

The Impact of Information and Communication Technologies on National Competitiveness: A Test of a Mediating Model in the European Union Countries Context

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Abstract

This paper investigates the relationship between determinants of information and communication technologies, such as information society, innovation and R&D and network industries, and global national competitiveness. The research is based on data from the 27 European Union member-states. A mediation model is tested to examine the link between determinants of the economic system, such as liberalization, financial services, enterprise environment, social inclusion and sustainable development, and global national competitiveness. The results of this study support the hypothesis that the relationship between the economic system and global national competitiveness is positively mediated through information and communication technologies.

Keywords: Global national competitiveness, economic system, mediation model.

Introduction

Under the present international financial crisis the concept of competitiveness has emerged as one of the most influential determinants of economic development. ‘*Competitiveness*’ captures the alertness of both the restrictions and challenges posed by competition in domestic and international markets. National competitiveness was ten years ago one of the objectives set by Europe’s heads of state at the European Council in Lisbon, Portugal, at the March 2000. Specifically, this objective was to improve the competitiveness of the EU member-states through various policy initiatives, referring to information and communication technologies (information society, innovation and R&D and network industries) and to economic environment (liberalization of markets, financial services, enterprise environment, social inclusion and sustainable development) (Blanke & Thierry, 2008).

However, some researchers are questioning whether the Solow (1987) ‘productivity paradox’ still holds. Solow (1987, p.36) said twenty years ago that “you can see the computer age everywhere but in the productivity statistics”. By rephrasing this paradox it may be questioned whether the introduction of information and communication technologies will (or will not) be reflected in the productivity statistics (Adams, 2004), or whether the introduction of these new

technologies will seriously dislocate some economies as competition intensifies (Kraemer & Dedrick, 2007).

Furthermore, although it is argued that information and communication technology is playing an increasing role in growth, capital investment, and other aspects of the economy, the actual influence of this role is still under empirical investigation because important underlying methodological and measurement problems have not yet been resolved (Brynjolfsson & Kahin, 2002). Accordingly, this study is aiming to fill this gap by empirically investigating whether the economic environment or the information and communication technologies have the highest influence in predicting global national competitiveness in the European Union.

Based on the above presentation, the primary questions examined in this research are:

1. What is the impact (if any) of information and communication technologies on the economic environment and global national competitiveness relationship in the European Union context?
2. Is it the economic environment or the information and communication technologies that has the highest influence in predicting global national competitiveness in the European Union?

Section two presents the operational model and develops the hypotheses to be tested. Data, constructs and the statistical analysis used in estimation, are described in section three. The statistical estimates of the model and discussion of the meaning of these estimates is presented in section four. Finally, section five presents the conclusions of the study.

Theory and Hypotheses

There is a general consensus that economic environment influences national competitiveness (Katsouli, 2006). The proposed model advocates that a positive economic environment (ECON) leads to higher levels of investment in information and communication technologies (ICT), leading to improved global national competitiveness (GNC). Figure 1 presents the general framework of a mediating model. In this model, one can see both '*direct linkage*', and '*indirect linkage*' via information and communication technologies, between economic environment and global national competitiveness. However, it is not necessary for these linkages to be present simultaneously. It is very possible, even in the absence of a direct linkage, economic environment to contribute significantly to global national competitiveness through the intervening process. The rationale of the 'Economic Environment – Global National Competitiveness linkage model' presented in Figure 1, and the hypotheses to be tested, are discussed below.

Global National Competitiveness

The factors that determine the competitiveness of nations are as diverse as they are numerous. However, based on theoretical and empirical research it is generally accepted that factors that are critical in improving national competitiveness may be categorized into the following nine pillars (Lopez-Claros, 2008): Institutions, Infrastructure, Macroeconomy, Health and primary education, Higher education and training, Market efficiency, Technological readiness, Business sophistication, Innovation.

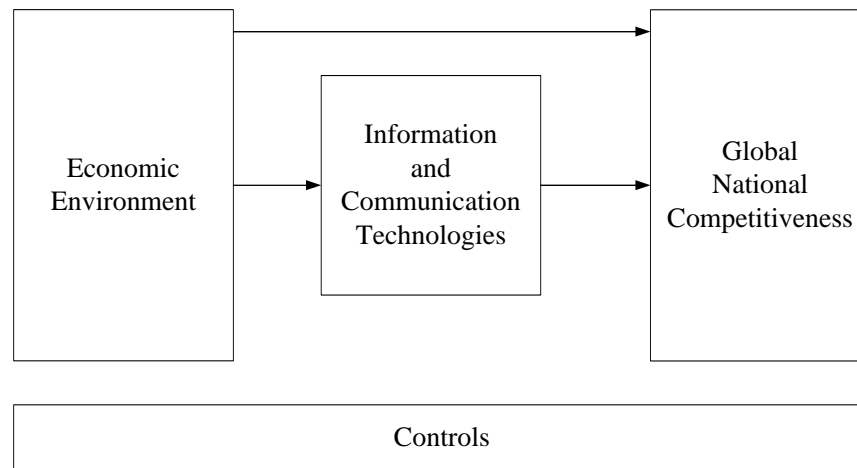


Figure 1. Mediating Model

Information and Communication Technologies

The critical factors of information and communication technologies that improve national competitiveness have been categorized into the following three dimensions (Blanke & Geiger, 2008): *'Creating an information society for all'*, that measures the extent to which an economy has harnessed the new information and communication technologies for sharing knowledge and enhancing the productivity of its industries. *'Developing an area for innovation, research and development'*, in order to make countries to have the necessary framework to ensure that they are ahead of innovation in products and processes. *'Building network industries in telecommunications, utilities and transportation'*, aimed at improving efficient functioning of markets.

Economic Environment

The critical factors of economic environment that improve national competitiveness have been categorized into the following five dimensions (Blanke & Geiger, 2008): *'Liberalization (Completing the single market / state aide and competition policy)'*, for the free movement of goods, services, capital and labor within the market. *'Creating efficient and integrated financial services'*, for making capital available for business investment from such sources such as a sound banking sector, well-regulated securities exchanges or venture capital. *'Improving the enterprise environment (Business start-ups / regulatory framework)'*, for improving the prospects of growth and employment. *'Improving social inclusion (bringing people to the workforce, upgrading skills and modernizing social protection)'*, in order to create jobs and bring more people into the work force, and ensure the ability to pay for growing pension expenditures. *'Enhancing sustainable development'*, in order to ensure that improvements in the quality of life for the present generation will not come at the expense of future generations.

From the discussion thus far and according to the relationships depicted in the operational model presented in Figure 1, we hypothesize that:

Hypothesis 1: A positive relationship exists between economic environment and global national competitiveness.

Hypothesis 2: A positive relationship exists between economic environment and information and communication technologies.

Hypothesis 3: A positive relationship exists between information and communication technologies and global national competitiveness.

Hypothesis 4: Increases in information and communication technologies mediate the relationship between economic environment and global national competitiveness.

Methodology

Data and constructs

All data in this study were taken from the World Economic Forum database. Table 1 presents the principal components factor analysis with varimax rotation, and eigenvalue greater than one, on the individual items used for each construct. Specifically, the results showed that the three items of the global national competitiveness were factored into one dimension that explains 98.7 percent of the variation, which is above the suggested construct validity level of 0.50 (Hair, Anderson, Tatham, & Black, 2006). The Cronbach alpha score for these items is 0.993, which is above the suggested reliability level of 0.70 (Nunnally, 1978). We used the scores of GNC for three successive years, to minimize random fluctuations of competitiveness over the past three years. Furthermore, the three items of the information and communication technologies were factored into one dimension that explains 85.4 percent of the variation, which is above the suggested construct validity level, and the Cronbach alpha score for these items is 0.913, which is above the suggested reliability level. Additionally, the five items of the economic environment were factored into one dimension that explains 85.4 percent of the variation, which is above the suggested construct validity level, and the Cronbach alpha score for these items is 0.956, which is above the suggested reliability level. Finally, the three constructs were created based on weighed averages with weights being the corresponding factor loadings.

Two control variables were included in the analysis, to capture other environmental forces that are related to all the variables involved in the study, as follows: ‘*Eurozone*’, to capture the effects of the common currency, and ‘*Accession*’, to capture the effects of the EU accession of the 12 member-states.

Table 1. Factor analysis results for the constructs used

Global National Competitiveness		Information and Communication Technologies		Economic Environment	
(GNC)		(ICT)		(ECON)	
Variables	Loadings	Variables	Loadings	Variables	Loadings
GNC_07	0.990	Information Society	0.918	Liberalization	0.966
GNC_08	0.998	Innovation and R&D	0.923	Financial Services	0.944
GNC_09	0.991	Network Industries	0.931	Enterprise Environment	0.828
				Social Inclusion	0.944
				Sustainable Development	0.933
Explained variation	98.686%		85.400%		85.429%
Eigenvalue	2.961		2.562		4.271
Cronbach alpha	0.993		0.913		0.956

Statistical analysis

Mediation is a hypothesised causal chain in which one variable (X) affects a second variable (Z) that, in turn, affects a third variable (Y). The ‘*intervening*’ variable is the ‘*mediator*’. For example, ECON affects ICT that, in turn affects GNC, as it is shown in Figure 1. Paths from X to Z and from Z to Y are called ‘*direct effects*’. The mediation effect in which X leads to Y through Z it is called the ‘*indirect effect*’. The indirect effect represents the portion of the relationship between X and Y that is mediated by Z (Newsom, 2001).

Baron and Kenny (1986) proposed a four-step approach in investigating mediation (Katou & Budhwar, 2006):

- Step 1:* Conduct a regression analysis with X predicting Y to test if there is an effect that may be mediated, $Y = a + bX + e$.
- Step 2:* Conduct a regression analysis with X predicting Z to test if X is related to Z, $Z = a + bX + e$.

Step 3: Conduct a regression analysis with Z predicting Y to test if Z is related to Y, $Y = a + bZ + e$.

Step 4: Conduct a regression analysis with X and Z predicting Y to test if Z completely mediates Y, $Y = a + b_1X + b_2Z + e$.

The purpose of Steps 1 to 3 is to establish that ‘*zero-order*’ relationships among the variables exist. If one or more of these relationships are non-significant, mediation is not likely. Assuming there are significant relationships from Steps 1 through 3, one proceeds to Step 4. In Step 4, some form of mediation is supported if the effect of Z remains significant after controlling for X. If X is no longer significant when Z is controlled, the findings support ‘*full mediation*’. If X is still significant (i.e., both X and Z significantly predict Y), the finding supports ‘*partial mediation*’ (Kenny, 2001).

The presentation above can be extended to include situations where additional variables need to be considered, even if they are somewhat tangential to the direct mediating relationship. The controlling of other variables is important to be included in the regressions because if these variables were omitted then the serious problem of specification error will be produced (Kenny, 2001).

Results

Table 2 presents the results of the regression analysis for testing the effects of economic environment (ECON) on global national competitiveness (GNC), using as mediator the information and communication technologies (ICT). The mediation effect is tested through the steps presented above:

1. From the regression results in Model 1, we see that ECON positively affects GNC, thus supporting Hypothesis 1.
2. From the regression results in Model 2, we see that ECON positively affects ICT, hence supporting Hypothesis 2.
3. From the regression results in Model 3, we see that ICT positively affects GNC, consequently supporting Hypothesis 3.
4. From the regression results in Model 4, we see that both, ECON and ICT positively affect GNC, therefore supporting Hypothesis 4. Because both these variables are significant, this finding supports partial mediation (Kenny, 2001). Moreover, considering that the beta coefficient of ICT is greater than the beta coefficient of ECON, we conclude that information and communication technologies are more important than economic environment in predicting global national competitiveness in EU.

Table 2. Regression results for testing mediation of ICT

	Model 1	Model 2	Model 3	Model 4
	GNC	ICT	GNC	GNC
Constant	1.609 (0.000)	-0.196 (0.730)	2.000 (0.000)	1.690 (0.000)
Controls				
Eurozone	-0.172 (0.040)	-0.048 (0.673)	-0.146 (0.045)	-0.152 (0.029)
Accession	-0.311 (0.003)	-0.246 (0.084)	-0.196 [0.036]	-0.210 (0.019)
Mediators				
ICT			0.619 (0.000)	0.411 (0.002) [0.573]
ECON	0.704 (0.000)	1.052 (0.000)		0.271 (0.065) [0.301]
R ²	0.900	0.894	0.924	0.935
Adjusted R ²	0.887	0.880	0.914	0.924
F	69.361 (0.000)	64.325 (0.000)	93.679 (0.000)	79.692 (0.000)
N	27	27	27	27

Notes: Significant levels in parentheses
Beta coefficients in brackets

Furthermore, with the introduction of the control variables we tried to capture effects that may identify differences in competitiveness between the countries that are attributed to factors other than the factors that constitute the independent variables included in the regression equations. Specifically, from the results presented in Model 4 in Table 2 we found that both controls are significant and negatively related to global national competitiveness. This means that the level of global national competitiveness of the 15 EU member-states (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Cyprus, Malta, Slovenia) did not improve by establishing the Eurozone, compared to the EU member-states that did not enter the Eurozone. Similarly, the level of global national competitiveness of the 12 EU member-states (Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovak Republic, Slovenia) that lately entered European Union did not improve, compared to the initial EU member-states.

Conclusions

Although past research has demonstrated that there exists a positive relationship between economic environment and global national competitiveness, it has neglected to investigate the mediating mechanisms, usually called the 'black box', through which determinants of the economic environment are hypothesized to affect global national competitiveness.

The results of this study support that determinants of the economic environment positively affect global national competitiveness. Specifically, the relationship between liberalization, financial services, enterprise environment, social inclusion and sustainable development, and global national competitiveness, is mediated through information society, innovation and R&D and network industries. In particular, considering the highest loadings of the constructs in Table 1, it is seen that liberalization positively influences network industries, which in turn positively influence global national competitiveness. Additionally, it is supported that the influence of the information and communication technologies is higher than the influence of economic environment in predicting global national competitiveness in the European Union.

The conclusions above, nonetheless, should be treated with caution. This is mainly because biases in estimating equations employing weighted average indexes may have distorted the results (Katsouli, 2006). Therefore, further research is needed using disaggregated variables and considering the context of more countries.

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