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How Performance of Top Companies Are Related on IMD Digital Competitiveness Indicators?

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Abstract

Given the role and importance of digital competitiveness indicators for businesses' performance and profitability, the question arises why international research in this field has been conducted infrequently. Therefore, the main purpose of the present study is to investigate the impact of digital competitiveness index on the financial performance of top companies in the world using performance theory and to evaluate the validity of IMD digital competitiveness index data. For this purpose, 175 top companies in the world from 2013 to 2018 that were profitable among the top 200 companies each year were selected as the statistical population. IMD digital Competitiveness reports and Fortune site were used to collect the data. Also the data analysis was done according to the panel data method using Stata15 software. The results show that in general, there is a positive relationship between IMD digital competitiveness index and financial performance of top companies in the world.

Keywords: Competitiveness, Financial Performance, Profitability, Top Companies, IMD

1. Introduction

Factors affecting corporate performance include entrepreneurship, technology, marketing, product, management, finance, and environmental factors including turbulence, heterogeneity, environmental dynamics, competitiveness, and corporate exclusivity (Chorev & Anderson, 2006).

Roxas et al. (2017) found that entrepreneurial strategic orientation enables firms to take a more proactive stance towards environmental sustainability, which leads to successful corporate performance. Business success in any country is a function of the three factors of the political and economic context at the macro level of the country, the business environment of that country, and the strategy and operations of businesses in that country. These three factors are interrelated and their relationship is top-down or bottom-up (Ronald & Porter, 2000).

The nature of competitiveness constantly evolves, affecting not only how businesses function but how countries perform today and will perform in the future. Economies are experiencing more rapid technological changes than in the past – from 3D-printing, robotics and neuro-technology to digital-currencies and e-participation.

Governments around the world are investing in scientific and technological infrastructure to keep up with the possibilities of the digital economy and enhance the prosperity of their citizens. While technological development is a necessary condition for the future well-being of an economy, it is not sufficient to augment value creation. Digital technology needs not only to be implemented, it needs to be explored to achieve two important goals – improve efficiency and enhance the range and the quality of services.

Digital competitiveness is defined as the capacity of an economy to adopt and explore digital technologies leading to the transformation in government practices, business models and society in general. The innovative capacity of a country is heavily rooted in areas such as the concentration of scientists and engineers in the workforce, the degree of protection of intellectual property and the depth of cooperation among the public, private and academic sectors. In the IMD digital Competitiveness Ranking, these act as proxies for scientific and technological innovation.

Based on the above, it could be conclude that there has been no comprehensive research on the impact of IMD digital competitiveness on the financial performance of top companies in the world. Therefore, the present study attempts to investigate the impact of digital competitiveness index on financial performance of top companies in the world.

In this research, first, the theoretical foundations and research background are presented, followed by the research hypotheses. In the next step, the research method is outlined. Then data analysis, discussion and conclusions are done. Finally, suggestions for future research are presented.

2. Theoretical Foundations and Research Background

According to figure 1, Roxas et al. (2017) found that entrepreneurial strategic orientation

enables firms to take a more proactive stance towards environmental sustainability, which leads to successful corporate performance.

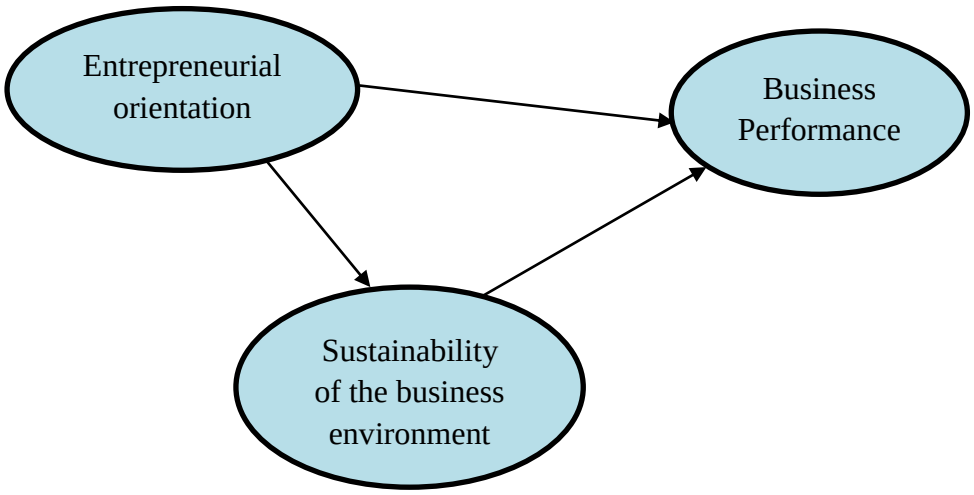

Figure 1. Performance model (Roxas et al., 2017)

In performance theory, the relationship between environmental, strategic and organizational factors on the one hand and the firm's financial performance on the other is examined. The performance of a company is measured using capital return, return on assets and return on capital applied (Ace Equity database). Zhang (2017) considers firm performance as a function of the characteristics of managers, business characteristics, environmental factors, and the urban population in which the company is located.

Contingency theory was introduced by Thompson in 1967, and he knows the key to business in how to achieve its goals in an uncertain environment based on rationality. According to Parsons (1960), businesses manage and control their affairs at the three technical, managerial, and institutional levels. These three levels differ in their origin and degree of uncertainty. The underlying assumption in this theory is that in order to achieve rationality and control the activities of the business, the business aims to reduce the impact of uncertainty on the technical core. This policy can only be enforced when the activities related to the supply of product and supply factors are separated from the technical sector, and there is a greater uncertainty over the managerial and institutional levels. The key contingency factors that influence the structure of an organization are uncertainty, complexity, and variability.

Technological transformation is gradual, requiring shifts at the organizational, institutional and structural levels. Organizations need to be able to recognize, communicate and assume the challenges brought about by the emergence of new technologies. Institutions must further their “openness and flexibility” to adapt to transformations and readjust relevant rules, regulations, norms and beliefs. Finally, the structural level is the degree of permeability of research, production, market, and demand conditions” in encouraging innovation, the development of new products, the emergence of new markets and the entry of new actors into

relevant sectors (Dolata, 2009). It follows that a digital competitiveness framework must encompass organizational, institutional and structural elements. The IMD world digital competitiveness ranking captures such elements through three factors – knowledge, technology and future readiness (IMD, 2019).

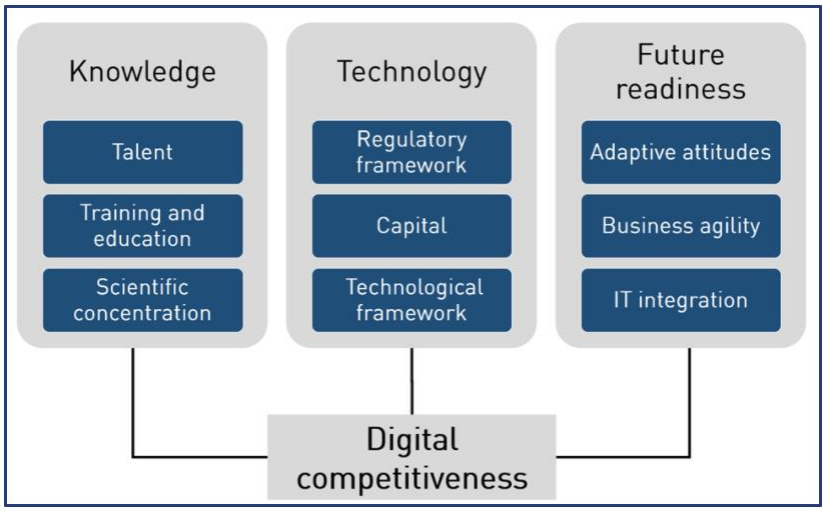

Figure 2. Illustrates the digital competitiveness model

According to figure 2, knowledge refers to the necessary infrastructure, which underlies the process of digital transformation through the discovery, understanding and learning of new technologies. Technology assesses the overall context through which the development of digital technologies is enabled. This context includes a supportive regulatory framework which allows for the efficient performance of business activities and the enforcement of relevant regulation while encouraging business development and innovation (IMD, 2019).

Future readiness examines the level of preparedness of an economy to assume its digital transformation. Competitiveness requires that available digital technologies be “absorbed” by society. The absorption of digital technologies needs particular adaptive attitudes, including the willingness of a society to participate in digital-related processes, for example, to engage in internet purchases. Readiness also requires business flexibility and implies that firms in a particular economy are able to transform their business models to take advantage of new opportunities. It also refers to the level of innovation that originates from the private sector. Readiness, finally, evaluates how well IT relevant practices and processes are applied by all actors (IMD, 2019).

Environmental turbulence researches divides it into three categories: technology turbulence, competition turbulence, and market turbulence (Ottesen & Gronhaung, 2004). Technology turbulence refers to the rate of technological progress in an industry. Another type of turbulence is the intensity of market competition, which means the intensity of a firm's competition within an industry and in the face of other competitors (Paladino, 2007). Market

turbulence is one of the components of environmental turbulence and is a critical element of the corporate environment that affects the operational and performance results of business. Market turbulence refers to the extent of change in the composition of customers and their preferences and competitive market conditions (Lee, 2010). Effective organizational structure (Zhou & Yim, 2005), supply chain (Trkman & McCormack, 2009), and product design.

The European Foundation's model of organizational excellence presents the quality of business performance as measuring an individual, a group, an organization or a process level in achieving a specific goal. In other words, performance is the measure of the efficiency and effectiveness of a mechanism or process by an organization in achieving its desired results (Wu, 2009). The measurement of business performance by financial and non-financial subjective indicators is adequate and this measurement can be used to measure business performance (Sandeep & Harpreet, 2016). In their research, Sandeep and Harpreet analyze the financial dimensions of sales growth, return on capital and turnover volume and non-financial dimensions of market share, service quality, customer satisfaction, product quality, employee satisfaction, product innovation and process innovation. They have considered. Increasing employees' abilities and capabilities has direct effects on financial outcomes and thus on corporate performance (Becker et al., 2001). Human resource storage is the basis for having a unique approach that thereby creates the potential for superior performance or sustained competitive advantage (Rynes et al., 2005). According to Demirguc-Kunt and Maksimovic (1998), as well as Levine's (2000) research, the financial system has an impact on corporate performance and economic growth. On the other hand, there is a positive and significant relationship between competitiveness and profit management, according to research by Datta et al. (2013), Shleifer (2004) and Rotemberg and Scharfstein (1990).

Strategic capabilities are important for the successful performance of companies (Simon et al., 2015). But they do not inform organizations how they can quickly and easily restructure their resources at the right time, in the form of dynamic business capabilities. Dynamic business capabilities generally include innovation, information capability and communication capability. Innovation capabilities include product design, new product development, and business process innovation (Camison & Villar, 2014). Information capability is one of the corporate processes for employing information technology to obtain, process and transfer information to improve business operations, support decision-making and facilitate communication and coordination with external partners (Mithas et al., 2011). Communication capabilities include developing, nurturing and managing external relations. Communication capabilities are the ability to create unity (Leischnig et al., 2014) and to collaborate between stakeholders (Allred et al., 2011).

According to the above, the research hypotheses are as follows:

Hypothesis 1: The Training and Education (TE) index has a positive relationship with the profitability of the world's top companies.

Hypothesis 2: The Capital (Ca) Index has a positive relationship with the profitability of the world's top companies.

Hypothesis 3: The Technological Framework (TF) index has a positive relationship with the profitability of the world's top companies.

Hypothesis 4: The Business Agility (BA) index has a positive relationship with profitability of the world's top companies.

Hypothesis 5: The IT integration (IT) index has a positive relationship with profitability of the world's top companies.

3. Hypothetical Research Model

Based on the hypotheses presented, the hypothetical model of the present study is shown in figure 3.

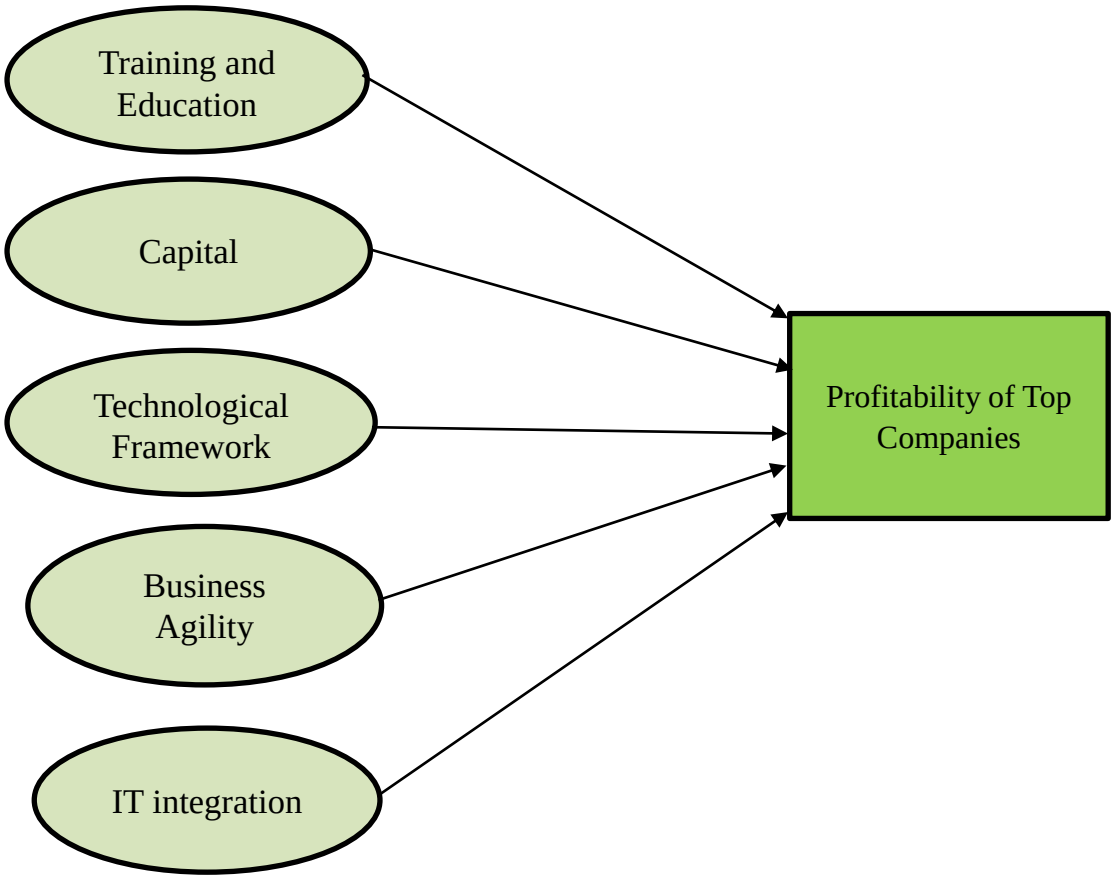

Figure 3. The hypothetical research model

4. Research Method

This quantitative study in terms of data type is secondary data. The research consists of three general stages; firstly, using library studies, reviewing existing texts, models, and related theories, and selecting the appropriate model. In the second step, the data are collected and pre-processed according to the hypotheses and sample size, and in the last step, using panel data modeling approach and using SPSS and Stata software, the collected data were analyzed

using econometric methods and data were analyzed.

The dependent variable of the research is the profitability of the world's top companies (Profit). The independent variables of the research are elements of IMD digital competitiveness index including Training and Education (TE), Capital (Ca), Technological Framework (TF), Business Agility (BA), and IT integration (IT).

Every year, Fortune site publish a report on revenue, profitability, industry type, number of employees, and more from the top 500 companies in the world. Given that the dependent variable in this study is the profitability of the top companies and the profitability difference between the top companies and the down companies is high, out of 500 companies, 200 companies that have profitably ranged from 1 to 200 ranks are considered as a statistical population. As the present study attempts to investigate the impact of competitiveness indices on the profitability of top companies, the statistical population of the study is the countries whose company or companies were among the top 200 companies in the world for profitability from 2013 to 2018. In the present study, from 2013 to 2018, data on the top 200 companies in the world were extracted for profitability from 32 countries. Of these, 175 companies over the past six years have been among the top 200 profitable companies in 22 countries. Therefore, the world's top 175 companies are considered as sample size in terms of profitability of 22 countries in the statistical community. Data on the dependent variables, profitability of top companies, are extracted from Fortune's annual reports and data on independent research variables from the IMD digital Competitiveness ranking annual reports between 2013 and 2018.

5. Data Analysis

Descriptive and inferential statistics were used to analyze the collected data. The descriptive statistics of the graphs, Central indicators (mean) and dispersion (standard deviation) indices and SPSS software is used for this purpose. In the inferential statistics section, since the nature of the data is cross-sectional and time series, the panel data technique is used.

Panel data is a combination of cross-sectional data and time series, meaning that we observe cross-sectional data over time. It is clear that such data have two dimensions, one dimension being related to different units at each specific time point and the other dimension being time. The use of panel data methods over cross-sectional and time series methods has two major advantages: First, it allows the researcher to consider the relationship between variables and even units (companies) over time, and The second advantage is the ability of this method to control the individual effects of companies (as cross-cutting units) that are not observable and measurable.

In statistics, linear regression is a linear model approach between response variables with one or more descriptive variables. Regression is often used to explore the linear relationship model between variables. In this case, it is assumed that one or more descriptive variables whose value is independent of the other variables or under the researcher's control can be effective in predicting the response variable whose value is not dependent on the descriptive variables under the researcher's control. The purpose of regression analysis is to identify the

linear model of this relationship.

The general form of the linear K-variable regression model is as follows:

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta_K X_{Ki} + u_i \qquad (i = 1, 2, \ldots, N) \tag{1}$$

Where the β_1 is width of the origin, β_K is the coefficients of partial angles, u are the random disruption component (estimation error), N is the size of the original population, and i represents the i-th observation. Y denotes the dependent variable and X denotes the independent variable. (Gujarati, 1995:323).

By expanding the main equation we will have:

$$Y_1 = \beta_1 + \beta_2 X_{21} + \beta_3 X_{31} + \ldots + \beta_K X_{K1} + u_1$$

$$Y_2 = \beta_1 + \beta_2 X_{22} + \beta_3 X_{32} + \ldots + \beta_K X_{K2} + u_2$$
$$\vdots$$
$$Y_N = \beta_1 + \beta_2 X_{2N} + \beta_3 X_{3N} + \ldots + \beta_K X_{KN} + u_N$$

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_N \end{bmatrix} = \begin{bmatrix} 1 & X_{21} & X_{31} & \ldots & X_{K1} \\ 1 & X_{22} & X_{32} & \ldots & X_{K2} \\ \ldots & \ldots & \ldots & \ldots & \ldots \\ 1 & X_{2N} & X_{3N} & \ldots & X_{KN} \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_K \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_N \end{bmatrix} \tag{2}$$

$$\begin{array}{ccccccc} Y & = & X & & \beta & + & u \\ N \times 1 & & N \times K & & K \times 1 & & N \times 1 \end{array}$$

$$Y = X\beta + u$$

If one observes autocorrelation or variance heterogeneity, the generalized least squares (GLS) method can be used to estimate the coefficients. However, using this method requires some guesses about the variance-covariance matrix of the disturbance statements that the use of the variance-covariance matrix of the estimated OLS model as a starting point and the use of iterative methods can be helpful in this regard.

6. Results

The minimum, maximum, mean, standard deviation, Kurtosis and skewness of the research variables are listed in Table 1. Because the distribution of the research variables is not normal by logarithmizing the data, their distribution is normalized. It should be noted that due to the large amount of corporate profits, these values are scaled between 0 and 100 to allow for comparison with other variables. For example, the highest profit is $ 53394 million, which is scaled to 99.8. Figure 4 shows trend of the mean of the research model variables between 2013-2018.

Table 1. Descriptive indices of the research variables

Variable	Skewness	Kurtosis	St. Deviation	Mean	Max.	Min.
Profit	2.827	9.632	13.656	14.775	99.80	1.8
TE	-0.269	0.113	10.202	69.112	96.26	43.09
BA	-0.837	-0.539	14.178	78.481	98.43	41.43
TF	-1.041	0.402	10.961	77.961	94.08	39.51
Ca	-0.335	-0.694	13.444	81.732	100	49.07
IT	-1.442	0.537	12.436	80.189	94.52	50.87

6.1 Research Model Analysis

The purpose of this study is to investigate the effects of Training and Education, Capital, Technological Framework, Business Agility and IT integration from IMD digital competitiveness index on profitability of top companies in the world. This model has the following functional form:

$$lnProfit_{i,t} = \alpha_0 + \beta_1 lnTE_{i,t} + \beta_2 lnBA_{i,t} + \beta_3 lnTF_{i,t} + \beta_4 lnCa_{i,t} + \beta_5 lnIT_{i,t} + \varepsilon \quad (3)$$

Where α_0 is the width of the origin and ε is the estimated error. In order to estimate the above model, the F-Limer test and then the Hausman test for the type of estimation model should be performed. After confirming the results of these tests, the final model is estimated.

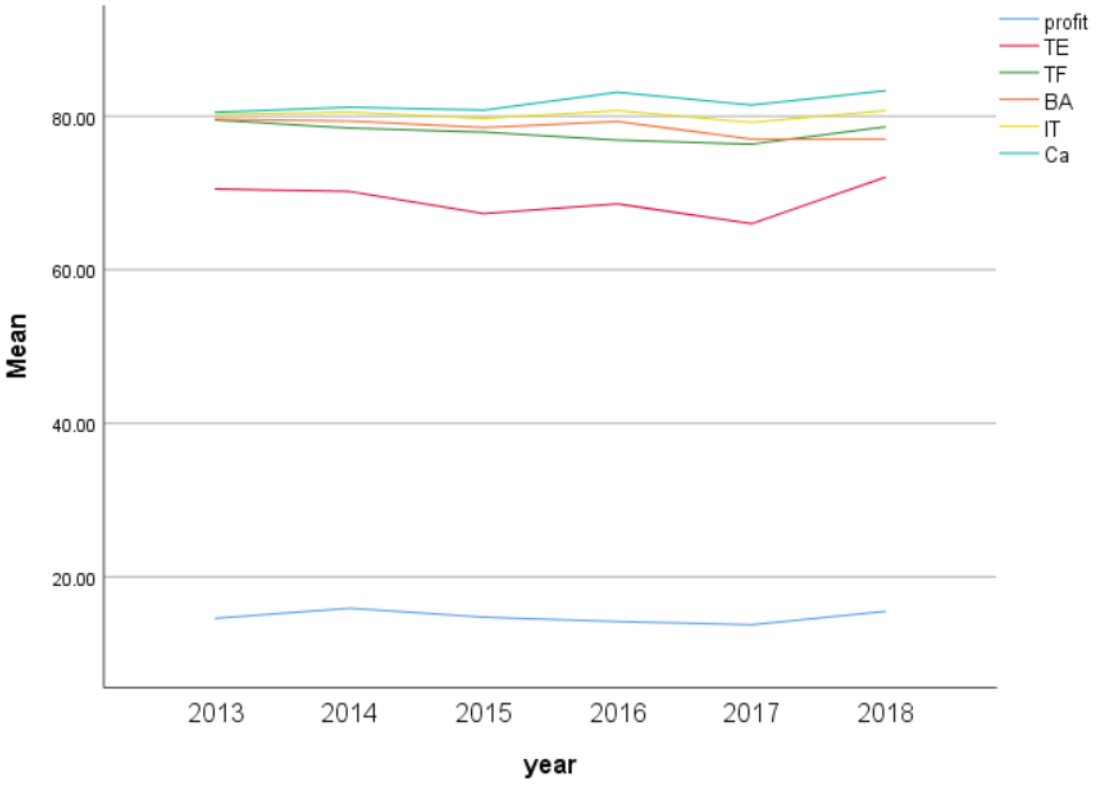

Figure 4. Trend of the mean of the research model variables between 2013-2018

In order to analyze the data using the panel data method, a number of tests must be performed in the first step to determine the method of analysis. These tests are:

6.2 F-Limer Test

In order to investigate the type of model in panel data method, F-Limer test was used. In this test, the null hypothesis of the existence of a pool method is tested against the hypothesis of a panel data method. If the null hypothesis is rejected, the model is panel data type and then fixed and random effects tests should be performed in the next step. If the null hypothesis is confirmed, the pool model should be used. Based on the results in Table 2, the null hypothesis is rejected. Therefore, panel data method should be used to estimate the model.

Table 2. F-Limer fixed effects test for the research model

Prob.	d.f.	Statistic	Test
0.000	(174,870)	19.21	**F**
0.252	174	6.59	**Chi-square**

6.3 Hausman Test

Once the type of data has been determined, it is now clear which model should be used Fixed effects model or random effects model. In this study, the Hausman test was used to determine the type of model. If the null hypothesis of this test is rejected, the fixed effects model should be used, otherwise the random effects model should be used. Based on the results in Table 3, the null hypothesis is confirmed. Therefore, the random effects model should be used to estimate the model.

Table 3. Hausman test for the research model

Prob.	d.f.	Statistic	Test
0.252	5	6.59	**Chi-square**

6.4 Research Model Estimation

Based on the findings, all model variables have a positive and significant effect on corporate profitability. According to the results, Technological Framework has the greatest impact on corporate profitability. The estimated coefficient for the Training and Education efficiency is 0.0008, which is significant. The estimated coefficient for the Capital is 0.4405, which is significant. The estimated coefficient for Technological Framework is 0.7111 which is significant. That is, as Technological Framework increases by one percent, corporate profits increase by 0.7111 percent. The estimated coefficient for Business Agility is 0.0167 which is significant. The estimated coefficient for IT integration is 0.3626 which is significant.

At the end of Table 4, the coefficient of determination, the adjusted coefficient and the Durbin-Watson statistic are presented. The coefficient of determination is 0.959, indicating that the independent variables were able to explain 95.9% of the dependent variable changes. Also the adjusted coefficient of determination is 0.955 which due to the small difference of this coefficient with the coefficient of determination it can be said that there is no surplus variable model and the model is well fitted. Durbin-Watson statistic is also 1.587, so there is no correlation between the residuals.

Table 4. Estimation of Research Model

Prob.	t-Statistic	Std.error	Coefficient	Var.
0.003	2.66	0.0003	0.0008	lnTE
0.005	13.72	0.0321	0.4405	lnCa
0.000	25.67	0.0277	0.7111	lnTF
0.001	5.96	0.0028	0.0167	lnBA
0.000	27.05	0.0134	0.3626	lnIT
0.0019	9.32	0.0982	0.9154	C
D.W=1.587		$R^2_{adjusted}$ =0.955	R^2=0.959	

7. Discussion

Hypothesis 1: The Training and Education (TE) index has a positive relationship with the profitability of the world's top companies.

According to the results of this study, Training and Education index has a significant positive effect on profitability of top companies in the world. The estimated coefficient is 0.0008, which is significant. Therefore, this hypothesis is confirmed.

In Becker et al. (2001) study, increasing employees' abilities and capabilities has direct effects on financial outcomes and thus on firm performance. Also, according to Rein et al. (1994), human resource storage provides the context for a unique approach that thereby creates the potential for superior performance or sustained competitive advantage.

The present study examines the impact of the Training and Education efficiency index on the profitability of the world's top corporations and shows that the Training and Education index, published annually by the IMD digital competitiveness ranking, has a significant relationship with the profitability of the world's top corporations.

Hypothesis 2: The Capital (Ca) index has a positive relationship with the profitability of the world's top companies.

According to the results of this study, Capital index has a significant positive effect on profitability of top companies in the world. The estimated coefficient is 0.4405 which is significant. Therefore, this hypothesis is confirmed.

Berger and Patti (2006) have proved that there is a positive relationship between capital structure and firm performance, Margaritis and Psillaki (2007), Cheng, Liu and Chien (2010), have also supported Berger and Patti (2006) when they found reliable evidences of a significant relationship between capital structure and firm performance.

The present study examines the impact of the Capital index on the profitability of the world's top corporations and shows that the Capital index, released annually by the IMD digital competitiveness ranking, has a significant relationship with the profitability of the world's top companies.

Hypothesis 3: The Technological Framework (TF) index has a positive relationship with the profitability of the world's top companies.

According to the results of this study, Technological Framework index has a positive and significant effect on profitability of top companies in the world. The estimated coefficient is 0.7111 which is significant at 99% level. Therefore, this hypothesis is confirmed.

According to Stoneman & Kwon's (1996) research, adoption and application of technology will increase corporate profits. The results of this study also confirm this.

The present study examines the impact of the Technological Framework index on the profitability of the world's top companies and shows that the Technological Framework index, released annually by the IMD digital competitiveness ranking, has a significant relationship with the profitability of the world's top companies.

Hypothesis 4: The Business Agility (BA) index has a positive relationship with profitability of the world's top companies.

According to the results of this study, the Business Agility index has a positive and significant effect on profitability of top companies in the world. The estimated coefficient is 0.0167 which is significant. Therefore, this hypothesis is confirmed.

Strategic agility has been conceptualized as a capability that enables firms to be more proactive in changing their organizational systems to gain advantages as part of their intended strategy rather than only reacting to external change (Sambamurthy & Grover, 2003; Doz & Kosonen, 2008).

The present study examines the impact of the Business Agility index on the profitability of the world's top corporations and shows that the Business Agility index, which is published annually by the IMD digital competitiveness ranking, has a significant relationship with the profitability of the world's top companies.

Hypothesis 5: The IT integration (IT) index has a positive relationship with profitability of the world's top companies.

According to the results of this study, the IT integration index has a positive and significant effect on the profitability of the world's top companies. The estimated coefficient is 0.3626 which is significant at 99% level. Therefore, this hypothesis is confirmed.

Information Technology (IT) capabilities play a significant role in increasing firm performance (Aydiner et al., 2017; Benitez et al., 2018; Oh et al., 2016). IT capabilities are the multifaceted bundles of IT resources which enable firms to coordinate business activities efficiently through the mobilization and deployment of these IT-based resources, hence improve various firm performance indicators (Bharadwaj, 2000; Nevo & Wade, 2010).

The present study examines the impact of IT integration index on profitability of top companies in the world and shows that IT integration index, published by the IMD digital competitiveness ranking every year, has a significant relationship with profitability of top companies in the world.

8. Conclusions

According to the existing literature, digital competitiveness index has a positive and significant relationship with firm profitability. In the present study, the impact of Training and Education, Capital, Technological Framework, Business Agility and IT integration on the profitability of top companies in the world were investigated. The findings show that the elements of Training and Education, Capital, Technological Framework, Business Agility and IT integration have a positive and significant relationship with the profitability of the world's top companies.

9. Research Limitations

In addition to the original findings, this study has some limitations that could be an opportunity for future research. The first limitation is that we only considered the macro factors affecting corporate financial performance. However, many factors at lower levels such as industry and firm also influence the financial performance of the company. Therefore, multilevel studies of corporate performance are a good opportunity for research. The second limitation concerns the financial performance of a company studied in this study. While nonfinancial factors are both important and essential for companies and may provide the basis for successful financial performance, this study ignored the corporate nonfinancial performance. The third limitation relates to the nature of data comparisons in secondary data, whose quality and conditions may vary across industries, companies and countries.

10. Future Suggestions

1) In the present study, the digital competitiveness index elements are considered as independent variables. Other important factors, such as company size, human capital, type of industry, etc., affect the profitability of the world's top companies. Therefore, future research can investigate the impact of these factors on the profitability of top companies in the world.

2) China is not very good at the IMD digital Competitiveness ranking, but between 2013 and 2018, about 11% of the world's top 175 companies were Chinese. Therefore, future research can examine the reasons for this.

3) The present study investigated the impact of digital competitiveness indicators on the profitability of top companies in the world, most of which belong to advanced

industrialized countries. Future research can examine the impact of the digital competitiveness Index on the profitability of top developing countries and compare its results with those of this study.

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