



Cumulative belief degrees approach for analyzing the competitiveness of the automotive industry



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ABSTRACT

As traditional competition becomes global, businesses fail to take, on their own, the measures that are required to become more competitive. Hence, in a globally competitive environment, national improvement and competitiveness have also become vital. Businesses must utilize and be supported by the international competitiveness of their nations. This study aims to analyze the competitiveness of the automotive industry from a national competitiveness perspective, using a three-stage methodology. For this purpose, a novel cumulative belief degrees (CBD) approach is introduced, to quantify the causal relations among the variables in the system. This methodology is illustrated by the analysis of the Turkish automotive industry for developing suggestions to assist policymakers in their decisions to improve the competitiveness of the industry. Although the findings are country specific, the methodology is applicable to a wider range of industries in developed and developing countries.

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1. Introduction

Competition at the international level has increased greatly in significance for all countries since the globalization of the world economy. The basic aim of policymakers is to bring the economy of their countries onto a competitive footing and, thus, to increase the welfare of their society. Competitiveness is generally defined as the set of institutions, policies and relevant factors that determine the level of productivity of a country [3]. Each year, selected organizations, such as the World Economic Forum (WEF) and the Institute for Management Development (IMD), apply several hundreds of objective and subjective indicators to assess the wealth created by the world's nations and, subsequently, publish rankings of national competitiveness. These rankings serve as a benchmark for policymakers and other interested parties, for judging the competitive success of their country within a global context.

As traditional competition becomes global, businesses fail to take the required measures on their own to become more competitive. In fact, an increase in competitiveness cannot be realized based solely on the effort of a specific industry. Hence, in a globally competitive environment, national improvement must also

become vital. Therefore, it is the responsibility of governments to increase the competitive advantage of industries. To offer a competitive edge to firms, governments must take action to increase the respective industry's competitiveness, given the current competitiveness level of the nation. According to Sala-i Martin [22], national competitiveness in terms of a macroeconomic environment, higher education level, labor market efficiency, financial market development, technological readiness, business sophistication, and innovation level are very important for the success of an industry.

When working at the industry level, there are a number of factors, such as education, infrastructure, and business sophistication, that can be manipulated by the government to increase the industry's competitiveness. Usually, such factors are interrelated, and it is a scientific problem to quantify the causal relationships among them. Initially, it is necessary to produce clarity and insight by modeling and quantifying the causal relations among the factors that affect the competitiveness of an industry. Then, it will be possible for governments to make informed policy decisions, to improve the competitiveness of the industry in question.

In parallel with these assertions, this study analyzes the system of the automotive industry, based on the assessment of the national competitive advantage. The WEF indicators for the competitiveness of nations are considered to be the fundamental source of criteria for the competitiveness of the automotive industry. The factors that affect the competitiveness of an industry

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are interrelated, and quantification of the causal relations among these factors emerges as a challenge that is addressed by this paper.

This study aims to develop a decision-making tool to support the policymakers in their decisions to improve a given industry. The proposed methodology enables them to facilitate the selection and prioritization of policies to be followed by their respective governments. For the purpose of illustration, the methodology is applied to the Turkish automotive industry. The main reason for selecting this industry is its locomotive effect on the whole economy of most of the developed and developing countries, including Turkey. This effect is mainly the result of its close relation with other industries in the economy. The automotive industry is the main buyer for the iron and steel, petrochemical, and tire industries and is the driving force behind technological development in these industries. All of the types of motor vehicles that are needed by the tourism, infrastructure, transport and agriculture industries are produced by this industry. Therefore, any change in this industry deeply affects the economy as a whole, and hence, its competitiveness plays an important role for the country.

The secondary aim of this study is to propose a novel approach, called the cumulative belief degree (CBD) approach, for the quantification of causal relations among variables in a system. By using this approach, the competitiveness of the automotive industry can be analyzed, based on the primary national competitiveness factors that influence the automotive industry's performance.

Therefore, the main contributions of this study can be listed as follows:

- a novel approach for the quantification of causal relations;
- a three-stage methodology for analyzing the competitiveness of an industry; and
- an application of the proposed methodology to the automotive industry. For this aspect, the system of the automotive industry is structured, the causal relations in the system are quantified using the CBD approach, and policy suggestions are developed.

This paper is organized as follows. The second section summarizes the related literature. The third section introduces the CBD approach that is developed for the quantification of causal relations in a system. The fourth section presents the details of the proposed methodology and provides its application to the Turkish automotive industry. Finally, the paper concludes with policy suggestions in the fifth section.

2. Literature review

2.1. Competitiveness of the automotive industry

There are few studies on assessing the competitiveness in an automotive industry. Evidence from the Polish automotive industry suggests that the knowledge transfer from transnational corporations improves the performance of local suppliers and, subsequently, their ability to compete [23]. Tcha and Kuriyama [27] analyze the effects of government policies on the Australian

automotive industry, using a partial equilibrium model. The authors warn that the globalization of the world automotive market will decrease the prices, and consequently, the expected welfare effects of government policies will depend on each country's tariff rates as well as its manufacturing costs. In a similar study, Williamson [30] investigates the relationship between exchange rate exposure and competition in the automotive industry. Evidence supports the theoretical determinants of foreign exchange rate exposures for firms in the globally competitive automotive industry.

Sirikrai and Tang [24] suggest a four-level Analytical Hierarchy Process (AHP) model to analyze the competitiveness of the automotive components industry in Thailand, where at the base level, the sub-elements of competitive conditions—namely, the government roles, managerial resources and technological capabilities—are compared. However, owing to the nature of the method employed, this study cannot capture the interactions between the variables of the model. A comparable study by Laosirihongthong and Dangayach [14] presents an empirical analysis of the implementation of manufacturing strategies in Thai and Indian automotive manufacturing companies. In these countries, the priorities of the companies when attempting to be competitive are improving product and process-related quality and on-time delivery.

Table 1 provides a summary of previous research that involves attempting to explain the competitiveness of the automotive industry, including the methods used for that purpose.

This literature review shows that the indicators and drivers of competitiveness are multifaceted in nature, with complex relationships. Therefore, single or a few aspects will not be sufficient to explain competitiveness thoroughly at the industrial or national level. In general, previous studies analyzed only the impact of the technology [8,29] or knowledge transfer [16] on the competitiveness. However, the competitiveness level of the industry depends on the global competitiveness level of the related country. In the literature, this linkage is shown only for some specific indicators of global competitiveness, but this paper attempts to explain industry level competitiveness, with a comprehensive holistic approach encompassing all of the factors that constitute the country-level competitiveness. The automotive industry is selected specifically, as an example to show this linkage, owing to its significant role in the economy. To highlight the relationship between the global competitiveness of a country and the competitiveness of the industry of interest, a causal mapping approach combined with a CBD approach is used in this study.

2.2. Causal mapping approach

Causal knowledge based on causal analysis increases the quality of decision-making in most real-world situations [33]. Utilizing causal modeling helps to develop an explanation of relationships and to provide a basis for inference [2]. It links strategic thinking and acting, helps make sense of complex problems, and communicates these aspects to others [7]. Causal relationships can be used effectively to develop inferences for diagnostic reasoning from

Table 1
Studies on the competitiveness of the automotive industry.

Determinants of competitive advantage	Method	Authors
Exchange rate exposure	Econometric models	Williamson [30]
Government policies	Econometric models	Tcha and Kuriyama [27]
Quality, delivery, flexibility, cost	Survey, inferential statistics	Laosirihongthong and Dangayach [14]
Industrial competitive conditions, governmental roles, managerial resources, technology capabilities	Analytical hierarchy process	Sirikrai and Tang [24]
Knowledge transfer	Survey, inferential statistics	Simona and Axèle [23]

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