sustainability

MDPI

Article

Sustainability and Economic Performance of the Companies in the Renewable Energy Sector in Romania

Mihail Busu [1,*] and Alexandra Catalina Nedelcu [2]

1 Faculty of Management, The Bucharest University of Economic Studies, 6 Piata Romana, 1st district, 010374 Bucharest, Romania

2 Faculty of Business Administration in Foreign Languages, The Bucharest University of Economic Studies, 6 Piata Romana, 1st district, 010374 Bucharest, Romania; catalina.nedelcu@fabiz.ase.ro

* Correspondence: mihail.busu@man.ase.ro; Tel.: +40-722-697-324

Received: 29 October 2017; Accepted: 16 December 2017; Published: 22 December 2017

Abstract: In this paper, we focus on the sustainability and economic performance of the renewable energy sector of Romania. In our analysis, we have used Total Quality Management (TQM) model, which is an economic modern tool used for improving the quality of management for all companies. The aim of this study is to bring into discussion the conceptualized TQM model of Edward Deming underlying different stages of its evolution as it is described in the economic literature. Conceptual model is applied in a case study of the renewable energy sector of Romania. The quantitative research evaluates the impact of the total quality management to achieve the sustainable development, performance objectives and the competitive advantage of the companies in the renewable energy sector. Data was collected through a survey and the questionnaire was addressed to the management and employees in the renewable energy sector. Structural equation modelling (SEM) was used and the hypotheses were tested by partial least square (PLS) equations. Data was analyzed through the Smart PLS 3 software. The main contribution of this paper is to identify and evaluate the relationship among sustainable development, economic performance of the companies and TQM model indicators. The conclusions of our research are in line with the existing literature and confirm the theoretical assumptions, underlining the fact that the undertaking's performance and sustainable development is a direct consequence of the combination among a series of factors like decisional power quality, motivated workforce as well as integrity of operational process.

Keywords: renewable energy sector; total quality management; structural equation modelling; economic performance; sustainable development; motivated workforce

1. Introduction

The pioneers of Total Quality Management (TQM) theory were Walter Shewhart and Edwards Deming. Shewhart [1] developed a probabilistic model for managerial processes used to statistically control the production and give the management the chance to intervene optimally. This model was perfected by Deming [2] who firstly introduced the "quality control cycles" concept, which reveals a group of volunteers' employees who identify real solutions for problems related to work.

The goal of this paper is to validate the causality relation between the TQM model and economic performance through examining the data collected from the Romanian renewable energy sector. As such, the causal relationship between the TQM model, economic performance and sustainable development is evaluated by the use of structural equation modelling, tested with the least square method.

Armand Feigenbaum [3] has developed the Total Quality Control model by making a synapse between the customers and suppliers, supporting the involvement of the employees in achieving competitive results for satisfying the needs of the customers. Another economist, Joseph Juran, published the Handbook of Quality Control [4], which is considered to be the first manual of quality control defining a landmark of the TQM's three pillars, which is also known as "trilogy of quality". According to [5], the three pillars refer to planning, controlling and quality improvement. Planning is to identify the objectives as well as the activities deployments framework to accomplish quality criteria. Statistical control is to apply the techniques of the total quality management. Quality improvement is focusing on removal and correction of defects, also known as the techniques of "zero defects". The last concept developed in time and led to correction of errors and then identified and reported the activities with prevention. Juran, unlike Deming who put the accent on the importance and the role of the employees in achieving quality, highlighted the manager's role and conducted his research by assessing the practical methods that were used, with a focus on the presentation of services and goods, as well as on their compliance with the standards of quality, stock's availability, their safe utilization and comfort provided. Therefore, the total quality model, in Juran's opinion, incorporates the vision of consumers. His management techniques are focused on assessment, compliance and remediation.

The conceptualization of the TQM model is currently performed by research and academic institutions in the field of standardization, innovation and research, the Japanese Union of Engineers and Scientists, as well as the European Foundation of Quality Management and the American Institute for Standardization and Technology, without this enumeration to be an exhaustive one. In order to get the expected results, conceptual modelling is applied on empirical data.

Nowadays, a managerial concept focuses on the final consumers and it determines a continuous improvement at the level of the quality of goods and services [6,7]. The generated positive externalities have a lot of benefits for the profitability of the company and prosperity on a horizon of time. Customer fidelization and loyalty programs as well as the reputation of the companies on the market represent significant issues for evaluation of its competitiveness, beyond the quantitative data of financial and economic profitability.

The Japanese Union of Scientists and Engineers developed statistical and mathematical models relevant to corporate management [8]. Quality control incorporates analogically different fields in the American continent, with applicability in assessment, standardization and quantification, by means of the Institute of American Standardization and technology [9].

The TQM model should also incorporate statistical techniques of quality control. The evolution of the TQM model from the Deming definition to the contemporary model determined the change of the optic regarding the aim of quality control activities.

As it was recently observed, the TQM model reveals the main relevant factors, which contribute to the sustainable development, quality assurance, motivated workforce, strategies of marketing and policies of trade directed towards performance, as well as the operational process emerged in the informatics flows. Another important factor is that of the final consumer satisfaction. Their works [10,11] have highlighted the importance of the techniques of marketing plot to the needs of satisfying the customers.

The correlation between the economic performance achieved by the companies, which are active in a particular sector and the application of TQM model, requires statistical data that covers a time period of at least five years in order to examine the evolution of the profitability and the impact of the implemented TQM model. This comes from the examples provided by several economists [12,13], who have analyzed the Mercadona management business model. Back in 1993, Mercadona introduced the TQM model and it became a well-known supermarket, having made the TQM concept to attract new clients, through high quality of products, customer loyalty and minimum prices. By using the TQM model of management, Mercadona eluded the bad consequences of the world economic crisis during 2008 [14]. Khanam has recently conducted a study of the importance of applying IT resources

and TQM in order to meet the customers' demands, with direct application in the renewable energy sector and IT industry [15].

A highly interesting research paper is that of Izogo [16] in which the author examines how companies could influence the loyalty of its customers' engagement by insuring reliability. Another example that reflects the application of the TQM model is presented in the paper of the economists in the manufacturing sector [17]. Examples continue with the use of International Organization for Standardization (ISO) standards as models of performance used by companies [18–20].

Other studies are focused on the economic performances of the companies producing various types of renewable energy on the stock market [21,22]. Other types of analysis, such as the Bohl et al. study [23], could not be replicated for the Romanian market since there are a few companies operating in the renewable energy sector that are listed on the stock exchange. An overview of the sustainability and financial performance of the companies in the energy sector in Romania [24] has been recently undertaken, so the authors of this paper decided to take a different approach by investigating the economic performance of the companies in this sector. Energy and clean energy have been one of the most widely debated issues in the last years. Many countries from all over the world are still using coal, nuclear or other types of non-green energy that could affect the health of the population in the long run. Although producing non-green energy is still cheaper than producing energy from renewable energy sources, it is worth paying the price and investing in renewable energy. The determinant factors to switch to renewable energy, at the European level, was Agenda 2020, which has energy among its priorities. Additionally, it could be seen that, in many countries, the energy sector has become of great interest. Besides the already mentioned energy independence, there is also a demand for finding solutions for sustainable development and to approach the impact of fossil fuels on the environment [24].

The main contribution of this paper is to analyze the sustainability of the renewable energy sector in Romania and to evaluate the relationship among sustainable development, economic performance of the companies in this sector and TQM model determinants. A second objective was to examine whether there are significant differences in the economic performances of the companies in the sector. This paper is structured as follows: firstly, we present an overview of the Romanian renewable energy sector. Secondly, the research hypotheses are presented and tested. The conceptual structural model based on a survey questionnaire is analyzed using Partial Least Square equations. The application results show the promising computational advantage of the TQM model. Finally, we can draw up the conclusions deriving from the testing of hypotheses.

2. The TQM Model Applied in the Renewable Energy Sector

2.1. Short Description of the Romanian Renewable Energy Sector

In the past 30 years, hydropower plants were the most important source of clean energy in Romania [25]. By 2012, other renewable sources represented only a very small share of electricity produced in Romania. In 2014, the situation started to change abruptly in favour of renewable energy sources, especially wind.

Figure 1 is presenting the shares of renewable energy in gross final energy consumption in EU member states in 2015.

From Figure 1, we could see that the renewable energy consumption share in Romania is 24.8%, which is above the EU average. In 2015, the countries with the largest share of renewable energy consumption of green energy were Sweden (53.9%), Finland (39.3%) and Latvia (37.6%). In the meantime, the countries with the lowest green energy consumption were the Netherlands (5.8%), Luxembourg (5.05%) and Malta (5%).

Figure 2 below presents the evolution of renewable energy shares in gross final energy consumption in Romania between 2007 and 2015.

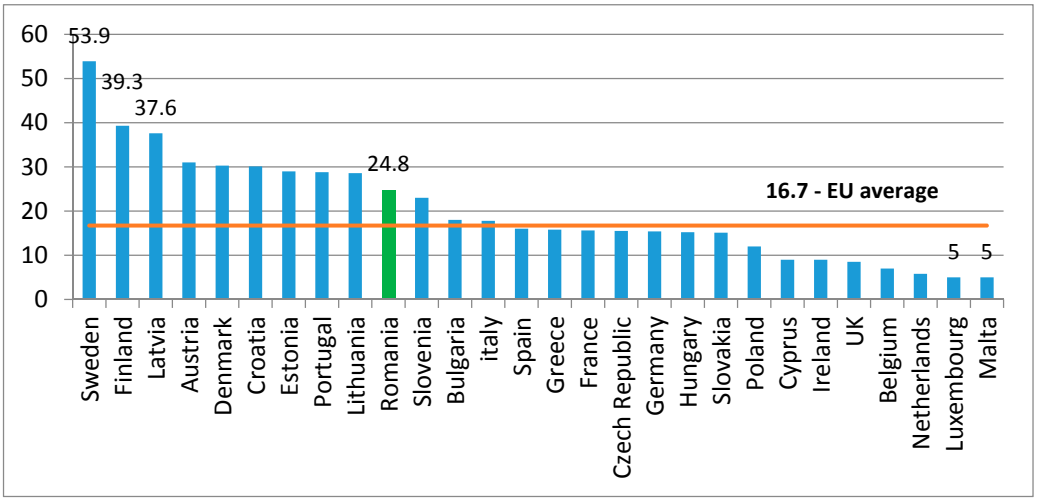

Figure 1. Share of the renewable energy in gross final energy consumption in EU Member States in 2015. Source: Romanian Energy Regulatory Authority (ANRE).

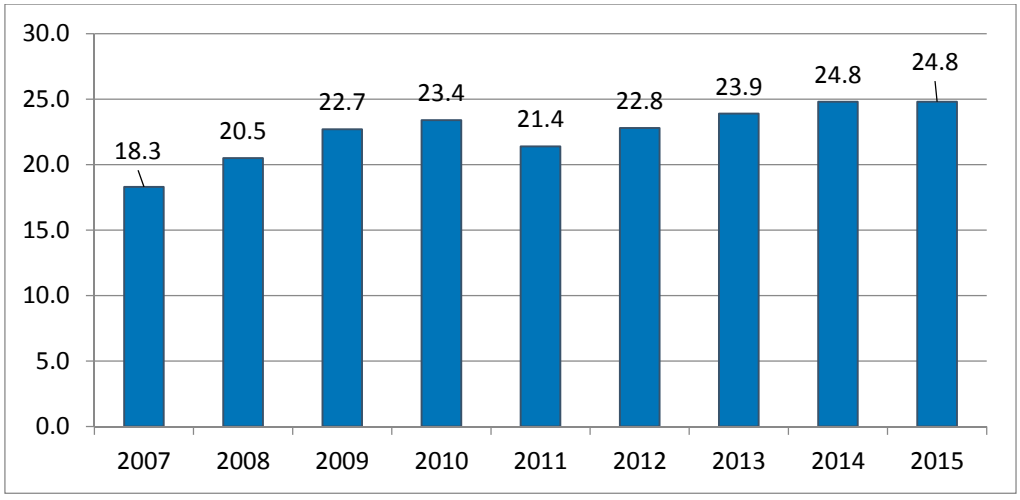

Figure 2. Share of renewable energy in gross final energy consumption in Romania between 2007 and 2015. Source: Romanian Energy Regulatory Authority (ANRE).

From Figure 2, we could see that 24.8% of Romania's energy consumption was covered by alternative energy in 2015, which represents a 36% increase from 2007. Alternative energy includes: wind energy, photovoltaic, hydro energy and biomass energy.

At the end of 2016, the produced electricity in Romania was 64.15 TWh (terawatt hour), which was split into:

- wind power;
- conventional thermal power;
- nuclear power;
- hydropower and
- other renewable energy sources.

Figure 3 shows the share of each sector in total electric energy, which was produced in Romania.

From Figure 3, we could conclude that the most green energy produced in Romania was from Hydro resources (35.4%), followed by Wind power (9.77%), Solar energy (2.08%) and Biomass (0.07%).

The high level of hydro energy produced in Romania explains the good ranking from Figure 1 that Romania has among the EU renewable energy ranking countries.

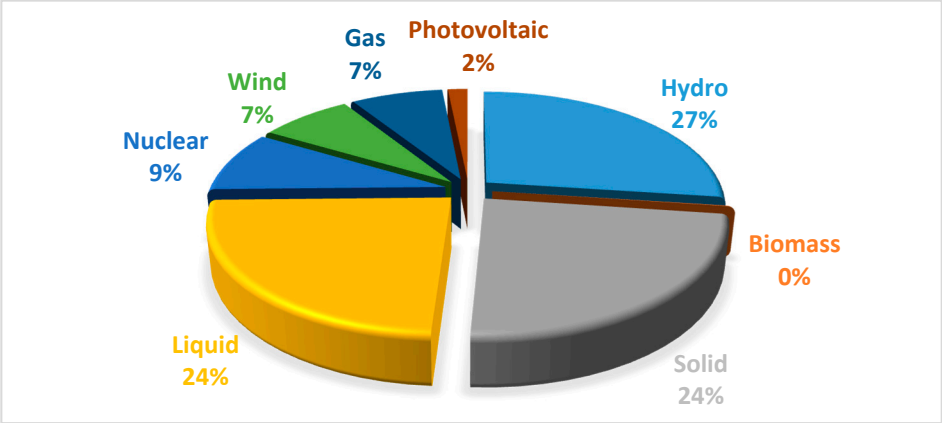

Figure 3. Electricity sources in Romania by primary sources in 2015. Source: ANRE.

2.2. Research Methodology

A survey analysis was conducted based on a questionnaire and the structural modelling hypotheses were tested by using the Partial Least Square model. Data was analyzed by using SmartPLS 3 software (SmartPLS GmbH, Boenningstedt, Germany) [26]. The main goal was to analyze the influence of the implementation of TQM in achieving the competitive advantage and the performances of the companies in the renewable energy sector.

The objective of the research paper is to validate the relationship between the TQM model, sustainable development and the economic performance by analyzing the data which was collected in the renewable energy sector in Romania. The paper also analyses the impact of TQM model, represented by quality of management, employee motivation, trade policies and strategies, employee satisfaction, and integrated operational processes on the organizational performances.

The collection of the data was performed through a survey which was addressed to the employees and the managers in the renewable energy sector. The renewable energy companies were selected proportionally with the size. The number of people who answered the survey was chosen according to each type of renewable energy produced by the selected companies and the sample was random. The sample volume was computed by multiplying the number of indicators with 5–10 [27]. Hence, the sample size must have at least 15 indicators × 5 = 75 respondents. The authors collected data from 90 respondents and only 80 questionnaires were valid.

The questions were either binary, with answers (Yes = 1, No = 0), or used a Likert 7-point scale, where the choices were from "very little = 0" to "very much = 1". The questionnaire was pretested several times to make sure that the language, the format and the question order are adequate.

Starting with Deming's conceptualized model, which was described in the previous chapter, the following five proxy variables were considered important factors in terms of the TQM implementation: the motivated workforce, trade strategies and policies, quality of the managerial activities, integrated operational processes and satisfaction of the customers. Some authors have used these proxy variables as important factors of the TQM model: the motivated workforce, quality of the managerial activities, and satisfaction of the customers [28], trade strategies and policies [29] and the motivated workforce, quality of the managerial activities and integrated operational processes [30].

The economic aspect of the factors used in our model has been previously discussed by many economists. Juran [31] considers that a critical part of the management of quality is the strategic and systematic approach to achieving an organization's vision, mission, and goals. This process, called "trade strategies and policies", includes the formulation of a strategic plan that integrates quality as a

core component. In his opinion, although an organization may consist of many different functional specialties, the process of integrating the operations should be the focus of TQM. Another important aspect of economic performance is motivation. According to Ishikawa [32], motivation of employees is a key success factor for the innovative and challenging organization. He also argues that the customer ultimately determines the level of management quality. No matter what an organization does to foster quality improvement—training employees, integrating quality into the design process, upgrading computers or software, or buying new measuring tools—the customer's satisfaction determines whether the efforts were worthwhile. Feigenbaum [3] underlines that the quality of the managerial activities is a critical component in the successful management and it should be the center point of any TQM model.

The economic performance of an organization is fundamental to comprehend the organization and its foundation for sustainability. Nowadays, this information could be seen in financial accounts and annual reports in many countries. Financial statements are providing information regarding the changes in the financial position as well as data on performance and financial position of the company. Economic Performance Indicators are designed to measure the economic outcomes of the company's activities and the effect of these results on a broad range of stakeholders.

Regarding the performance variables used in this model, we focused on one financial performance variable (return on assets) and one operational performance variable (product quality). Using Return on Assets (ROA) as a key performance metric, the attention of the management is drawn on the assets required to run the business. Some economists [23] consider that ROA is a better metric of analyzing financial performance than income statement profitability measured by return on sales. ROA explicitly takes into account the assets used to support management activities. It determines whether an undertaking is able to generate a suitable return on these assets instead of showing a robust return on sales. Although the quality of a product is an operational measurement, there is a linkage between product quality and the economic performance of firms [29]. Product quality is a direct responsibility of the managers and it is one of the most important reflections of the economic performance of a company [24].

These 15 variables are the latent variables in the formative model, while the variables in the latent reflective model, i.e., the dependent variables, are the two proxy variables: "return on assets" and "quality of the product" [33]. Return on assets (ROA) is an indicator of how profitable a company is based on its total assets. It was calculated for each company in the sample by dividing company's annual earnings by its total assets. ROA is also referred to us as "return on investment" and it is used in the model as a proxi variable for economic performance [34]. "Quality of the product" is a non-financial operational performance measure and is part of the internal activities of a company. According to Carton [35], the advantage of using operational measurements takes place when the available information related to the opportunities already exists, but they have not yet been valued financially.

The enumerated five independent variables in the above table, which were described previously, build the structural model, which will be tested and then validated in this paper. This conceptual model could be seen in Figure 4.

Now, we will formulate the statistical hypothesis, tested with SMART-PLS, which come to fill the gaps [36,37] in the literature, which were mentioned in the introductory part.

Hypothesis 1 (H_1). *The employees' motivation has a positive impact on the performance of the undertakings.*

Hypothesis 2 (H_2). *The quality of the management is positively correlated with the undertakings' performances.*

Hypothesis 3 (H_3). *The commercial policies and the strategies have a positive influence on the performance of the undertakings.*

Hypothesis 4 (H_4). *Operational integrated processes are positively related to the performances of the undertakings.*

Hypothesis 5 (H_5). *Employees' satisfaction has a positive impact on the performance of the undertaking.*

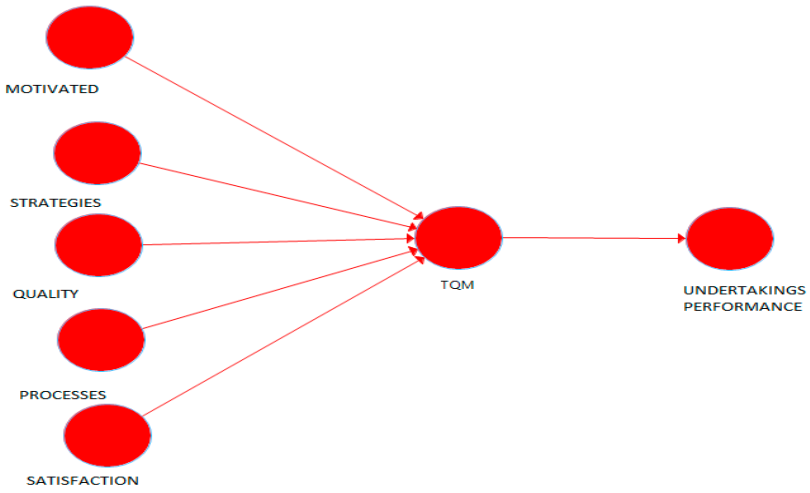

Figure 4. Conceptual structural model with the Total Quality Management (TQM) effects on performance of the companies. Source: Authors' own calculations.

3. Model Estimation and Results

The construction of the formative variables is described in Table 1.

Table 1. Construction of the formative variables (independent variables).

Motivated Workforce (MOTIVATED)	
motivated_1	There exist professional training programs
motivated_2	The employees are motivated to participate in decision-making processes
motivated_3	Assessment programs existing to improve quality
Trade Strategies and Policies (STRATEGIES)	
strategies_1	Activities are planned according to market evolution
strategies_2	Managerial strategies are adapted to market model of competition
strategies_3	Marketing strategies are adapted to consumers
Quality of Managerial Activities (QUALITY)	
quality_1	Quality of the managerial activities
quality_2	Control actions used in management policy
quality_3	Periodic evaluation for employees through managerial programs
Integrated Operational Processes (PROCESSES)	
processes_1	Existence of technical facilities needed for operationalization/functioning
processes_2	Resilience capacity of the functioning/operating processes
processes_3	Error identification in operational processes
Consumers' Satisfaction (SATISFACTION)	
satisfaction_1	Acquiring quality for training programs
satisfaction_2	Quality performance
satisfaction_3	Motivation of the employees to achieve quality

In Romania, at the end of 2015, there were 482 undertakings activating in the renewable energy sector [21]. In Table 2, we could see the split of these companies by type of renewable energy produced.

The questionnaires were addressed to both execution staff and the management of the companies in the first month of 2017 and were completed by the end of trimester of this year. In Table 2 we could see the distribution of the renewable companies, while in Table 3 we have the distribution of the respondents, grouped by the undertaking renewable energy type, based on the location of the respondents. They were selected proportionally with the values from Table 2 and we obtained a sample approaching the optimal theoretical combination.

Table 2. Distribution of the renewable energy companies, by type, in 2015.

Companies	Hydro Power	Wind Power	Solar Energy	Biomass Energy	Total
Small to Medium Enterprises (SMEs) (up to 250 employees)	161	119	94	82	456
Big companies (over 250 employees)	12	7	4	3	26
Total	173	126	98	85	482

Source: Romanian Energy Regulator Authority (ANRE).

Table 3. Distribution of respondents.

Level	Hydro	Eolian	Solar	Biomass	Total
Executive	21	18	15	10	64
Management	5	4	4	3	16
Total	26	22	19	13	80

Source: Data analysis was done by the authors valuing SmartPLS 3 software.

The analyzed sample was comprised of 80 executive and managers from companies from the renewable energy sector in Romania, stratified by gender, age, income, employment status and level of education, which were directly interviewed, the questionnaire containing 25 items.

In designing the questionnaire, the stratified sample method was applied. Data were collected during 1 February–30 March 2017, using an open questions questionnaire, and the main limitation of data collection process was the lack of cooperation of the persons surveyed. The main objectives of the study were to: identify the level of motivation of the respondents, based on their educational level, gender, age and interests; evaluate the main reasons for the quality of the managerial activities in the respondents' opinion; determine the advantages and disadvantages of implementing integrated operational processes; assess the degree of consumer's satisfaction; and observe the trade strategies and policies in the renewable sector in Romania in order to increase companies' sustainability.

The degree of significance of the formative variables is verified before the model is analyzed. Therefore, Dillon–Golstein s ρ and Cronbach's alpha coefficients will be performed [38]. The results are shown in Table 4.

Table 4. Reliability and validity of the formative variables.

Construct	Dillon Golsteins' Rho	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)	Variance Inflection Factor (VIF)
Motivated	0.875	0.987	0.988	0.945	2.217
Strategies	0.908	0.921	0.967	0.983	1.720
Quality	0.856	0.728	0.854	0.712	1.634
Processes	0.793	0.739	0.787	0.685	2.846
Satisfaction	0.781	0.729	0.685	0.677	2.485

Source: Data analysis was done by the authors valuing SmartPLS 3 software.

The above table shows us that all values associated with the previously introduced variables are above 0.7. This means that the five independent latent variables used in this analysis are reliable. Moreover, we have tested the collinearity. Hair et al. [39] mentions that the collinearity is present among the independent variables if the VIF (variance inflection factor) values of the variables is greater than 5. In Table 4, we could see that all of these values are less than 5, so we could conclude that the exogenous variables are not collinear.

There are a few different approaches to TQM. These refund the companies on a flow basis, with competitors directing the process capabilities and customers and the content of the flow. The following are major approaches to TQM:

- Just in Time: Denotes a system in which the materials are delivered before they are required and in the amount needed.

- Quality Circles: Management techniques used to help the employees solving their problems.
- Statistical Process Control: Quality control method used to monitor the control process.
- Total Quality Control: Applying the principles of quality management to all business areas.
- Process architecting: Re-building the workforce from zero for increasing the quality.
- Process improvement: Improving the business architecture by analyzing the process.
- Process Deployment Automation: The engineering process is automated through the organization.
- Process Execution Automation: The routine processes is automated across the entire organization.
- Total Preventive Maintenance: Scientific prevention of equipment through systematized care.

An interesting approach developed by Ragin [40] uses Qualitative Comparative Analysis (QCA) methodology, which is a comparative technique to analyze complex causal relationships. This could be used to analyze a relationship between environmental, social and financial performance in companies [41]. The authors employed the fuzzy-set qualitative comparative analysis (fsQCA) to find new evidence on the relationship between the three types of performance in a sample of undertakings listed in the capital market of Spain. This method has also been used in other research papers [42,43] in which the authors were analyzing the data using fsQCA 2.5 software (Irvine, CA, USA) to determine the causal relationship between economic and environmental performances.

The authors of this paper made a quantitative analysis of the data done by PLS-SEM, which is divided by two sub-models. The first one is the quantification model, also called the outer model (formative model), and the second one is the inner model (structural model). In their work [44], the authors have chosen to use PLS-SEM because this method is more robust than other methods, like Covariance Based (CB)-SEM, and also less sensitive to distributions that are skewed, surveys with small sizes or to the multicollinearity [45].

PLS-SEM is a data analysis method that is often used in marketing research to test theoretically supported linear and causal models [46]. With PLS-SEM, managers could visually examine the relationships that exist between variables of interest in order to prioritize the companies' resources to better serve the final consumers. The structural equation model is based on two sub models; the outer model analyzes the relationships between the observed indicator and corresponding latent variables, whereas the inner model analyzes the relationships between the exogenous and endogenous latent variables. In PLS-SEM, a variable is either independent or dependent. An independent variable has path arrows pointing outwards and none leading to it. Meanwhile, a dependent variable has one or more paths leading to it and represents the effects of other variable(s).

3.1. The Outer Model

The outer model was analyzed by using convergent and discriminant validity. From the statistical point of view, the congruence between the reflexive and formative variables is determined by the linear structural equations models (SEM):

$$\{x = \Gamma_x\, \vartheta + \varepsilon_x, \quad (1)$$

$$\{y = \Gamma_y\, \eta + \varepsilon_y, \quad (2)$$

where

- η and ϑ are the independent and dependent latent variables, respectively,
- x and y are the observed variables (measurement variables) of η and ϑ,
- Γ_x and Γ_y are matrices of the systems of linear equations related to latent variables,
- ε_x and ε_y are the measurement errors (residual variables).

3.1.1. Convergent Validity

When a latent variable explains a significant part of the variance of its manifest variables, the convergent validity should be checked [47]. Convergent validity is examined through the variance extracted indicator (AVE), which is a measure of the variance that a latent variable captures from

its associated manifest variables relative to the total amount of variance, including the variance due to measurement error [48]. At a level above 0.50, the latent variable explains more than half of its manifest variables' variance. At this level, it may be argued that the variation is not coincidental, i.e., error variance, and a "true" relation between the manifest variables and the latent variable may thus be argued to exist [49].

According to Chin [50], it should be excluded from the model the variables that have path coefficients less than or equal to 0.5. Therefore, it the following variables will be excluded: motivate_1, motivate_2, strategy_1 and strategy_3. As we can see in Figure 5, the path coefficients of all these variables are less than 0.5.

Model I

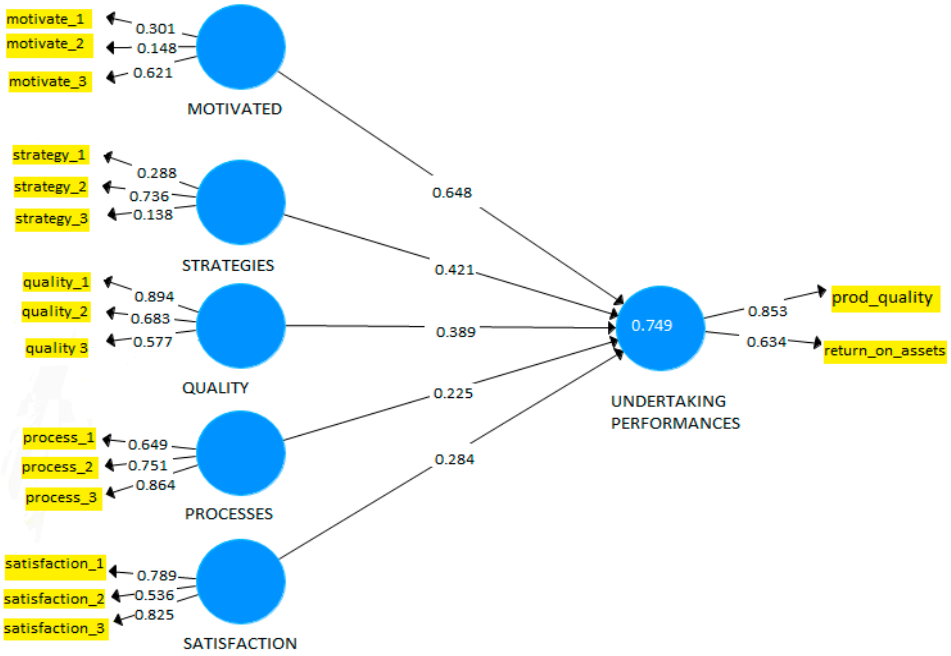

Figure 5. Partial Least Square Structural Equation Modelling (PLS-SEM) Model 1. Source: Authors' determined values by using SmartPLS 3 software package [26].

After the mentioned variables were excluded, a second model is obtained from the first one. The SEM-PLS equations run on the left variables and are leading us to a new model.

As we could observe in Figure 6, none of the path coefficients is less than or equal to 0.5, and hence the convergent validity is confirmed for this model.

3.1.2. Discriminant Validity

AVE could be also used for checking the discriminant validity [51]. It is stated by the authors that, if the correlation coefficients among the latent variables squared are less than the AVE values of the latent variables, the discriminant validity is confirmed. All of these values are given in Table 5 below.

Table 5. Correlation coefficients among the latent variables.

Latent Variables	AVE	Correlation Coefficients Squared				
		Motivated	Strategies	Quality	Processes	Satisfaction
Motivated	0.945	1				
Strategies	0.983	0.646	1			
Quality	0.712	0.691	0.485	1		
Processes	0.685	0.567	0.469	0.521	1	
Satisfaction	0.677	0.513	0.375	0.567	0.478	1

Source: Data analysis was done by the authors valuing SmartPLS 3 software.

Model II

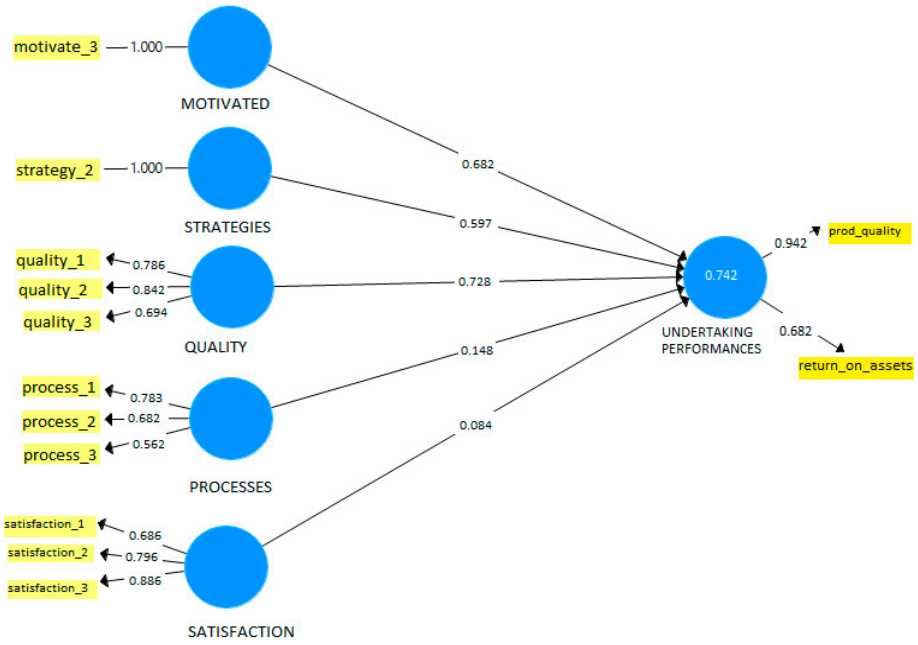

Figure 6. PLS-SEM Model 2. Source: Authors' determined values by using SmartPLS 3 software package [26].

By comparing correlation coefficients among the latent variables squared with the AVE indicators, we confirm the discriminant validity of the model.

3.2. The Inner Model

The inner (structural) model was previously described in Figure 1. It indicates the relationship (paths) between the latent exogenous and the endogenous variables of the model. From the statistical point of view [52], the inner model is:

$$\eta = B\eta + \Lambda\zeta + \xi, \quad (3)$$

where

- η is a dependent vector of latent variables,
- ζ is vector of latent independent variables,
- ξ is a vector of white noise (residual) variables,
- B and Λ are the matrices with path coefficients.

4. Discussion of the Results

The inner model is evaluated through the path coefficients and the R-squared value. According to Figure 6, the R-squared value is 0.742, which means that about 74.2% of the variability of the undertaking's performance from the renewable energy sector is explained by the variability of the TQM model. Moreover, the values of the path coefficients of the inner model are all positive, and this means that the greater the values that the latent variables have, the greater organizational performance there will be. From the five indicators, the variable with the most impact is "motivation" (path coefficient 0.659), followed by the "strategy" (path coefficient 0.628), and the "resilience capacity of the functioning/operating processes" (path coefficient 0.542). The organizational performance with the smallest impact is given by the indicators "degree of employee's satisfaction" (path coefficient 0.056) and "marketing strategies are adapted to consumers" (path coefficient 0.047).

The two reflective indicators calculated for the endogenous variable "organizational performance" have positive values of the path coefficients, which are greater than 0.5. This means that these variables from the reflective model (prod_quality and return_on_assets) are statistically significant. The high values of the path coefficients of the reflective variables, i.e., "Return on assets" (path coefficient 0.682) and "Quality of product" (path coefficient 0.942) shows us that the performances of the companies in the renewable energy sector are well represented by the two reflective indicators. Multiple items generally increase reliability and improve model performance compared to single-item measures. In our model, the dependent variable has two reflective variables reflecting economic performance, one financial and the other one operational variable. In addition, a construct has greater performance if it has higher mean latent variable scores, reflecting stronger measurement paths. This is also underlined by the high values of the two path coefficients.

Moreover, for testing the research hypothesis described before, a Bootstrap Test (300 sample) was realized to generate the standard errors and *t*-values of the model parameters. Bootstrapping allows assigning measures of accuracy to sample estimates. The results are given in Table 6.

Table 6. Research hypothesis results, after a bootstrap test was performed.

Research Hypothesis	Path Coeff.	Std. Error	*t*-Value *	*p*-Value
H_1: Motivation → Organizational Performance	0.623	0.214	3.982	0.008
H_2: Quality → Organizational Performance	0.581	0.334	2.688	0.047
H_3: Strategies → Organizational Performance	0.697	0.190	3.369	0.027
H_4: Integrated methods → Organizational Performance	0.048	0.148	0.359	0.260
H_5: Satisfaction → Organizational Performance	0.226	0.234	1.067	0.307

* *t*-Value 2.58 (sig. level = 5%).

The validated hypotheses are the ones that have *p*-values less than 0.05, while the other ones with *p*-values greater than 0.05 are not. Hence, we could conclude that H_1, H_2 and H_3 are valid hypotheses, while H_4 and H_5 are not. Table 7 shows which hypotheses are valid and which ones are not, out of the five statistical hypotheses tested.

Table 7. Validation of statistical hypotheses.

Hypothesis	Validated (Yes/No)
Hypothesis 1	Yes
Hypothesis 2	Yes
Hypothesis 3	Yes
Hypothesis 4	No
Hypothesis 5	No

Therefore, we could conclude that quality of the management and the motivations of the employees both have positive impacts on the performances of the organizations in the renewable energy sector.

5. Conclusions

By using structural equation modelling SEM-PLS in the research area, this paper identifies and subsequently evaluates the relationship among sustainable development, economic performance of the companies and TQM model determinants. A significant proportion of the variability in the endogenous variables is explained by the exogenous latent variables.

Hence, the results underline that TQM practices are based on the motivation of the staff, in view of the significant and positive impact of the staff motivation and undertaking's performance. When the competitive pressure is growing, the organizations are forced to hire and keep the best employees, and this is primarily achieved through the way the companies could manage to motivate them. Offering competitive salaries and performance-oriented frameworks are necessary to motivate staff enterprise and attributes. Focusing on the motivation of the employees, the undertakings active in the renewable energy sector will be able to improve their performances. We could also observe that the last two research hypotheses were not validated. This means that the integrated methods and consumer satisfaction do not have an impact on organizational performance. Therefore, the managers should focus more on the hypotheses that have been validated and less on the other ones.

In line with the conclusions of this paper, the management quality also has a powerful and direct impact on the performance of the renewable energy companies. Top management indirectly and directly affects the performance of the companies in the sector by mediating the effects of the management processes. As a result, the success of TQM applications depends at a significant level on the management quality.

The quality of the management and the continued involvement are leading to an increase in companies' performances and the sustainability of the renewable sector. The management of an enterprise is directly responsible for the determination of corporate culture, the policies and the organizational vision enforced by the undertaking. Managers must also develop measurable and specific targets to achieve the needs and expectations of the final consumers and to increase companies' performances.

The survey used in the research emphasizes that integrated operational processes used by an undertaking have a positive impact on its performance and sustainable development. Important factors that are converging towards high performance regard the technical equipment's quality, the adaptation of the organizational procedures to the market needs and regular reporting of the errors identified by the top management in order to have them fixed. In light of this, the significant contributions of the processes done by the management (including supervisions and inspections) lead to increased TQM of these corporations. This argues for the value of the high coefficients of the processes at the management level of this model.

Another important result is that the renewable energy organizations should focus on reducing variability in marketing processes to improve performance. To increase performance, a strong connection between the business process integration, motivation of the workforce, and quality of the management should exist. For Romanian renewable energy organizations, targeting both their customers and their own employees is one of the most important practices that could increase the performance and the sustainability development of the corporations.

A limitation of this study is given by the relatively small number of the respondents of the survey, and also that the study is analyzing a single industry. Other limitations of this research could be related to the subjective answers of the persons surveyed and the number of formative and reflective variables. These limitations could be overcome in future research by increasing the sample size and the number of formative and reflective variables, as well as by having more open- questions in the questionnaire.

Further studies in the area of the TQM effects on companies' performances should be extended to other sectors or industries and the research may include as such some probable macroeconomic effects. The analysis could also be developed by analyzing the way that companies in the field have financed themselves during this time and the efficiency for their sustainable development. A future study to

analyze the causal relationship between financial performance of the renewable companies and their environmental performance could be performed with QCA methodology.

In addition, future research to analyze the increase of companies' performances and sustainable development by using TQM techniques could be very useful.

Acknowledgments: This work was supported by PRO MAGNA Association.

Author Contributions: Mihail Busu. gathered the data, and estimated the TQM model performance and the competitive advantage of the companies in the renewable energy sector; Alexandra Catalina Nedelcu presented the Romanian renewable energy sector and put together all the numerical results; Mihail Busu contributed with conclusions and recommendations as well as with the limitations of the study and further research; Alexandra Catalina Nedelcu conducted the literature review; and Mihail Busu was responsible for the overall writing process.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Shewhart, W.A. *Economic Control of Quality of Manufactured Product*; ASQ Quality Press: Milwaukee, WI, USA, 1931.
2. Deming, W.E. *Out of the Crisis*; Massachusetts Institute of Technology, Center for Advanced Engineering Study: Cambridge, MA, USA, 1986; Volume 510.
3. Feigenbaum, A.V. *Quality Control: Principles, Practice and Administration: An Industrial Management Tool for Improving Product Quality and Design and for Reducing Operating Costs and Losses*; McGraw-Hill: New York, NY, USA, 1951.
4. Juran, J.M. Directions for ASQC. In Industrial Quality Control. Available online: http://www.pqm-online.com/assets/files/lib/books/juran.pdf (accessed on 8 May 2017).
5. Juran, J. Juran on Leadership for Quality. An Executive Handbook. Available online: http://www.pqm-online.com/assets/files/lib/books/juran.pdf (accessed on 8 May 2017).
6. Drucker, P.E. The Emerging Theory of Manufacturing. In *Harvard Business Review*; Harvard Business School Publication Corp: Boston, MA, USA, 1990; pp. 94–102.
7. Easton, G.S.; Jarrell, S.L. The effects of total quality management on corporate performance: An empirical investigation. *J. Bus.* **1998**, *71*, 253–307. [CrossRef]
8. Terzioski, M.; Samson, D. The effect of company size on the relationship between TQM strategy and organizational performance. *TQM Mag.* **2000**, *12*, 144–148. [CrossRef]
9. Rao, S.S.; Solis, L.S.; Raghu-Nathan, T.S. A framework for international quality management research: Development and validation of a research instrument. *Total Qual. Manag.* **1998**, *10*, 1047–1075. [CrossRef]
10. Mohr-Jackson, I. Conceptualizing total quality orientation. *Eur. J. Mark.* **1998**, *32*, 13–22. [CrossRef]
11. Longbottom, D.; Mayer, R.; Casey, J. Marketing, total quality management and benchmarking: Exploring the divide. *J. Strateg. Mark.* **2000**, *8*, 327–340. [CrossRef]
12. Ton, Z.; Harrow, S. *Mercadona*; Harvard Business School Cases. 9-610-089; Harvard Business School: Cambridge, MA, USA, 2010.
13. Blanco, M.; Gutierrez, S. Application of the Total Quality Management Approach in a Spanish Retailer: The Case of Mercadona. *Total Qual. Manag. Bus. Excell.* **2010**, *21*, 1365–1381.
14. Callejo, M.B. Using Total Quality Management Model to Face the Economic Crisis: The Case of Mercadona. Available online: https://cdn.intechopen.com/pdfs-wm/36160.pdf (accessed on 12 March 2017).
15. Khanam, S.; Siddiqui, J.; Talib, F. A Theoretical Model on Total Quality Management Enablers and Information Technology Resources for the Information and Communication Technology Industry. In Proceedings of the International Conference on Research and Sustainable Business (ICRSB-2014), Roorkee, India, 8–9 March 2014; p. 831.
16. Izogo, E.E. Customer loyalty in telecom service sector: The role of service quality and customer commitment. *TQM J.* **2017**, *29*, 19–36. [CrossRef]
17. Abrunhosa, A.; Sa, P.M.E. Are TQM principles supporting innovation in the Portuguese footwear industry? *Technovation* **2008**, *28*, 208–221. [CrossRef]
18. Ab Wahid, R.; Corner, J.; Tan, P.L. ISO 9000 maintenance in service organisations: Tales from two companies. *Int. J. Qual. Reliab. Manag.* **2011**, *28*, 735–757. [CrossRef]

19. İlkay, M.S.; Aslan, E. The effect of the ISO 9001 quality management system on the performance of SMEs. *Int. J. Qual. Reliab. Manag.* **2012**, *29*, 753–778. [CrossRef]
20. Basaran, B. The effect of ISO quality management system standards on industrial property rights in Turkey. *World Pat. Inf.* **2016**, *45*, 33–46. [CrossRef]
21. Kumar, S.; Managi, S.; Matsuda, A. Stock prices of clean energy firms, oil and carbon markets: A vector autoregressive analysis. *Energy Econ.* **2012**, *34*, 215–226. [CrossRef]
22. Managi, S.; Okimoto, T. Does the price of oil interact with clean energy prices in the stock market? *Jpn. World Econ.* **2013**, *27*, 1–9. [CrossRef]
23. Bohl, M.T.; Kaufmann, P.; Stephan, P.M. From hero to zero: Evidence of performance reversal and speculative bubbles in German renewable energy stocks. *Energy Econ.* **2013**, *37*, 40–51. [CrossRef]
24. Paun, D. Sustainability and Financial Performance of Companies in the Energy Sector in Romania. *Sustainability* **2017**, *9*, 1722. [CrossRef]
25. Colesca, S.E.; Ciocoiu, C.N. An overview of the Romanian renewable energy sector. *Renew. Sustain. Energy Rev.* **2013**, *24*, 149–158. [CrossRef]
26. Ringle, C.M.; Sven, W.; Jan-Michael, B. *SmartPLS 3*; SmartPLS: Bönningstedt, Germany, 2015; Available online: http://www.smartpls.com (accessed on 24 February 2017).
27. Kristensen, K.; Eskildsen, J. Design of PLS-based satisfaction studies. In *Handbook of Partial Least Squares*; Springer: Berlin/Heidelberg, Germany, 2010; pp. 247–277.
28. Goetsch, D.L.; Davis, S.B. *Quality Management for Organizational Excellence*; Pearson: Upper Saddle River, NJ, USA, 2014.
29. Liebowitz, S. *Product Quality and the Economic Performance of Firms*; University of Dallas: Dallas, TX, USA, 2000.
30. Oakland, J.S. *Total Quality Management and Operational Excellence: Text with Cases*; Routledge: New York, NY, USA, 2014.
31. Juran, J.M. *Juran on Leadership for Quality*; Simon and Schuster: New York, NY, USA, 2003.
32. Ishikawa, K. *What Is Total Quality Control? The Japanese Way*; Prentice Hall: Englewood Cliffs, NJ, USA, 1985.
33. Cohen, B.; Smith, B.; Mitchell, R. Toward a sustainable conceptualization of dependent variables in entrepreneurship research. *Bus. Strategy Environ.* **2008**, *17*, 107–119. [CrossRef]
34. Ștefănescu-Mihăilă, R.O. Social Investment, Economic Growth and Labor Market Performance: Case Study—Romania. *Sustainability* **2015**, *7*, 2961–2979. [CrossRef]
35. Carton, J.A.; Giese, B.S.; Grodsky, S.A. Sea level rise and the warming of the oceans in the Simple Ocean Data Assimilation (SODA) ocean reanalysis. *J. Geophys. Res. Oceans* **2005**, *110*. [CrossRef]
36. Lippiatt, B.C. *BEES 3.0 Building for Environmental and Economic Sustainability: Technical Manual and User Guide*; NIST Interagency/Internal Report (NISTIR)-6916; NIST: Gaithersburg, MD, USA, 2017.
37. Delgado, M.; Porter, M.E.; Stern, S. Clusters, convergence, and economic performance. *Res. Policy* **2014**, *43*, 1785–1799. [CrossRef]
38. Tenenhaus, M.; Vinzi, V.E.; Chatelin, Y.M.; Lauro, C. PLS path modeling. *Comput. Stat. Data Anal.* **2005**, *48*, 159–205. [CrossRef]
39. Hair, J.F.; Ringle, C.M.; Sarstedt, M. Editorial-partial least squares structural equation modeling: Rigorous applications, better results and higher acceptance. *Long Range Plan.* **2013**, *46*, 1–12. [CrossRef]
40. Ragin, C.C. *Redesigning Social Inquiry: Fuzzy Sets and Beyond*; Wiley Online Library: Hoboken, NJ, USA, 2008; Volume 240.
41. Lassala, C.; Apetrei, A.; Sapena, J. Sustainability Matter and Financial Performance of Companies. *Sustainability* **2017**, *9*, 1498. [CrossRef]
42. Vis, B. The comparative advantages of fsQCA and regression analysis for moderately large-N analyses. *Sociol. Methods Res.* **2012**, *41*, 168–198. [CrossRef]
43. Tho, N.D.; Trang, N.T.M. Can knowledge be transferred from business schools to business organizations through in-service training students? SEM and fsQCA findings. *J. Bus. Res.* **2015**, *68*, 1332–1340. [CrossRef]
44. Iacobucci, D. Structural equations modeling: Fit indices, sample size, and advanced topics. *J. Consum. Psychol.* **2010**, *20*, 90–98. [CrossRef]
45. Busu, M.; Gyorgy, A. Real Convergence, Steps from Adherence to Integration. Countries from Central and Eastern Europe. *Amfiteatru Econ.* **2016**, *18*, 303–316.
46. Douglas, T.J.; Fredendall, L.D. Evaluating the Deming management model of total quality in services. *Decis. Sci.* **2004**, *35*, 393–422. [CrossRef]

47. Nacaskul, P. Financial Risk Management and Sustainability—The Sufficiency Economy Philosophy Nexus. Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3057886 (accessed on 29 June 2017).
48. Rust, R.T.; Huang, M.H. Optimizing Service Productivity. *J. Mark.* **2012**, *76*, 47–66. [CrossRef]
49. Čihák, M.; Demirgüč-Kunt, A.; Feyen, E.; Levine, R. *Financial Development in 205 Economies, 1960 to 2010*; No. w18946; National Bureau of Economic Research: Cambridge, MA, USA, 2013.
50. Chin, W.W. How to write up and report PLS analyses. In *Handbook of Partial Least Squares*; Springer: Berlin/Heidelberg, Germany, 2010; pp. 655–690.
51. Fornell, C.; Larcker, D.F. Structural equation models with unobservable variables and measurement error: Algebra and statistics. *J. Mark. Res.* **1981**, *18*, 382–388. [CrossRef]
52. Fornell, C.; Cha, J. Partial least squares. *Adv. Methods Mark. Res.* **1994**, *407*, 52–78.