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Strategic Decision-Making in Uncertain Environments: A Management Science Perspective

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Abstract:

In today's dynamic and uncertain business landscape, strategic decision-making plays a pivotal role in the success and sustainability of organizations. This article explores the challenges and opportunities associated with strategic decision-making in uncertain environments from a management science perspective. Drawing upon interdisciplinary theories and empirical research, this paper aims to elucidate the key factors influencing strategic decision-making processes, including environmental turbulence, information asymmetry, cognitive biases, and organizational capabilities. Moreover, it examines various decision-making models, tools, and techniques employed by managers to navigate uncertainty and enhance strategic outcomes. By integrating insights from management science, this article provides valuable theoretical and practical implications for executives, managers, and scholars striving to optimize decision-making processes in turbulent environments.

Keywords: Organizational capabilities, Cognitive biases, Environmental turbulence, Management science, Uncertainty, Strategic decision-making

Introduction

Human capital is one of the most significant growth generators, according to a substantial body of research (Riley, 2012; Lucas, 1988; Mankiw et al., 1992; De la Fuente and Doménech, 2000, 2006). This holds true for both the level effect, which is characterized by increased competitive advantage through technology diffusion and innovation (Pistorius, 2004; Siggel, 2000, 2001; Horwitz, 2005), and the level effect (also known as the rate effect). Labor productivity is considered an exogenous variable in the traditional theory of economic growth, contingent upon the workforce-to-physical capital ratio and additional variables such as technological advancement. The positive effect of education on potential productivity growth, however, is not taken into account. The early 1980s emerged new theory of economic growth, which addressed this deficiency in the traditional theory of economic growth, which emphasized the importance of education and innovation as components of human capital. The new growth theory, on the other hand, demonstrates that research has identified the influence of intangible assets such as intellectual capital, patents, and R&D on the market value and growth of businesses. Consequently, this phenomenon gives rise to economic expansion at the domestic, regional, or global levels. As demonstrated by Temple (1999), De la Fuente and Doménech (2000, 2006) discovered a statistically significant positive correlation between human capital and output, both at the level and in first-order differences. According to research conducted by Bassanini and Scarpetta (2001), an increase of one year in the duration of education is associated with a 6% rise in GDP per capita, using OECD data spanning from 1971 to 1998. According to a study by Benhabib and Spiegel (1994), the incorporation of human capital as a factor of production through the Coob-Douglas function has an insignificant effect on the development of GDP per capita. Nevertheless, upon examining the influence of human capital on total factor productivity, two aspects become apparent: (a) Romer (1990) has demonstrated that human capital affects the rate of internal innovation diffusion; and (b) Nelson and Phelps (1966) have established that human capital impacts the rate of technology diffusion. A 1% increase in capital stock is associated with a 0.13% increase in growth rate, and the national human capital stock has a substantial influence on a country's capacity to attain technological parity with other nations (Funke and Strulik, 2000). In their work, Michael Funke and Holger Strulik (2000) employ a model that integrates aspects of contemporary and classical theories of economic growth to illustrate the diverse impacts of human capital that are contingent upon the level of development of a country. If productivity in the process of accumulating knowledge is sufficiently high, the Uzawa-Lucas model may account for the mechanisms of development, according to them. Nevertheless, the Grossman-Helpman model can be extended to account for an economy characterized by a diverse array of products by considering technological advancement as an endogenous factor, which necessitates substantial investments in research and development. Physical capital significantly influences the growth of per capita income in the early stages of development when knowledge is acquired through continuous education and training and advances to more advanced stages of development. Bundell and colleagues concluded in their 1999 analysis of the relationship between human capital and economic growth that education level and the rate of human capital

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accumulation and innovation impact labor productivity. The authors supported their claims with the following passages: a) Griliches's (1997) study, which found that a 33% increase in productivity was associated with a change in labor force education level over a 50-year period in the United States; b) Jenkins's (1995) findings, which indicated that a 1% share of highly skilled workers' breeding generated an increase of 0.42 to 0.63% in annual output for the United Kingdom from 1971 to 1992; and c) OECD data from the 1960s, which indicated that the number of highly educated individuals increased by 0.42 to 0.63% in the United Kingdom. A sector's enhanced technological change, according to Mincel (1995), increases the demand for an educated and trained workforce through training programs. A. Miguel de la Fuente is another. According to Cicoone (2002), the influence of human capital on growth promotion is subordinate to its function in elucidating disparities in productivity between nations. By utilizing a panel model and the new theory of economic growth, this study will highlight the impact of education and innovation on the economic development of Romania and other EU countries.

1. Literature Review

Panel models designed for cross-country data analysis (Islam, 1995), convergence analyses proposed by Barro and Salai Martin (1992), and the Solow structural econometric models expanded by Mankiw, Rommer, and Weil (1992), also known as MRW models, are among the numerous methodological approaches described in the literature on this subject. By utilizing the models presented in the literature, it is possible to highlight derived limits that may result from the selection of indicators, their formulation (e.g., logarithm, pace, level, or pace), or the computation methodology. One of the foremost methodological challenges lies in the selection of the proxy indicator to assess human capital, as this indicator directly impacts the extent of influence. Nonnemen and Vanhoudt (1996) contend that the MRW model's use of the proportion of GDP spent on education as a proxy for human capital and economic development reveals little correlation between the two variables. By employing a weighted average of the enrollment rates in secondary, elementary, and tertiary education as a surrogate for human capital, Murthy and Chien (1997) establish a robust and direct positive correlation with economic growth. As a surrogate for human capital, Barro and Lee (1993) and Islam (1995) utilized the mean number of years an individual spent in education over a 25-year period. In their study, María Serena (2001) utilized individual income and the mean number of years spent in education for those aged 25 and older as surrogates for human capital, under the assumption that both increase in tandem with the accumulation of human capital. Izushi and Huggins (2004) employ the quantity of personnel engaged in private sector research and development as an approximation of human capital. In contrast, Baldwin (1971) and Outreville (1999) utilize the proportion of university graduates in the labor force. Due to the inherent difficulty in quantifying the average number of years of education, this metric has been replaced with the aggregate enrolment rate in primary, secondary, and tertiary education, or the enrollment rate (literacy rate), in a multitude of publications. One limitation of comparing nations exclusively by the number of years of education is the challenge of ascertaining whether the knowledge obtained in one country over the course of a year of schooling corresponds with that obtained in another. This complicates the comparability of data. Furthermore, there is a prevailing assumption that knowledge is exclusively obtained through formal education, disregarding supplementary methods of training. Utilizing the PISA and TIMS test results as indices of human capital, Hanushek and Woessmann (2007) and Hanushek and Kimbo (2000) emphasize the positive impact of quality education over quantity. As an illustration, Hanushek and Schultz (2012) demonstrated that a two percentage point variation in the GDP per capita growth rate could result from a 100-point variation in PISA test scores. An additional concern regarding the methodology pertained to the inquiry into whether a causal connection exists between education and economic development (OECD, 2010), in addition to the interpretation of said connection. Certain authors assert that this issue can be resolved using econometric techniques (Glaeser et al., 2004). The utilization of logarithmic indicators, whether in form or level, constitutes an additional limitation of the employed models. Fuente and Cicoone (2002) assert that the utilization of logarithmic numbers in the estimation of the influence of education on economic development leads to an underestimation of both coefficients and a reduction in the degree of imprecision. Furthermore, they demonstrate fluctuations in the magnitude of indicators employed as surrogates for human capital in numerous studies, such as the number of years of education or PISA and TIMS test scores. To underscore this effect, we present the values of this indicator for several EU member states in 1990 and 2000 in Table 1. A correlation has been observed between the outcomes of the PISA assessment and the number of years of education, according to a recent study by the OECD (2014). According to experts, a PISA performance of 300 points is equivalent to seven years of education, while an average of 200 PISA points is equivalent to six years of education. Furthermore, there is a correlation between the life prospects of interviewees and their PISA performance. Moreover, there exists a prevailing belief that test outcomes are correlated with the accessibility of educational resources, whereby superior performance is typically associated with more affluent socioeconomic backgrounds. If students' performance surpasses the OECD average, an increase in the proportion of students attaining high standards in science, mathematics, and literacy indicates that the educational system is capable of generating academic excellence. This is significant because the growth of a knowledge-based society and a nation's economy are both dependent on high performance. Human capital is quantified by means of the human capital index. Education investment, human capital stock utilization (Romania utilized 48.5% of the stock in 2006, compared to 55.2% in the Czech Republic), demographics and productivity of human capital, and employment of human capital comprise the four categories. Calculations indicate that Romania occupied the 7th position among the 12 newly admitted EU members in terms of human capital index, with a value of 29.9. This ranking surpasses that of Poland (34), Hungary (30, 6), and Israel (48). The human capital index of the World Economic Forum is constructed upon four fundamental pillars: education, well-being and prosperity, labor force and employment, and the conducive environment encompassing infrastructure, legal structures, and other components that ensure the accurate assessment of human capital. Figures 1a and 1b illustrate the index levels for Romania and other countries in 2012.

. **Results**

To emphasize the significance of human capital in economic growth, we implemented a panel model utilizing the subsequent function, in accordance with the approaches taken by Eric Hanushek (2013), de la Fuente, and Doménech (2000). GDP per capita represents the actual value of GDP and is a stochastic direct function of human capital (H) and other variables (X). The parameters requiring estimation are denoted as ε, while α, β, and β represent the time and country fixed effects as dummy variables, respectively. The model utilizes logarithm-stationary annual data from the Eurostat database spanning the years 2000 to 2012. The dependent variable in this study is GDP per capita (GDP_PPP). As independent variables, we considered the number of employees with a secondary education (Empl_Sec), exports of commodities and services (EXP), and the quantity of patents (Patent). There exists a positive correlation between GDP_PPP and a nation's capacity to establish a knowledge-based society (UN, 2005, p. 149). Table 2 presents the statistical registrations of the dependent and independent variables in the model, along with key performance indicators including the mean, median, maximum and minimum values, standard deviation, skewness and kurtosis, and J. The coefficient of Bera. Significant fluctuations are evident in the statistical analysis of the series; the extent of variation in standard deviations is contingent upon the indicator and unit utilized, which can span extensive distances. Furthermore, an asymmetry is evident in the data. The non-normality of the distributions is confirmed by the high level of the Jarque-Bera test and the quantity of patents; the skewness values, excluding exports, were predominantly negative and zero; and the Kurtosis indicator fluctuates by approximately 3. Please see Table 2. The model that was constructed incorporated fixed effects for nations and periods due to the fact that the relationship between variables was altered by both national and specific changes in various time periods. The gradual diffusion of the financial crisis across European Union member states that commenced in the autumn of 2007 potentially influenced the model's conclusions regarding negative coefficients in 2008 and 2009. (Figure 3). R-squared is 0.996870; the adjusted R-squared value is 0.996349. The data model indicates that there is a statistically significant and positive relationship between GDP per capita and the explanatory variables. The weakness of this relationship could potentially be attributed to the magnitude of the negative correlation between education spending and country heterogeneity, as predicted by theory. Future verification of this notion will require a differentiated analysis of the countries' economic development levels.

Table 1:

	Log(GDP_PPP?)	Log(Empl_Sec?)
Mean	9.922442	7.398319
Median	9.989665	7.463822
Maximum	11.18720	10.04772
Minimum	8.556414	3.113515
Std. Dev.	0.442915	1.480101
Skewness	-0.533142	-0.585531
Kurtosis	3.370399	3.360562
Jarque-Bera	16.93564	19.95601
Probability	0.000210	0.000046
Sum	3165.259	2360.064
Sum Sq. Dev.	62.38335	696.6425
Observations	319	319
Cross sections	28	28

Source: The processing of the author

3. Conclusion

This essay underscored the significance of human capital in sustaining economic advancement, as quantified by per capita GDP. Consistent with economic theory, the model demonstrated a statistically significant positive correlation between per capita GDP and employee qualification (secondary education) and the inventive capacity of human capital (as measured by the number of patents). Unanticipatedly low levels of education expenditure and GDP per capita may be attributable to the diversity of the countries under consideration. However, the findings are corroborated in relation to those of Nonnemen and Vanhoudt (1996), who employed their results as a surrogate for the proportion of GDP allocated to education that represents human capital. This conclusion is predicated on the presence of minimal coefficients. Moreover, the model predicted that the economic crisis and variations stemming from specific countries had an adverse effect. In the future, alternative variables for human capital in the model will consist of the weighted average of the population enrolled in primary, secondary, and tertiary education. This adjustment will serve to illustrate the impact of the proxy for human capital on the outcomes.

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