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Unified knowledge based economy hybrid forecasting

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ABSTRACT

Many synthetic composite indicators have been developed with the aim to measure micro- and macro-knowledge competitiveness, however, without any unified, easy to visualise and assessable forecasting capability, their benefits to decision makers remain limited. In this article, a new framework for forecasting knowledge based economy (KBE) competitiveness is proposed. Existing KBE indicators from internationally recognised organisations are used to forecast and unify the KBE performance indices. Three different forecasting methods including time-series cross sectional (TSCS) (also known as panel data), linear multiple regression (LMREG), and artificial neural network (ANN) are employed. The ANN forecasting model outperformed the TSCS and LMREG. The proposed KBE hybrid forecasting model utilises a 2-stage ANN model which is fed with a panel data set structure. The first stage of the model consists of a feed-forward neural network that feeds to a Kohonen's self-organising map (SOM) in the second stage of the model. A feed-forward neural network is used to learn and predict the scores of nations using past observed data. Then, a SOM is used to aggregate the forecasted scores and to place nations in homogeneous clusters. The proposed framework can be applied in the context of forecasting and producing a unified meaningful map that places any KBE in its homogeneous league, even when considering a limited data set.

1. Introduction

Nowadays, international competition and co-operation among nations in many aspects, including technology, innovation and knowledge progress are not uncommon. Utilising knowledge and innovation as the key driver for prosperity and growth at the macrolevel leads to the creation of knowledge based economy (KBE). KBE relies on the production, distribution, and use of knowledge and innovation as one of the main driver of growth, wealth creation, and employment across all industries. Numerous composite indicators have been created by highly regarded organisations including the World Bank (WB), the World Economic Forum (WEF), the United Nation (UN), the International Institute for Management Development (IMD), and the International Telecommunication Union (ITU). These indicators have been used by organisations including government agencies, aid agencies and research institutions to assess the competitiveness of a nation or nations in the context of KBE. However, these indicators yield different scores and ranking depending on the nature and type of assessments (see for example, [1,2]). Moreover, most of these indicators report past performance and do not provide forecasts, as to where a certain KBE will be headed in the near future, given all the known elements.

This article aims to contribute to the literature by giving decision makers a unified prediction and a near forecast of the progress and competitiveness of KBEs. We argue that this is possible by aggregating the major existing KBE indicators into a unified KBE forecast map (UKFM). The UKFM reflects the big picture of KBEs competitiveness and ranking. This picture can be easily visualised and interpreted rather than ranking and judging KBEs by a single and possibly biased indicator score

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value or even by searching a KBE development from many separate indicators.

The remainder of this article is organised as follows: Section 2 presents an overview of related work on the different forecasting categories and various computational intelligence studies to forecast complex and non-linear variables. In Section 3, the KBE progress forecasting framework is presented, which includes the selected indicators for the study; and the data treatment is explained. Section 4 includes the proposed forecasting methodologies for the multiple regression, panel data analysis and the ANN based KBE forecasting models, followed by performance measures, tests, analysis and

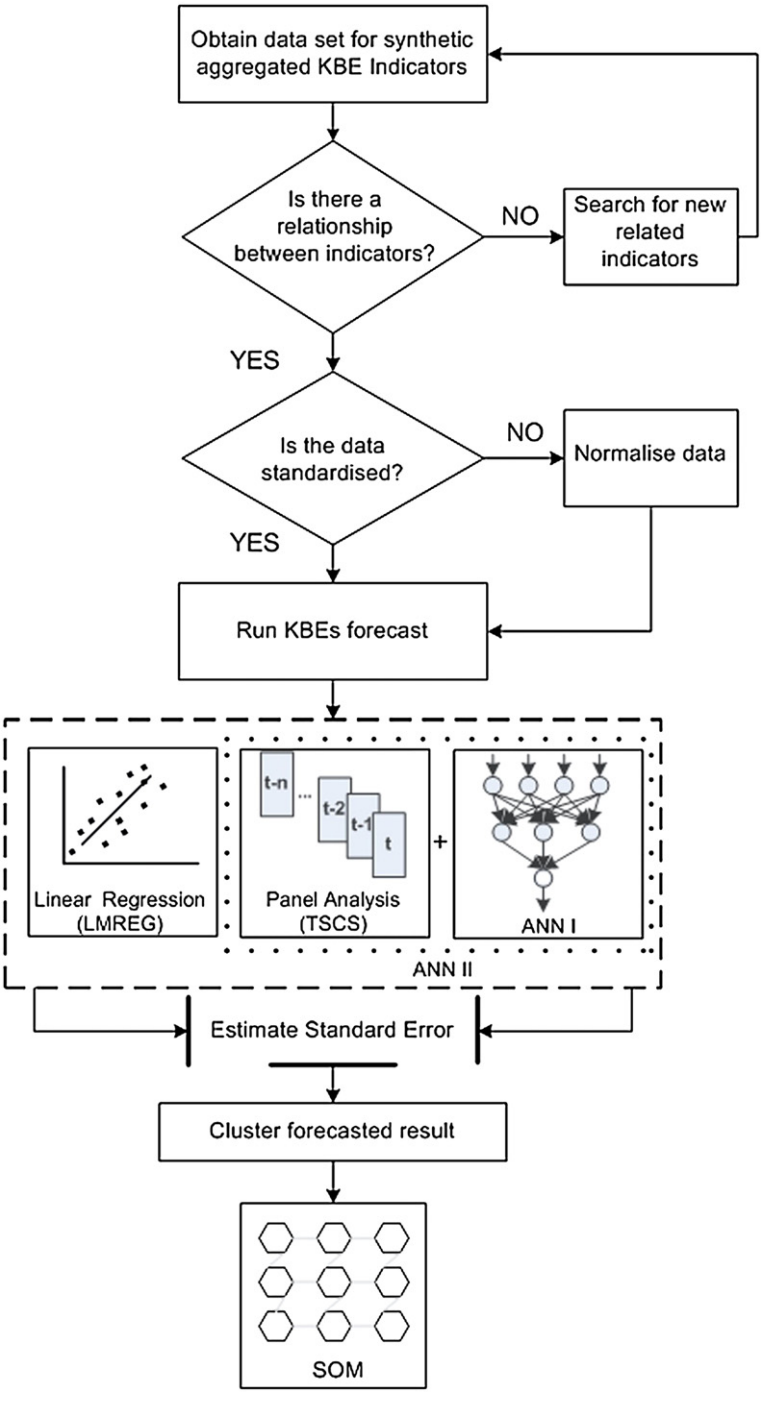

Fig. 1. Proposed KBE progress forecasting framework.

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