Examining the Global Knowledge Index: A Confirmatory Factor Analysis Approach.

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Abstract:
Growing emphasis from researchers and politicians has been placed on the knowledge economy, recognizing its crucial role as a cornerstone for sustainable development. However, researchers face a challenge in finding an accurate indicator to measure the extent to which each country is compatible with the knowledge-based economy. The Global Knowledge Index (GKI) represents the most comprehensive. This study seeks to investigate the degree to which the data aligns with the envisaged standard model across a sample of 133 countries in the year 2022. We use confirmatory factor analysis (CFA) to confirm the validity and accuracy of the GKI. The results indicated a poor fit of the data to the model. These outcomes might stem from the reliance on data from the second branch of the GKI during estimation or the potential insufficiency of variables included in capturing the primary indicators of the index. We propose directions for future research, recommending an exploration of the fourth branch in estimation or the inclusion of additional variables to improve the precision of the model.

Key Words: Global Knowledge Index, Confirmatory factor analysis, knowledge economy, MBRF.

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1. Introduction

The knowledge economy is a term that encapsulates the contemporary economic paradigm where the production and use of knowledge play a central role in wealth creation and economic growth (Powell & Snellman, 2004). The importance of the knowledge economy lies in its transformative impact on various sectors, fostering innovation, enhancing productivity, and positioning nations and organizations

at the forefront of global competitiveness (Dima, Begu, Vasilescu, & Maassen, 2018; Nijkamp & Siedschlag, 2010). As societies transition toward knowledge-driven models, the ability to harness and leverage intellectual capital becomes a key determinant of success, shaping the dynamics of industries, education, and overall socio-economic development.

In a rapidly evolving global landscape, countries are strategically transitioning towards a knowledge-based economy to stay competitive and foster sustained growth. This shift involves a departure from traditional models reliant on tangible assets and labour-intensive industries to a focus on knowledge creation, innovation, and information-driven activities (Antonelli, Orsatti, & Pialli, 2023; Jona-Lasinio, Manzocchi, & Meliciani, 2019; Kwasnicki, 1996). The journey toward a knowledge economy is characterized by investments in education, research and development, technology infrastructure, and the cultivation of a skilled workforce.

Measuring the knowledge economy and the progress of countries in it is crucial in understanding and harnessing the transformative forces that support the contemporary economic landscape. As countries increasingly shift towards knowledge-based models, rigorous assessments provide important insights into the effectiveness of policies, investments and innovation initiatives.

Human Development Index (HDI), Human Capital Index (HCI), Global Innovation Index (GII), and Economic Creativity Index (ECI). Collectively, these metrics provide a comprehensive assessment of a country's progress in embracing the knowledge economy paradigm. However, the GKI is considered the most comprehensive. The GKI offers several advantages: first, it provides data across its composite sub-sectoral indicators, which helps measure performance trends across the various components of knowledge; second, it provides comparison across regions and across time; Finally, it highlights successful experiences, identifies the factors behind these successes, and helps direct efforts and resources to develop solutions to existing problems.

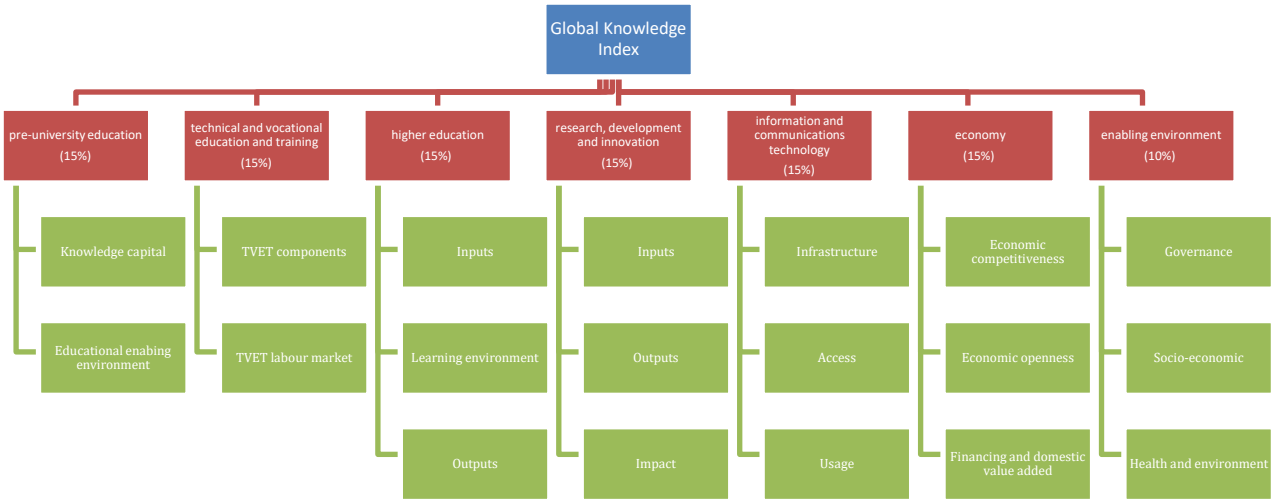
The creators of the GKI - the Regional Bureau for Arab States (UNDP RBAS) and the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF)- claim that it provides accurate and expressive estimates of aspects of knowledge and development. In this article, we aim to investigate the extent to which the GKI can reflect the knowledge economy in countries.

This paper is divided into four sections in addition to the introduction. The second section contains the literature review; The third section is concerned with designing the research methodology. Section fort presents the results and their discussion; In Section five we present the conclusion.

2. Description of the GKI

The GKI provides a comprehensive roadmap of the factors and attributes that drive knowledge competitiveness. The index focuses on six fundamental sectors as the building blocks of a knowledge society: pre-university education, technical and vocational education and training (TVET), higher education, research, development and innovation (RDI), information and communications technology (ICT), and economy. In 2021 and 2022, the GKI underwent a technical and statistical review process. The index now includes seven sectors, and the seventh sector measures the enabling environment. Each sector is constructed according to standard international methodologies for designing composite indicators. The structure of the Index features a hierarchy comprising sectoral indices (referred to as sub-indices), pillars, sub-pillars and variables. Each sub-indice weighs 15 percent, except for the enabling environment, which is assigned a weight of 10 percent (see: Figure1).

Figure.1: Structure of the GKI



Source: UNDP and MBRF.GKI 2022.

According to UNDP and MBRF(2022) The GKI was structured as follows:

- The pre-university education sub-index was structured as a methodological tool for measuring performance in the various stages of the pre-university education system. The focus is on measuring knowledge capital as one of the main outcomes of educational systems, in addition to the necessity of including relevant contextual variables that directly affect the value and quality of educational outcomes.
- TVET reflects the extent to which national economies are able to diversify their offerings and modernize their structures to ensure both their positive interaction with education and training systems, and their positive contribution to the development of human capital. There are three main factors that affect the structure of the economy and the dynamics of social systems today: the environment of the economy, the structure of the labour market and qualifications. These factors are all interconnected and enable societies to respond to challenges, including most notably the integration of young people into their economies. Also measures efficiency in training by adding the variable, 'participation rate in formal and non-formal education training'. It is a variable that combines both competencies and skills and treats both sexes equally, despite the gaps between them resulting from the rapid development of some economies. The principle of equality is also established, which reflects on gender equality in terms of the availability of qualified labour. The principles of equity and social integration have also been included in the form of a new variable that emphasizes the role of inclusion in education and training, and its contribution to fighting poverty and social marginalization, especially among the productive workforce. In addition, the review identified indicators to capture the dynamics between the structure of training and the labour market in a way that enables the evaluation of the education and training system based on its ability to respond positively to the determinants and constraints of the labour market, such as unemployment and qualification.
- The HE sub-index considers internal and contextual characteristics of higher education systems through a pillar that studies the learning environment in higher education institutions. The HE sub-index has three sub-pillars: inputs, learning environment and outputs. Under these pillars, three sub-pillars assess inputs (expenditure, enrolment and resources); two sub-pillars assess the learning environment (diversity and

academic freedom, and equity and inclusiveness); and three sub-pillars assess outputs (attainment, employment and impact).

- The RDI Sub-Index "comprise creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of humankind, culture and society—and to devise new applications of available knowledge". The RDI Sub-Index is broken down into three pillars, two for estimating the inputs and outputs of RDI, and a third for determining the impact of RDI. Based on this rationale, the design treats RDI as a unified or integrated sub-sector, with a production function (composed of inputs and outputs) and a separate pillar for its impact.
- The ICT sub-index indicates the progress made in developing the technological infrastructure and implementing its outcomes. The ICT sub-index comprises three pillars: infrastructure, access, and usage.
- The economy sub-index provides an evaluation of the components of the knowledge economy related to economic competitiveness, economic openness, and financing and domestic value-added, which represent important indicators of the ability and resilience of economies to face global transformations and developments.
- The Enabling Environment Sub-Index represents the necessary conditions for the incubation and support of the production, development and utilization of knowledge to achieve sustainable development. The Enabling Environment Sub-Index is a key determinant for the development of knowledge indicators as it is related to all sectors—institutional, social, economic and political enabling factors are considered as the main pillars for knowledge empowerment. This environment comprises many elements, such as development, education and qualification policies and plans; economic and political reform projects; and legislative frameworks that help support the processes of nurturing new generations, establishing the rule of law and strengthening human rights systems to ensure human safety, welfare and equality. Health services, quality of life and the environment are general elements that play a key role in achieving and sustaining human development.

The seven sectoral sub-indices that make up the GKI are open and dynamic systems that constantly interact with each other on the one hand, and with their surroundings within the general context on the other. They were linked to a number of contextual variables that have been proven to influence the functioning of sectors and their outputs, based on a holistic view of development and its components, placing them in the context of an integrated synthetic system that is dynamically active and interactive, without being closed or confined to one factor or component.

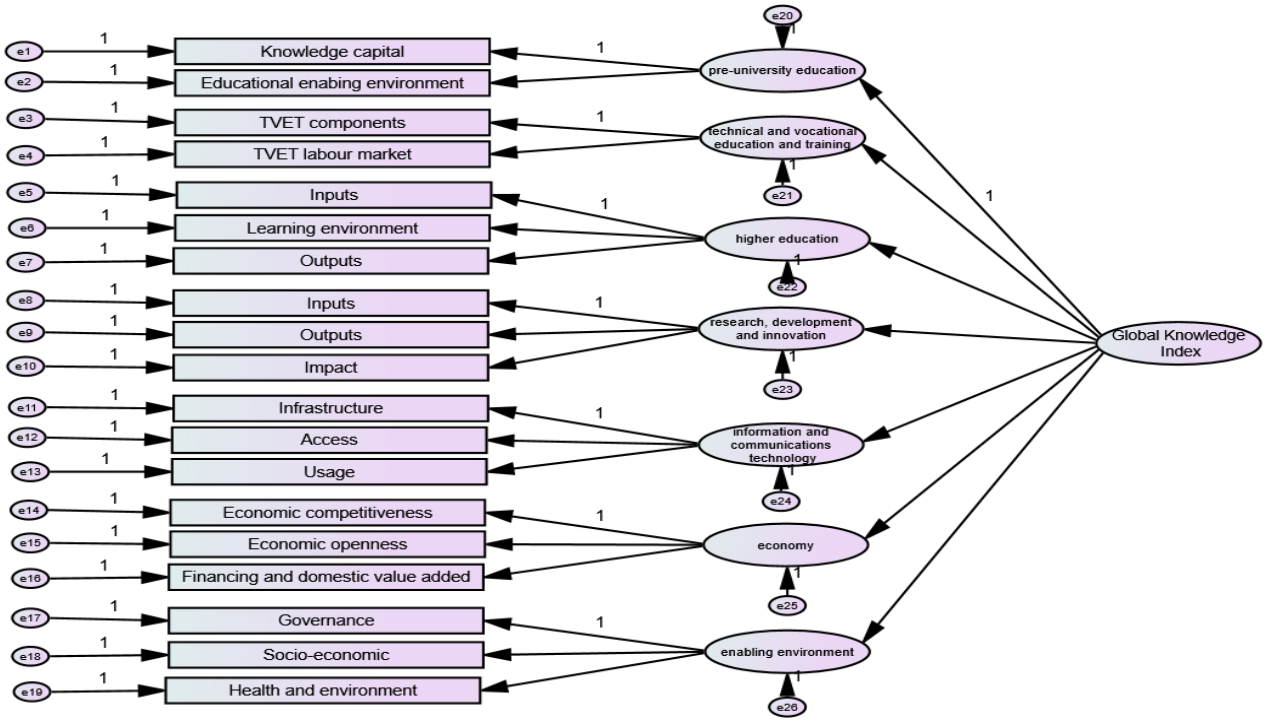
3. Methodology:

The CFA plays the role of validating and finding the reliability of any measurement in most social science studies (Harrington, 2009). The objective of CFA is to test whether the data fit a hypothesized measurement model. The CFA represents a potent method for dissecting the components of the GKI and pinpointing the factors that underpin its overall score. Within the context of the GKI, CFA can be employed to identify and measure the underlying constructs that constitute the seven sub-indices, yielding valuable insights into what drives the knowledge economy in different countries. We used AMOS version 22.0 to perform CFA.

4. Results:

Measurement Model of the GKI Indice The instrument contains both observed (measured) variables and latent constructs based on Figure 1.

Figure 2: The Finalized Standardized Measurement Model of CFA for GKI



Source: Generated by Researcher based AMOS.

In order to check the suitability of the prior model to the sample data and indicate which proposed model has the greatest fit. Absolute fit indices determine how well the proposed theory fits the data. Unlike incremental fit indices, their calculation is not based on comparison with a basic model but is instead a measure of how well a model fits compared to no model at all. This classification includes RMSEA, GFI, AGFI, RMR, and SRMR testing (Joreskog & Sorbom, 1993). The following table summarizes Fit indices and their acceptable thresholds:

Table 1: Fit Indexes and References Obtained as a Result of CFA.

Fit Index	Acceptable Threshold Levels	Value	The decision
Root Mean Square Error of Approximation (RMSEA)	Values less than 0.07	0.008	Good fit of the data to the model
Goodness-of-fit statistic (GFI)	Values greater than 0.95	0.90	Poor fit of the data to the model
The adjusted goodness-of-fit statistic (AGFI)	Values greater than 0.95	0.875	Poor fit of the data to the model
Root mean square residual (RMR)	Good models have small RMR	0.09	Model fit to the data is acceptable
Standardised root mean square residua (SRMR)	less than 0.08	0.09	Poor fit of the data to the model

source: (Joreskog & Sorbom, 1993)

In Table 1, which was obtained from the appropriate indexes and references as a result of CFA, it can be

seen that the value of (RMSEA=0.008) indicates that the model is a good fit to the data, (RMR=0.09) is an acceptable fit ratio, but the (GFI=0.90 , AGFI=0.875 and SRMR=0.09) values all came in an inappropriate range indicating poor fit of the data to the model.
We note that most indicators indicate poor matching of the data, the GKI for the year 2022, for the 133 countries. This could be due to our reliance in the model on the second branch, as the index contains four branches. Or the variables that express the seven main indicators of the index do not actually reflect these indicators.

5. Conclusion:

In recent years, interest in the knowledge economy has grown steadily, as it is an essential source of sustainable development. However, the most important problem facing researchers is obtaining an accurate indicator that measures each country's orientation towards a knowledge economy. Researchers use several indicators that measure countries' implementation of the knowledge economy, such as the HDI, HCI, GII, and ECI. However, the GKI is considered the most comprehensive. In this article, our objective is to examine the compatibility of the data with the proposed measurement model. To address this gap in research, we employ CFA on a dataset comprising 133 observations from the year 2022. It showed the results of the fit indices of the CFA poor fit of the data to the model.

The divergence of the data from the GKI index model utilized in this study may be attributed to two factors. Firstly, we depended on data from the second branch of the GKI index during estimation. Secondly, the variables included may be inadequate in effectively capturing the key indicators of the index. We offer suggestions for other studies to verify that the model matches the data, such as relying on the fourth and final branch in estimation or proposing other variables that can be included in the model.

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