kingdom (UK).

The variables employed within empirical investigation, as well as period availability and data sources are presented in Table no. 1.

Table no. 1: Description of the variables

Variables	Description	Period	Source
Dependent variables			
(1) ESI	The economic sentiment indicator, computed for every year as mean of monthly reported values.	1993-2014	DG ECFIN – Business and Consumer Surveys
Independent variables			
Variables related to ISO management system standards			
• **Quality**			
(2) ISO9001	The number of certifications regarding the implementation of standards for quality management systems.	1993-2014	ISO Survey
(3) ISO13485	The number of certifications regarding the implementation of quality management system standards for the medical device industry.	2004-2014	ISO Survey
(4) ISO16949	The number of certifications regarding the implementation of standards for quality management systems related to automotive industry.	2004-2014	ISO Survey
• **Safety and security**			
(5) ISO22000	The number of certifications regarding the implementation of standards for food safety management systems.	2007-2014	ISO Survey
• **Environment**			
(6) ISO14001	The number of certifications regarding the implementation of standards for environmental management systems.	1999-2014	ISO Survey
• **Information security**			
(7) ISO27001	The number of certifications regarding the implementation of standards for information security management systems.	2006-2014	ISO Survey

Variables	Description	Period	Source
Country-level control variables			
(8) Growth	Real gross domestic product growth.	1993-2014	Euromonitor International
(9) DCPS	Domestic credit to private sector (% of GDP), namely financial resources provided to the private sector by financial corporations.	1993-2014	World Bank
(10) RDE	Research and development expenditure (% of GDP), covering basic research, applied research, and experimental development.	1996-2014	World Bank
(11) CBB	Commercial bank branches (per 100,000 adults).	2001-2014	World Bank
(12) NBR	The number of new businesses registered.	2004-2014	World Bank
(13) PRB	The number start-up procedures to register a business.	2003-2014	World Bank
(14) TSB	The time required to start a business (days).	2003-2014	World Bank
(15) LDC	The number of listed domestic companies.	1993-2014	World Bank
(16) MCLDC	Market capitalization of listed domestic companies (% of GDP).	1993-2014	World Bank
(17) ST	Stocks traded, total value (% of GDP).	1993-2014	World Bank
(18) BEDI	Business extent of disclosure index (0 = less disclosure to 10 = more disclosure).	2005-2014	World Bank
(19) EMAS	The number of organizations and sites with eco-management and audit scheme registration.	2005-2014	European Commission – Directorate general for environment
(20) REGQ	Regulatory quality which reflects perceptions of the ability of the government to formulate and apply sound policies and regulations that allow and support private sector development (ranges from approximately –2.5 (weak) to 2.5 (strong) governance performance).	1996-2014	World Bank – Worldwide Governance Indicators

Therefore, we examine ISO standards concerning quality (ISO 9001, ISO 13485, ISO 16949), food safety (ISO 22000), environment (ISO 14001), and information security (ISO 27001). Moreover, since the effectiveness of ISO certification may also be determined by the country's whole institutional setting and economic progress (Ullah, Wei and Xie, 2014), several country-level control variables were covered within research. For instance, Djankov et al. (2002) explored the regulation of entry by start-up firms in 85 countries in 1999 and reveal that difficult law of access is related with greater corruption and a larger unofficial economy, but not with better quality of private or public goods. Using panel data for 130 countries from 1995 to 2001, Neumayer and Perkins (2005) stressed that a low regulatory burden, great manufacturing operations, large rates of secondary school enrolment, and weak productivity are positively linked with the number of ISO 9000 certificates. Contrariwise, based on firm-level data for 48 developing and emerging states, Paunov (2016) revealed that corruption negatively impacts firms' possession of quality certificates.

2.2 Quantitative approach

Our baseline model explores the impact of implementing ISO management system standards at country-level, both individual, as well as integrated, on ESI, by means of panel data fixed effects regressions, as below:

$$ESI_{it} = \alpha_0 + \sum_{j=1}^{6} \beta_j ISO_{it} + \sum_{k=1}^{13} \gamma_k Controls_{it} + \varepsilon_{it} \quad (1)$$

where:

i – EU countries: 1-21

t – period of time: 2005-2014

ESI – economic sentiment indicator (dependent variable)

ISO – variables regarding ISO management system standards (explanatory variables)

Controls – country-level control variables

α_0 – constant term

$\beta_1, \beta_2, \ldots, \beta_6, \gamma_1, \gamma_2, \ldots, \gamma_{13}$ – regression coefficients

ε_{it} – the error term.

Besides, the explanatory variables could be correlated with the error term, issue known as endogeneity. Onward, in order to address the potential endogeneity issue and to examine the robustness of empirical results, the basic model is estimated through a dynamic panel data (hereinafter 'DPD') framework by means of two-step system generalized method of moments (hereinafter 'GMM'), as follows:

$$ESI_{it} = \alpha_0 + \beta_1 ESI_{it-1} + \beta_2 ESI_{it-2} + \sum_{j=3}^{8} \beta_j ISO_{it} + \sum_{k=1}^{13} \gamma_k Controls_{it} + \varepsilon_{it} \quad (2)$$

Furthermore, we will employ the Granger approach in order to check the causal relationship between ISO management system standards and ESI. Accordingly, ISO certifications Granger-cause ESI if predictions of the value of ESI based on its own past values and on the past values of ISO certifications are better than predictions of ESI based only on its own past values. The aforementioned statement implies the following general system which comprises two sets of equations (Kónya, 2006):

$$\begin{aligned} ESI_{1t} &= \alpha_{11} + \sum_{l=1}^{p_1} \beta_{11l} ESI_{1t-l} + \sum_{l=1}^{p_1} \delta_{11l} ISO_{1t-l} + \varepsilon_{11t} \\ &\vdots \\ ESI_{Nt} &= \alpha_{1N} + \sum_{l=1}^{p_1} \beta_{1Nl} ESI_{Nt-l} + \sum_{l=1}^{p_1} \delta_{1Nl} ISO_{Nt-l} + \varepsilon_{1Nt} \end{aligned} \quad (3)$$

$$\begin{aligned} ISO_{1t} &= \alpha_{21} + \sum_{l=1}^{p_2} \beta_{21l} ISO_{1t-l} + \sum_{l=1}^{p_2} \delta_{21l} ESI_{1t-l} + \varepsilon_{21t} \\ &\vdots \\ ISO_{Nt} &= \alpha_{2N} + \sum_{l=1}^{p_2} \beta_{2Nl} ISO_{Nt-l} + \sum_{l=1}^{p_2} \delta_{2Nl} ESI_{Nt-l} + \varepsilon_{2Nt} \end{aligned} \quad (4)$$

where:

i – EU countries: 1-21

t – period of time: 2005-2014

l – lag.

In addition, ε_{1Nt} and ε_{2Nt} are supposed to be white-noise errors that may be correlated for a given country, but not across countries, whereas ESI and ISO are presumed stationary.

3. Empirical findings

3.1 Summary statistics, correlation analysis, and stationarity examination

Descriptive statistics for the selected variables are revealed in Table no. 2, whereas Figure no. 1 and Annex no. 1 provide the evolution of ESI, respectively ISO management system standards, over the examined period. The highest mean values of ESI are registered by FI (102.03), SE (101.90), and DK (101.64), but the lowest mean values are observed in PT (99.07), DE (99.04), and HR (98.16). In respect of the ISO management system standards, we notice that ISO 9001 standard for quality management systems and ISO 14001 standard for environmental management systems show the highest mean rate of adoption, whilst ISO 27001 standard for information security management systems and ISO 22000 standard for food safety management systems reveal the lowest mean rate of implementation.

Table no. 2: Descriptive statistics

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
(1) ESI	555	100.22	8.86	74.76	117.44
(2) ISO9001	584	10,357.84	21,715.27	1.00	168,960.00
(3) ISO13485	282	282.66	651.30	0.00	4,140.00
(4) ISO16949	280	342.17	614.97	1.00	3,356.00
(5) ISO22000	213	204.74	291.35	1.00	1,720.00
(6) ISO14001	428	2,203.91	4,011.57	1.00	27,178.00
(7) ISO27001	234	164.07	313.10	1.00	2,261.00
(8) Growth	594	2.32	3.55	-16.20	11.60
(9) DCPS	552	77.19	51.31	1.13	311.98
(10) RDE	459	1.38	0.87	0.20	3.91
(11) CBB	291	39.33	22.92	11.29	110.98
(12) NBR	251	45,663.05	76,473.12	1,641.00	53,7658.00
(13) PRB	308	6.47	2.74	2.00	15.00
(14) TSB	308	20.76	18.60	2.50	138.00
(15) LDC	514	365.66	658.51	0.00	3,538.00
(16) MCLDC	407	56.15	49.10	0.06	330.02
(17) ST	491	27.43	37.65	0.00	265.96
(18) BEDI	260	5.73	2.50	1.00	10.00
(19) EMAS	259	151.95	350.83	0.00	1,619.00
(20) REGQ	432	1.16	0.45	-0.16	2.08

Notes: Variables' description is provided in Table no. 1.

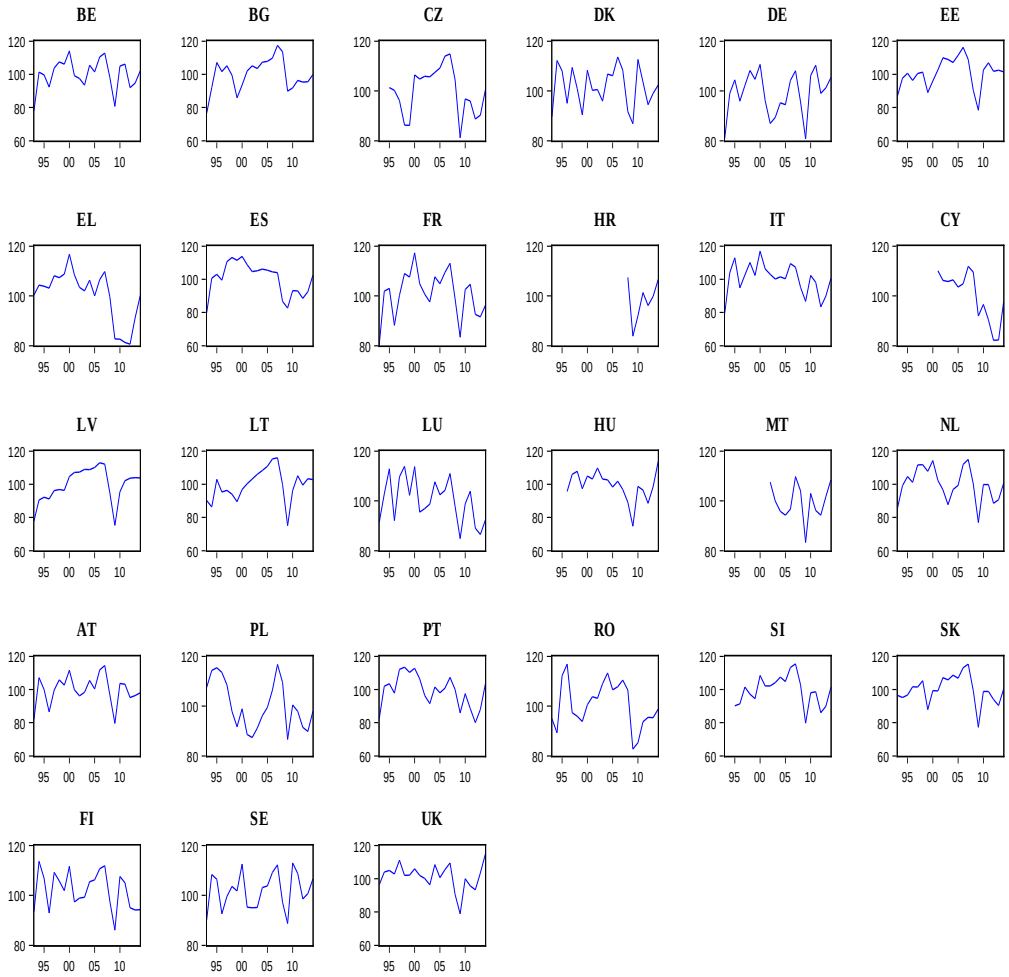

Figure no. 1: Panel-data line plots for ESI (EU 28, except IE)

Notes: Variables' description is provided in Table no. 1.

The highest versus the lowest mean values of ISO certifications by EU countries are pointed out in Table no. 3.

Table no. 3: Highest vs. lowest mean values of ISO certifications

ISO	Highest mean values	Lowest mean values
ISO9001	IT (75,903.09), UK (47,851.45), DE (34,259.18)	CY (338.41), MT (240.14), LU (130)
ISO13485	DE (2,476.55), IT (1,424.60), UK (1,250.82)	LV (3.27), MT (1.83), CY (1.57)
ISO16949	DE (2,870.36), FR (970.18), IT (948.45)	LT (4.70), MT (4.10), EL (3.91)
ISO22000	EL (1,158.38), RO (720.38), PL (510.13)	EE (13.75), LU (3.17), MT (2.86)
ISO14001	IT (10,898.88), ES (10,527.69), UK (8,763.56)	CY (54.69), LU (35.31), MT (11.40)
ISO27001	UK (1,243.89), ES (495.56), IT (446.44)	LU (4.33), MT (3.25), EE (1.50)

Notes: Variables' description is provided in Table no. 1.

We notice that Italy registers almost the highest mean values for all ISO standards, except ISO 22000, whereas Malta shows nearly the lowest mean values for all ISO standards.

The correlations between variables are exhibited in Table no. 4. We remark strong uphill (positive) linear relationships between: ESI and Growth (0.71), ISO9001 and ISO14001 (0.83), ISO9001 and EMAS (0.71), ISO131485 and ISO16949 (0.85), ISO16949 and EMAS (0.82), ISO27001 and NBR (0.72). Thereby, in order to get rid of the occurrence of multicollinearity statistical phenomenon, we will include the variables previously stated in separate regression equations.

Table no. 4: Correlation matrix

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
(1) ESI	1									
(2) ISO9001	-0.05	1								
(3) ISO13485	-0.03	0.63	1							
(4) ISO16949	-0.03	0.58	**0.85**	1						
(5) ISO22000	-0.19	0.28	0.14	0.12	1					
(6) ISO14001	-0.16	**0.83**	0.57	0.52	0.31	1				
(7) ISO27001	-0.06	0.49	0.51	0.33	0.24	0.75	1			
(8) Growth	**0.71**	-0.17	-0.1	-0.07	-0.15	-0.2	-0.04	1		
(9) DCPS	-0.12	0.21	0.12	0.1	-0.02	0.23	0.16	-0.29	1	
(10) RDE	-0.01	0.1	0.27	0.24	-0.26	0.13	-0.04	-0.17	0.23	1
(11) CBB	-0.05	0.24	-0.12	-0.06	0.1	0.22	0	-0.03	0.27	-0.31
(12) NBR	-0.04	0.44	0.4	0.3	0.05	0.56	**0.72**	-0.05	0.26	0.06
(13) PRB	0.05	0.15	0.09	0.21	0.26	0.08	0.1	0.11	-0.08	-0.42
(14) TSB	0.18	-0.03	-0.17	-0.03	-0.01	-0.03	-0.05	0.26	-0.15	-0.26
(15) LDC	0.01	0.48	0.23	0.31	0.06	0.57	0.52	-0.06	0.36	0.15
(16) MCLDC	0.25	0.07	-0.05	-0.04	-0.15	0.01	-0.04	0.21	0.22	0.29
(17) ST	0.18	0.44	0.37	0.39	-0.05	0.37	0.4	-0.02	0.33	0.4
(18) BEDI	0.06	0.16	0.17	0.05	0.07	0.24	0.27	0.02	0.12	0.11
(19) EMAS	-0.07	**0.71**	0.67	**0.82**	0.18	0.64	0.31	-0.12	0.12	0.21
(20) REGQ	0.03	0.04	0.18	0.13	-0.41	0.04	0.05	-0.04	0.4	0.65
Variables	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**	**(19)**	**(20)**
(11) CBB	1									
(12) NBR	0.01	1								
(13) PRB	0.14	-0.02	1							
(14) TSB	0.26	-0.09	0.52	1						
(15) LDC	0.24	0.66	0.15	0.2	1					
(16) MCLDC	0.32	0.2	0	0.1	0.3	1				
(17) ST	0.04	0.64	0.01	-0.04	0.58	0.43	1			
(18) BEDI	0.23	0.45	-0.42	-0.23	0.26	0.07	0.2	1		
(19) EMAS	0.15	0.15	0.32	0.14	0.43	-0.02	0.39	-0.05	1	
(20) REGQ	-0.18	0.18	-0.24	-0.11	0.22	0.55	0.44	0.12	0.04	1

Notes: Bold facts indicate high correlations. Variables' description is provided in Table no. 1.

Further, the results of panel unit root tests are displayed in Table no. 5. The outcomes provide support for data stationarity for the first generation, except ISO13485, ISO14001, ISO27001, PRB, BEDI, and REGQ. However, even though non-stationarity in panels may result in spurious regressions, Kao (1999) proved that the fixed effects estimator is consistent.

Table no. 5: Panel unit root tests

Variables	Method			
	Null: Unit root (assumes common unit root process)	Null: Unit root (assumes individual unit root process)		
	Levin, Lin & Chu t* (statistic)	Im, Pesaran and Shin W-stat (statistic)	ADF – Fisher Chi-square (statistic)	PP – Fisher Chi-square (statistic)
(1) ESI	**-7.74318*****	**-7.65341*****	**166.282*****	**226.456*****
(2) ISO9001	-0.95007	1.42815	52.7039	**69.7778**†
(3) ISO13485	0.32100	3.02772	35.6778	39.7858
(4) ISO16949	**-12.5151*****	**-6.42945*****	**144.328*****	**263.231*****
(5) ISO22000	**-4.39855*****	1.81592	45.3321	**88.7089****
(6) ISO14001	3.27271	6.81171	25.3602	28.5966
(7) ISO27001	3.13455	5.86611	11.1873	28.1555
(8) Growth	**-6.83729*****	**-6.43212*****	**136.214*****	**198.049*****
(9) DCPS	**-4.61434*****	-0.44645	55.1170	55.5625
(10) RDE	**-1.68481***	2.63611	35.2616	34.9380
(11) CBB	**-3.29354*****	1.20308	60.1126	**80.5880***
(12) NBR	**-7.97692*****	**-1.68620***	**74.5213****	33.8277
(13) PRB	-1.16400	0.26476	40.5824	36.5631
(14) TSB	**-19.4807*****	**-6.58508*****	**116.610*****	**146.645*****
(15) LDC	**-3.08679****	-0.93660	59.8568	53.0682
(16) MCLDC	**-5.64707*****	**-2.59260****	**67.8331***	**74.1638****
(17) ST	**-3.87557*****	**-2.90752****	**79.6549****	**83.3967****
(18) BEDI	-0.10783	1.44694	4.04213	11.2690
(19) EMAS	**-5.30540*****	1.05262	51.8122	63.0977
(20) REGQ	-0.52312	0.94301	49.5265	56.9581

*Notes: ***, **, *, † indicates statistical significance at the 0.1%, 1%, 5% and 10% significance level, respectively. Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality. Variables' description is provided in Table no. 1.*

3.2 Estimation results

The output of panel data fixed effects regressions concerning the influence of adopting ISO standards, independently considered and country-level controls on ESI is provided in Table no. 6. The results reveal that ISO 16949 standard for quality management systems related to automotive industry positively influences ESI (Eq3), but for the rest of ISO examined standards the associations are not statistically significant. The worldwide automotive industry runs under great pressures of cost and time and call for world class levels of product quality, productivity and competitiveness, alongside sustained progress. However, ISO 16949 underlines the development of a process adapted to quality management system that affords constant improvement, defect prevention, and decrease of variation and waste in the supply chain. The standard also supports manufacturers from emerging economies set dealings with producers in developing countries since this certificate serves as proof that they are skilled towards offering goods in line with the best industry practices. Also, several manufacturers cooperate only with enterprises which own such certification since they claim that suppliers should follow the rigorous technical provisions expose in the standard.

As regards the effect of control variables, we notice the positive impact on ESI by the Growth (Eq1-Eq6), MCLDC (Eq1-Eq3, Eq5, Eq6), as well as ST (Eq1-Eq6), but a negative influence as of LDC (Eq4) and BEDI (Eq1, Eq2, Eq4, Eq5). Based on the values related to R-sq within, the percent of the variation that can be explained by the regression equations varies between 83% and 86%.

Table no. 6: Panel data fixed effects regression models on the impact of adopting individual ISO management system standards and country-level controls on ESI

Variables	Eq1	Eq2	Eq3	Eq4	Eq5	Eq6
ISO9001	-0.00 (-0.24)					
ISO13485		0.00 (1.38)				
ISO16949			**0.0026†** **(2.09)**			
ISO22000				-0.00 (-0.14)		
ISO14001					0.00 (0.44)	
ISO27001						0.01 (1.68)
Growth	**2.44***** **(11.48)**	**2.44***** **(10.89)**	**2.44***** **(10.98)**	**2.43***** **(8.62)**	**2.43***** **(11.15)**	**2.44***** **(11.22)**
DCPS	0.01 (0.23)	0.03 (0.62)	0.03 (0.52)	-0.00 (-0.03)	0.01 (0.15)	0.02 (0.31)
RDE	1.13 (0.33)	-0.74 (-0.22)	0.76 (0.22)	3.76 (1.04)	0.14 (0.04)	-2.94 (-0.75)
CBB	0.04 (0.59)	0.05 (0.48)	0.02 (0.31)	0.11 (1.70)	0.04 (0.47)	0.12 (1.62)
NBR	0.00 (0.41)	0.00 (0.03)	0.00 (0.29)	0.00 (0.86)	0.00 (0.44)	
PRB	0.74 (0.93)	0.67 (0.81)	0.82 (1.07)	1.26 (1.15)	0.73 (0.94)	0.58 (0.86)
TSB	-0.09 (-1.24)	-0.10 (-1.60)	-0.09 (-1.31)	-0.07 (-0.56)	-0.10 (-1.46)	-0.10 (-1.27)
LDC	-0.00 (-0.30)	-0.00 (-0.23)	-0.00 (-0.28)	**-0.03*** **(-2.72)**	-0.00 (-0.14)	-0.01 (-1.54)
MCLDC	**0.03†** **(2.03)**	**0.04*** **(2.11)**	**0.03†** **(2.02)**	0.03 (1.17)	**0.04*** **(2.10)**	**0.05†** **(1.88)**
ST	**0.08*** **(2.64)**	**0.08*** **(2.53)**	**0.08*** **(2.39)**	**0.09*** **(2.50)**	**0.07*** **(2.58)**	**0.09**** **(2.93)**
BEDI	**-1.47***** **(-4.05)**	**-1.12*** **(-2.62)**	-1.24 (-1.53)	**-1.13*** **(-2.14)**	**-1.41**** **(-3.56)**	0.53 (0.83)
EMAS		-0.00 (-0.60)		0.00 (0.30)	-0.00 (-0.44)	**-0.01†** **(-1.84)**
REGQ	5.53 (0.91)	5.00 (0.96)	6.04 (1.00)	10.86 (1.71)	4.85 (0.95)	-0.01 (-0.00)
_cons	**85.90***** **(4.88)**	**85.28***** **(5.76)**	**82.10***** **(4.73)**	**79.54***** **(4.31)**	**87.03***** **(6.17)**	**86.35***** **(5.25)**
F stat	**392.59*****	**666.29*****	**541.66*****	**1374.24*****	**554.20*****	**189.90*****
R-sq within	0.84	0.84	0.84	0.86	0.84	0.83
Period	2005-2014	2005-2014	2005-2014	2007-2014	2005-2014	2006-2014
# Obs.	135	127	130	98	130	135
# Countries	21	20	20	20	20	20

*Notes: ***, **, *, † indicates statistical significance at the 0.1%, 1%, 5% and 10% significance level, respectively. The t-statistics are given in parentheses. Clustered robust standard errors at country level were considered. Eqs. 2, 3, 5, and 6 does not comprise Croatia. Eq. 4 does not comprise Cyprus. Variables' description is provided in Table no. 1.*

Onward, the impact of implementing ISO standards, simultaneously employed and country-level controls on ESI is provided in Table no. 7. We notice that ISO 27001 standard for information security management systems positively influences ESI (Eq1, Eq2), whereas the other ISO standards show no influence. Within current era of amplified information security breaches, ISO 27001 reveals to customers the pledge to high levels of information security. Thus, the clients may be confident that their information is set aside private, its integrity is preserved, being reachable only by right persons. In addition, Growth (Eq1-Eq4), CBB (Eq1-Eq3), MCLDC (Eq1-Eq2), and ST (Eq1-Eq4) exert a positive influence on ESI, whilst LDC (Eq1-Eq4) and BEDI (Eq4) negatively influence ESI. Almost as in Table no. 6, the explanatory power of the estimated models varies between 84% and 86%.

Table no. 7: Panel data fixed effects regression models on the impact of implementing integrated ISO management system standards and country-level controls ESI

Variables	Eq1	Eq2	Eq3	Eq4
ISO9001	-0.00 (-1.51)	-0.00 (-1.45)		
ISO13485	0.00 (0.77)		0.00 (0.38)	
ISO16949		-0.01 (-0.44)		-0.00 (-0.03)
ISO22000	-0.00 (-0.19)	-0.00 (-0.26)	-0.00 (-0.41)	-0.00 (-0.27)
ISO14001			0.00 (0.23)	0.00 (0.48)
ISO27001	**0.0078†** **(1.82)**	**0.0099*** **(2.31)**		
Growth	**2.52***** **(10.73)**	**2.55***** **(10.47)**	**2.45***** **(8.78)**	**2.44***** **(8.77)**
DCPS	0.02 (0.47)	0.03 (0.45)	0.02 (0.29)	0.02 (0.28)
RDE	-0.98 (-0.29)	-0.27 (-0.08)	3.10 (0.85)	4.79 (1.46)
CBB	**0.19†** **(1.91)**	**0.17**** **(2.92)**	**0.17†** **(1.79)**	0.09 (1.20)
NBR			0.00 (0.61)	0.00 (0.88)
PRB	0.33 (0.47)	0.41 (0.53)	1.33 (1.13)	1.43 (1.27)
TSB	-0.08 (-0.91)	-0.06 (-0.67)	-0.12 (-1.00)	-0.08 (-0.60)
LDC	**-0.01*** **(-2.57)**	**-0.01†** **(-2.09)**	**-0.03*** **(-2.33)**	**-0.03*** **(-2.10)**
MCLDC	**0.04*** **(2.14)**	**0.04†** **(2.08)**	0.03 (1.16)	0.03 (1.19)
ST	**0.11*** **(2.58)**	**0.10*** **(2.50)**	**0.09*** **(2.42)**	**0.09*** **(2.57)**
BEDI	0.25 (0.43)	0.52 (0.62)	-0.80 (-1.18)	**-1.81†** **(-2.06)**
EMAS			0.00 (0.21)	
REGQ	-0.44 (-0.08)	0.92 (0.15)	10.98 (1.65)	12.01 (1.72)
_cons	**87.40***** **(5.95)**	**86.38***** **(5.25)**	**72.01**** **(3.45)**	**76.95**** **(3.19)**
F stat	**145.97*****	**260.50*****	**4040.27*****	**490.53*****

Variables	Eq1	Eq2	Eq3	Eq4
R-sq within	0.84	0.84	0.86	0.86
Period	2007-2014	2007-2014	2007-2014	2007-2014
# Obs.	120	117	95	97
# Countries	21	20	20	20

*Notes: ***, **, *, † indicates statistical significance at the 0.1%, 1%, 5% and 10% significance level, respectively. The t-statistics are given in parentheses. Clustered robust standard errors at country level were considered. Eq. 2 and Eq. 4 does not comprise Cyprus. Eq. 3 does not comprise Croatia. Variables' description is provided in Table no. 1.*

3.3 Robustness checks

Two-step system GMM estimations' results on the influence of adopting ISO standards, independently considered and country-level controls on ESI is provided in Table no. 8. The results show the lack of any significant association between ISO standards and ESI. Concerning the control variables, the coefficients of Growth (Eq1-Eq5), PRB (Eq1-Eq3, Eq5), MCLDC (Eq5), and ST (Eq1-Eq3, Eq5) are positive and statistically significant, whilst TSB negatively influences ESI (Eq1-Eq5). Besides, the results of Sargan and Hansen test support the validity of the over-identifying restrictions. Also, Arellano-Bond test for AR(1) and AR(2) documents the absence of second order serial correlation.

Table no. 8: DPD estimations (two-step system GMM) on the impact of adopting individual ISO management system standards and country-level controls on ESI

Variables	Eq1	Eq2	Eq3	Eq4	Eq5	Eq6
L.ESI	-0.46 (-1.43)	-0.17 (-0.40)	-0.30 (-0.77)	-0.17 (-0.72)	**-0.29†** **(-1.93)**	0.04 (0.11)
L2.ESI	**0.67*** **(2.19)**	0.11 (0.13)	0.25 (0.71)	0.26 (0.36)	0.16 (0.45)	-0.44 (-0.47)
ISO9001	-0.00 (-0.85)					
ISO13485		-0.00 (-0.33)				
ISO16949			-0.00 (-0.38)			
ISO22000				-0.00 (-0.10)		
ISO14001					0.00 (0.17)	
ISO27001						0.01 (0.31)
Growth	**3.07***** **(5.63)**	**2.39**** **(3.02)**	**2.50**** **(3.79)**	**3.14**** **(3.00)**	**2.55***** **(4.59)**	1.91 (1.11)
DCPS	0.00 (0.01)	-0.03 (-0.35)	-0.09 (-0.47)	-0.02 (-0.19)	-0.03 (-0.37)	-0.04 (-0.40)
RDE	3.41 (0.37)	1.86 (0.30)	5.97 (1.24)	5.01 (0.77)	-2.95 (-0.99)	-2.42 (-0.32)
CBB	-0.00 (-0.01)	-0.02 (-0.09)	0.08 (0.37)	0.22 (0.86)	0.03 (0.19)	0.16 (0.56)
NBR	-0.00 (-0.31)	-0.00 (-0.37)	-0.00 (-0.15)	-0.00 (-0.11)	0.00 (0.03)	
PRB	**2.95**** **(3.05)**	**2.32*** **(2.12)**	**2.67*** **(2.60)**	2.42 (0.83)	**3.22***** **(6.10)**	0.65 (0.22)
TSB	**-0.32**** **(-2.92)**	**-0.29*** **(-2.54)**	**-0.25*** **(-2.25)**	**-0.47†** **(-1.74)**	**-0.42***** **(-6.61)**	-0.02 (-0.04)
LDC	-0.00	-0.00	-0.00	-0.00	0.00	-0.01

Variables	Eq1	Eq2	Eq3	Eq4	Eq5	Eq6
	(-0.21)	(-0.19)	(-0.26)	(-0.33)	(0.14)	(-0.77)
MCLDC	-0.01 (-0.59)	0.05 (1.68)	-0.00 (-0.09)	0.03 (0.51)	**0.06*** **(2.55)**	0.08 (1.45)
ST	**0.13†** **(2.01)**	**0.11*** **(2.58)**	**0.16**** **(3.29)**	0.09 (1.19)	**0.07*** **(2.41)**	0.16 (1.24)
BEDI	1.88 (1.26)	0.32 (0.13)	0.37 (0.25)	-0.44 (-0.25)	0.06 (0.05)	-1.68 (-0.31)
EMAS		-0.00 (-1.05)		-0.00 (-0.14)	-0.01 (.)	0.00 (0.05)
REGQ	-3.47 (-0.23)	1.39 (0.06)	-3.99 (-0.24)	5.35 (0.29)	7.12 (0.39)	12.08 (0.41)
_cons	48.31 (0.96)	**85.61†** **(1.88)**	**81.53†** **(1.82)**	55.57 (0.98)	**88.06***** **(5.29)**	122.59 (1.69)
F stat	**30.58*****	**127.81*****	**77.12*****	**15.97*****	**10.33*****	**173.40*****
AR(1) (p-value)	0.021	0.196	0.096	0.297	0.110	0.298
AR(2) (p-value)	0.229	0.421	0.194	0.632	0.084	0.881
Sargan test (p-value)	0.626	0.219	0.415	0.204	0.259	0.000
Hansen test (p-value)	0.682	0.957	0.856	0.553	0.996	0.549
# Instruments	26	28	26	28	28	26
Period	2005-2014	2005-2014	2005-2014	2007-2014	2005-2014	2006-2014
# Obs.	133	127	128	98	130	135
# Countries	21	20	20	20	20	20

*Notes: ***, **, *, † indicates statistical significance at the 0.1%, 1%, 5% and 10% significance level, respectively. The t-statistics are given in parentheses. Robust standard errors were considered. Eqs. 2, 3, 5, and 6 does not comprise Croatia. Eq. 4 does not comprise Cyprus. Variables' description is provided in Table no. 1.*

Forwards, the impact of implementing ISO standards, simultaneously employed and country-level controls on ESI assessed via two-step system GMM is showed in Table no. 9.

Table no. 9: DPD estimations (two-step system GMM) on the impact of implementing integrated ISO management system standards and country-level controls on ESI

Variables	Eq1	Eq2	Eq3	Eq4
L.ESI	0.40 (0.66)	0.52 (0.62)	0.66 (1.44)	0.34 (1.02)
L2.ESI	-0.17 (-0.23)	-0.43 (-0.40)	-0.42 (-0.81)	-0.34 (-1.31)
ISO9001	-0.00 (-0.44)	-0.00 (-0.51)		
ISO13485	**0.01†** **(1.77)**		0.01 (1.52)	
ISO16949		0.02 (1.24)		-0.01 (-0.86)
ISO22000	0.00 (0.10)	0.00 (0.25)	-0.00 (-0.64)	**-0.01*** **(-2.13)**
ISO14001			-0.00 (-1.69)	-0.00 (-0.56)
ISO27001	-0.02 (-1.22)	-0.00 (-0.00)		
Growth	**3.68***** **(4.87)**	**3.34*** **(2.54)**	0.97 (0.67)	1.35 (1.32)
DCPS	0.19	0.30	-0.08	-0.32

Variables	Eq1	Eq2	Eq3	Eq4
	(1.29)	(1.00)	(-0.59)	(-1.62)
RDE	-3.76 (-0.58)	-3.95 (-0.47)	**-26.60**† **(-1.94)**	-1.16 (-0.16)
CBB	0.22 (0.90)	0.22 (0.93)	-0.08 (-0.37)	-0.21 (-0.48)
NBR			0.00 (0.04)	-0.00 (-0.37)
PRB	-0.80 (-0.50)	-0.32 (-0.12)	-1.58 (-0.76)	1.51 (1.07)
TSB	**-0.44*** **(-2.27)**	-0.29 (-1.30)	-0.15 (-0.62)	0.01 (0.03)
LDC	0.01 (1.17)	-0.00 (-0.23)	0.00 (0.23)	0.01 (0.81)
MCLDC	**0.06**† **(1.86)**	0.05 (1.09)	**0.16*** **(2.13)**	**0.14**† **(1.79)**
ST	0.04 (0.68)	0.06 (0.86)	-0.05 (-1.00)	0.01 (0.19)
BEDI	-1.69 (-0.63)	-1.61 (-0.51)	5.14 (1.62)	4.38 (0.72)
EMAS			0.00 (0.44)	
REGQ	**-39.66**† **(-1.93)**	-27.03 (-0.62)	8.33 (0.72)	9.84 (0.71)
_cons	**101.34***** **(5.79)**	**86.91*** **(2.78)**	**97.07*** **(2.32)**	**93.16**** **(2.94)**
F stat	**54.79*****	**444.34*****	**97.86*****	**37.61*****
AR(1) (p-value)	0.064	0.414	0.312	0.191
AR(2) (p-value)	0.749	0.559	0.545	0.855
Sargan test (p-value)	0.019	0.054	0.352	0.045
Hansen test (p-value)	1.000	0.987	1.000	1.000
# Instruments	30	30	32	42
Period	2007-2014	2007-2014	2007-2014	2007-2014
# Obs.	118	115	95	95
# Countries	21	20	20	20

*Notes: ***, **, *, † indicates statistical significance at the 0.1%, 1%, 5% and 10% significance level, respectively. The t-statistics are given in parentheses. Robust standard errors were considered. Eq. 2 and Eq. 4 does not comprise Cyprus. Eq. 3 does not comprise Croatia.*
Variables' description is provided in Table no. 1.

We notice a positive influence on ESI by ISO 13485 standard of quality management systems for the medical device industry (Eq1) due to giving potentially entrance into new marketplaces since this standard fulfils the demands of legislation in every corner of the international trade. However, even if food safety has become an overwhelming challenge, the reduced mean number of ISO 22000 certifications (Table no. 2) caused a negative impact on ESI (Eq4).

In addition, the coefficients of Growth (Eq1, Eq2) and MCLDC (Eq1, Eq3, Eq4) are positive and statistically significant, but RDE (Eq3), TSB (Eq1), and REGQ (Eq1) negatively influence ESI. The Sargan and Hansen test indicate the validity of the instrumental variables, whilst Arellano-Bond test for AR(1) and AR(2) shows the lack of second-order serial correlation.

3.4 Causal relationships examination

The results of Granger causality analysis are revealed in Table no. 10. Therefore, we notice that ISO 9001 Granger causes ESI (for all the three lags) and ESI Granger causes ISO 9001 (for the first lag). Also, ISO 22000 (for the second and third lag) and ISO 14001 (for the first lag) Granger cause ESI. Moreover, ESI Granger causes ISO 16949 (for the third lag), ISO 14001 (for the second and third lag), and ISO 27001 (for the second and third lag).

Table no. 10: Pairwise Granger Causality Tests

Null Hypothesis	Lags					
	1		2		3	
	# Obs.	F-Stat (Prob)	# Obs.	F-Stat (Prob)	# Obs.	F-Stat (Prob)
ISO9001 does not Granger Cause ESI	519	**3.19008† (0.0747)**	492	**2.47103† (0.0856)**	465	**3.47129* (0.0161)**
ESI does not Granger Cause ISO9001		**3.19415† (0.0745)**		0.94754 (0.3884)		0.67828 (0.5657)
ISO13485 does not Granger Cause ESI	248	0.01823 (0.8927)	218	0.01149 (0.9886)	190	1.84723 (0.1402)
ESI does not Granger Cause ISO13485		0.07253 (0.7879)		0.02309 (0.9772)		0.61076 (0.6088)
ISO16949 does not Granger Cause ESI	250	0.07582 (0.7833)	224	1.97638 (0.1410)	198	0.32088 (0.8103)
ESI does not Granger Cause ISO16949		2.22892 (0.1367)		0.68176 (0.5068)		**3.58529* (0.0148)**
ISO22000 does not Granger Cause ESI	184	1.96094 (0.1631)	156	**5.60956** (0.0045)**	128	**4.11530** (0.0081)**
ESI does not Granger Cause ISO22000		0.81197 (0.3687)		0.50941 (0.6019)		0.04039 (0.9891)
ISO14001 does not Granger Cause ESI	388	**3.68305† (0.0557)**	361	2.05204 (0.1300)	334	1.42095 (0.2365)
ESI does not Granger Cause ISO14001		1.12899 (0.2887)		**5.14232** (0.0063)**		**2.95759* (0.0325)**
ISO27001 does not Granger Cause ESI	205	0.99843 (0.3189)	178	0.28774 (0.7503)	151	1.61627 (0.1882)
ESI does not Granger Cause ISO27001		0.64368 (0.4233)		**3.51970* (0.0317)**		**2.36593† (0.0734)**

*Notes: ***, **, *, † indicates statistical significance at the 0.1%, 1%, 5% and 10% significance level, respectively. Variables' description is provided in Table no. 1.*

Concluding remarks

Quality management systems are tremendously imperative for producers aiming to achieve better global competitiveness. However, customers are more selective in the lookout for only those products that are of high quality. Besides, an essential way of reaching high product quality is the attainment of ISO certification. Thus, implementing international standards within market emphasizes an essential approach in the course of improving competitiveness. Current research aimed to empirically investigate the impact of following ISO management system standards on economic sentiment indicator for European Union member states.

This study documented a positive impact of ISO 16949 standard for quality management systems related to automotive industry on ESI since innovation, first-class quality, and the highest standards across the whole supply chain are vital for success in the global automotive industry. The augmented worldwide competition within automotive industry, along with customer pressure determined manufacturers seek other ways aiming to become superior than the opponent, and provide higher quality products. Therefore, a certified management system in compliance with ISO 16949 is a pass to novel markets and clients.

As well, breaks in information security can let key data to be retrieved, stolen, degraded, or misplaced. Inasmuch as information is a precious resource which requests to be suitably sheltered, we find that ISO 27001 standard for information security management systems positively influences ESI. Besides, ISO 27001 aid to an enhanced oversight of information assets and apply controls to uphold defend for an information security breach.

Furthermore, supervisory authorities in major markets request manufacturers selling medical products in their countries to have a third-party audited and certified quality management system ready. Thus, ISO 13485 set requisites for organisations asked to exhibit their skill to offer medical devices that constantly meet client and regulatory requirements. Our results provide support for a positive influence of ISO 13485 standard of quality management systems for the medical device industry on ESI.

Due to globalization of production and procurement, food chains are extended and more complex, the safety of food being affected. Therefore, ISO 22000 is planned to afford safety by certifying that there are no fragile portions in the food supply chain. Unfortunately, we find a reduced mean number of such certifications and a negative impact on ESI. As for ISO 9001 standard for quality management systems and ISO 14001 standard for environmental management systems, we document the lack of statistically significant associations with ESI. Likewise, ISO 9001, ISO 22000, and ISO 14001 Granger cause ESI. Also, future research should be conducted by accounting for developed and developing nations.

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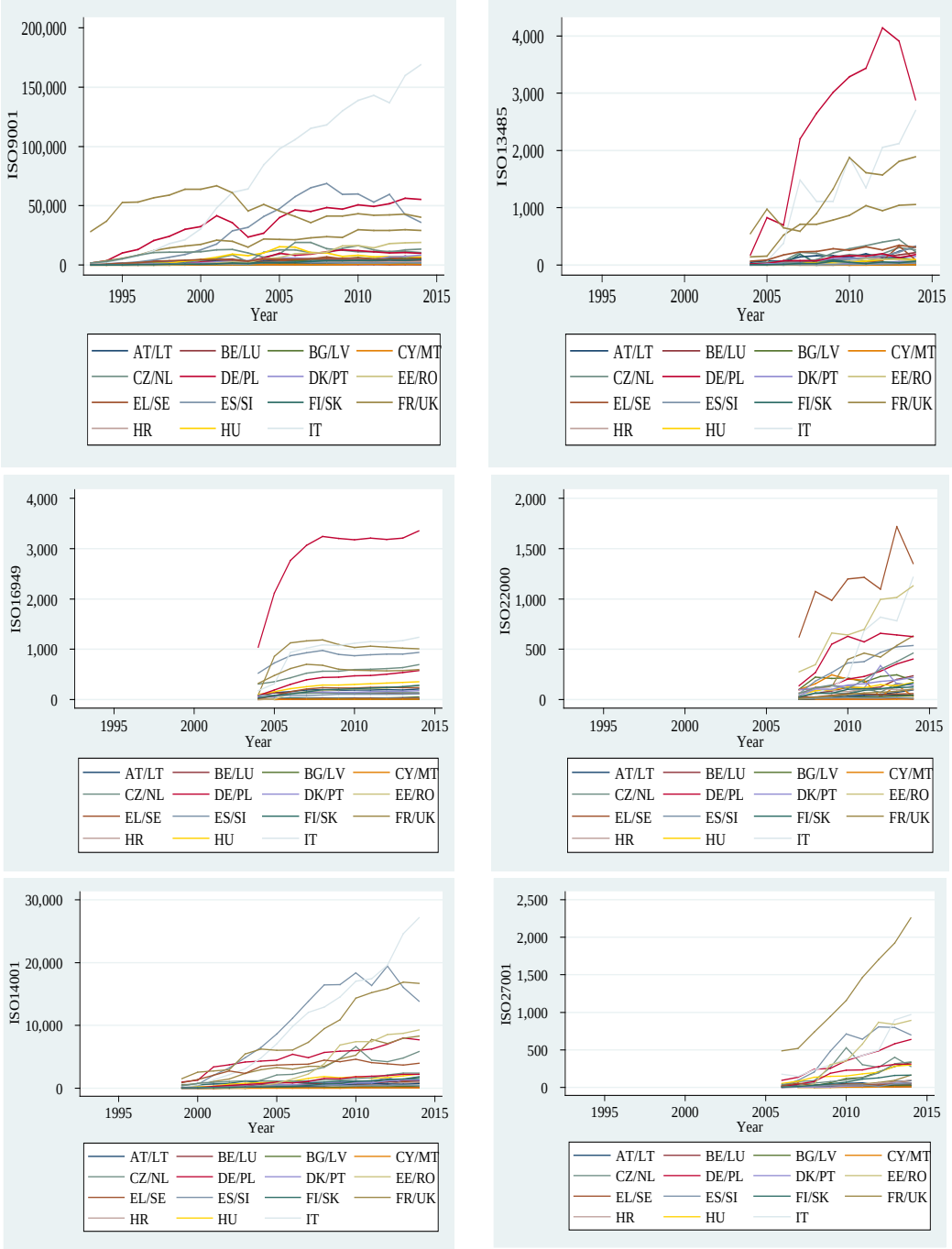
Annex no. 1: Panel-data line plots for ISO management system standards (EU 28, except IE)



Notes: Variables' description is provided in Table no. 1.