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Competitiveness of nations: A knowledge discovery examination

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Abstract

This paper presents the insights gained from the use of data mining and multivariate statistical techniques to identify important factors associated with a country's competitiveness and the development of knowledge discovery in databases (KDD) models to predict it. In addition to stepwise regression and weighted non-linear programming techniques, intelligent learning techniques (artificial neural networks), and inferential techniques (classification and regression trees), were applied to a dataset of 43 countries from the World Competitiveness Yearbook (WCY). The dataset included 55 variables on economic, internationalization, governmental, financial, infrastructure, management, science and technology, as well as demographic and cultural characteristics. Exploratory data analysis and parameter calibration of the intelligent method architectures preceded the development and evaluation of reasonably accurate models (mean absolute error <5.5%), and subsequent out-of-sample validations. The strengths and weaknesses of each of the KDD techniques were assessed, along with their relative performance and the primary input variables influencing a country's competitiveness. Our analysis reveals that the primary drivers of competitiveness are lower country risk rating and higher computer usage, in entrepreneurial urbanized societies with less male dominance and basic infrastructure, with higher gross domestic investment, savings and private consumption, more imports of goods and services than exports, increased purchase power parity GDP, larger and more productive but not less expensive labor force, and higher R&D expenditures. Without diminishing the role and importance of WCY reports, our approach can be useful to estimate the competitiveness of many countries not included in WCY, while our findings may benefit policy makers and international agencies to expand their own abilities, insights and establish priorities for improving country competitiveness.

Keywords: Data mining; Knowledge discovery; Statistics; Competitiveness; Country comparisons

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1. Introduction

A nation's competitiveness, quoted widely by many authors, has been defined by the US President's Commission on Industrial Competitiveness (1985) as "the degree to which a nation can, under free and fair market conditions, produce goods and services that meet the test of international markets while simultaneously expanding the real incomes of its citizens", thus improving their quality of life. Although many view competitiveness as a synonym for productivity (Porter, 1990), these two related terms are in fact quite different, in that, "productivity refers to the internal capability of an organization, while competitiveness refers to the relative position of an organization against its competitors" (Cho and Moon, 1998). Country risk, namely the evaluation of the creditworthiness and the economic performance of a country, is regularly assessed in two magazines, *Euromoney* and *Institutional Investor*. Country risk may be viewed as a component rather than substitute of competitiveness (as is innovation); both country risk and innovation are input variables in our study. In particular because of recent pressures introduced by globalization, it is important to have a model for analysis of a country's competitive position in the international market, and not simply its internal measure of productivity. A nation's competitiveness can be viewed as a nation's relative competitive position in the international market among other nations of similar economic development (Cho and Moon, 1998).

The foundations for competitiveness measures are built on the economic theories of exchange, supply and demand, unit total cost (or unit labor costs) and market behavior, and may be used to define competitiveness in one of the following ways (Artto, 1987):

1. Cost-competitiveness—the most common measure, based on unit labor costs.
2. Price-competitiveness—measured with relative export prices.
3. Non-price competitiveness—based on cost and price competitiveness measures.

Although many researchers have studied the subject of competitiveness and suggested relevant measures, most of the studies focus on the firm level (Karnani, 1982; Oral, 1985, 1993; Oral and Chabchoub, 1996; Oral et al., 1999; Li and Deng, 1999). Table 1 summarizes the measures proposed in these studies, which are primarily within a firm or an industry, and mostly within a single country.

Fewer studies have attempted to compare the relative competitiveness of countries for a specific industry, as shown in Table 1. While unit labor cost (ULC) is typically used to define a country's manufacturing competitiveness (Enoch, 1978), other measures such as relative total cost (RTC) have also been proposed (Artto, 1987). Menzler-Hokkanen (1989) points that the limitation of the customary measures of competitiveness is that many of them, like for example ULC, are arbitrary and thus they are not adequate indicators of a country's true competitive position. He also points out that the RTC index has a major shortcoming in that the financial and economic conditions are treated as if they were deterministic. In fact, the motivation for our study is best summarized by Menzler-Hokkanen (1989) in his concluding remarks: "The level of international competitiveness of an industrial sector or a given firm depends on several forces on the micro and macrolevel. Only the collective consideration of these variables will lead to an understanding of the dynamics underlying international competitiveness... Employing single indices as the sole measure of competitiveness appears to oversimplify the problem."

Very few studies have attempted a more comprehensive comparison of multicountry competitiveness. Extending his prior work for competitive firm advantage, Porter (1990) suggested the well-cited "national diamond" framework and applied it to each economic sector of ten industrialized nations based on six sources of national competitiveness: sector, related industries, demand, firm environment, government, and chance. Rugman and Cruz (1993) criticized its limitations for Canada and extended it to a "double diamond". Cho and Moon (1998) present a related framework based on physical, human, and governmental