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A comprehensive fuzzy DEA model for emerging market assessment and selection decisions

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ABSTRACT

The changing economic conditions have challenged many financial institutions to search for more efficient and effective ways to assess emerging markets. Data envelopment analysis (DEA) is a widely used mathematical programming technique that compares the inputs and outputs of a set of homogenous decision making units (DMUs) by evaluating their relative efficiency. In the conventional DEA model, all the data are known precisely or given as crisp values. However, the observed values of the input and output data in real-world problems are sometimes imprecise or vague. In addition, performance measurement in the conventional DEA method is based on the assumption that inputs should be minimized and outputs should be maximized. However, there are circumstances in real-world problems where some input variables should be maximized and/or some output variables should be minimized. Moreover, real-world problems often involve high-dimensional data with missing values. In this paper we present a comprehensive fuzzy DEA framework for solving performance evaluation problems with coexisting desirable input and undesirable output data in the presence of simultaneous input–output projection. The proposed framework is designed to handle high-dimensional data and missing values. A dimension-reduction method is used to improve the discrimination power of the DEA model and a preference ratio (PR) method is used to rank the interval efficiency scores in the resulting fuzzy environment. A real-life pilot study is presented to demonstrate the applicability of the proposed model and exhibit the efficacy of the procedures and algorithms in assessing emerging markets for international banking.

1. Introduction

The intensity of global competition has forced banks to expand their global operations in emerging markets and develop growing networks of physical branches and subsidiaries in foreign countries. Multinational banks enter emerging markets largely to increase their profitability within an acceptable risk profile. Despite a large body of literature on the role of foreign banks in emerging economies, the subject of selecting the most suitable emerging market has received very little attention in the literature and remains a difficult task. This difficulty is due to multiple and often conflicting factors that add to the inherent technical complexities and valuation uncertainties involved in the assessment process. As such, a comprehensive and systematic decision making framework is needed to guide the assessment process, shape the decision outcomes and enable confident choices to be made.

Multinational banks and emerging economies share common incentives regarding the development of the financial market of the host country. Banks try to increment their profits by exploiting their competitive advantage in technological and knowledge management terms within the host financial system. At the same time, emerging markets aim at developing and stabilizing their banking and financial systems via competition and spillover effects.

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Clearly, foreign banks have imperfect information regarding the state of the host banking system, which due to its developing quality is inherently unstable and subject to different types of government and institutional controls. As a result, banks must consider the main characteristics of the host country and its banking sector together with the consequences derived from their exposure to the international financial market. Both the characteristic and the consequences comprise desirable and undesirable elements that foreign banks must simultaneously account for. Moreover, the resulting consequences determine the subsequent policies implemented by the government and the financial structure of the country.

For example, when a country opens its financial system to the international market, the exposure and risk faced by its banks increases [1,2].

- At the same time, as the financial system of an emerging country develops, so does the scope and range of its financial services, i.e., loans and deposits, among the local population [1].
- However, the decrease in activity restrictions required from local governments together with the increase in competition and efficiency of the financial system do not necessarily improve its stability. That is, countries must be macroeconomically stable before opening their financial systems [1].
- As a result, the relationship between competition and stability would differ among countries depending on multiple hard to quantify factors such as their market structure together with their regulatory and institutional environments [3].

These facts add a strategic dimension to the country selection decision of foreign banks. Indeed, foreign banks must consider the coexistence of both desirable and undesirable market conditions (inputs) and also expect both desirable and undesirable outputs determined by the evolution of the host financial and banking systems [4]. Thus, multinational banks must perform a careful analysis of the local banking system, its regulatory restrictions and institutional conditions before deciding whether or not to entry a country. Despite the obvious importance of the emerging market evaluation and selection problem, our knowledge about how this process takes place remains rather limited [5]. In this regard, most of the research in economics and business has focused on how the firm should select a country based on its financial and institutional environments.

This evaluation process represents a particularly difficult task given the subjectivity displayed in the evaluation of many of the factors that banks must account for. Such a problem prevails even when evaluators design their surveys so as to avoid it. For example, consider the Bank Regulation and Supervision Survey performed by the World Bank [6]. It is acknowledged that while quantitative variables comprise a subset of the data available, qualitative ones subject to different value judgments on the side of the respondent constitute also an important part of the information available. Banks have access to this information together with several other sources subject to the same type of constraint. Additional examples are given by the database on bank regulation compiled by Barth et al. [7], or the study of Cihak et al. [8], where fundamental questions such as “What was the impact of moving to Basel II on the overall regulatory capital level of the banking system?” (Fig. 2, p. 27) must be categorically addressed and analyzed.

Thus, a formal ranking evaluation model implementable by managers when selecting a country must satisfy the following requirements.

- Given the substantial amount of highly diverse information available, it must allow managers to eliminate any redundancy existing in the data. Econometricians have access to collinearity tests to deal with highly correlated variables. An equivalent mechanism simplifying the posterior data envelopment analysis (DEA) implementation is required.
- The DEA section of the model must account for positive and negative factors comprising the evaluation of the different alternatives. In this regard, econometrics allows for both positive and negative factors influencing a given dependent variable.
- Crisp evaluation factors are generally analyzed alongside fuzzy ones. The coexistence of both types of factors requires models that allow for the analysis of fuzzy variables based on the subjective evaluations of different information sources.
- Finally, any evaluation model must deliver a ranking of the available alternatives. That is, the (fuzzy) efficiency scores obtained after applying the fuzzy DEA method must be ranked, concluding the corresponding evaluation process.

We propose a comprehensive and structured method for emerging market assessment and selection which is grounded in DEA. A fuzzy version of DEA is used to capture the ambiguity and vagueness associated with real-world performance measurement problems. At the same time, coexisting desirable input and undesirable output data are considered in the presence of simultaneous input–output projection in DEA. A dimension-reduction method is used to improve the discrimination power of DEA, while a preference ratio (PR) method is implemented to rank the interval efficiency scores of different emerging market alternatives in a fuzzy environment. It should be noted that the non-parametric model introduced in this paper complements and competes with the parametric econometric models commonly used in the international business literature.

The remainder of this paper is organized as follows. In Section 2 we review the relevant literature on conventional and fuzzy DEA. In Section 3 the comprehensive DEA model proposed in this study is introduced. In Section 4 a real-world pilot study is presented to demonstrate the applicability of the proposed model and exhibit the efficacy of the procedures and algorithms in assessing emerging markets for international banking. In Section 5 we provide managerial implications and describe how to extend our approach to similar environments within the international business literature. Section 6 presents our conclusions and suggests future research directions.

2. Literature review

In this section we review the relevant literature on conventional DEA models with precise input–output data, fuzzy DEA models with imprecise input–output data, DEA models with desirable inputs and/or undesirable outputs, and fuzzy ranking methods.