



Decision Support

A decision support methodology to enhance the competitiveness of the Turkish automotive industry

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ABSTRACT

Three levels of competitiveness affect the success of business enterprises in a globally competitive environment: the competitiveness of the company, the competitiveness of the industry in which the company operates and the competitiveness of the country where the business is located. This study analyses the competitiveness of the automotive industry in association with the national competitiveness perspective using a methodology based on Bayesian Causal Networks. First, we structure the competitiveness problem of the automotive industry through a synthesis of expert knowledge in the light of the World Economic Forum's competitiveness indicators. Second, we model the relationships among the variables identified in the problem structuring stage and analyse these relationships using a Bayesian Causal Network. Third, we develop policy suggestions under various scenarios to enhance the national competitive advantages of the automotive industry. We present an analysis of the Turkish automotive industry as a case study. It is possible to generalise the policy suggestions developed for the case of Turkish automotive industry to the automotive industries in other developing countries where country and industry competitiveness levels are similar to those of Turkey.

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1. Introduction

In a globalised world, both developed and developing countries compete at an international level. For policy makers in general, one of the most significant issues is making their economies competitive and coping with global risks through rational policies.

The automotive industry is a key contributor to the national economy, particularly for industrialised countries. As the primary customer, the automotive industry motivates technical development in the iron–steel, petrochemical and tire industries. The automotive industry produces all types of motor vehicles needed for tourism, infrastructure maintenance, transportation and agriculture. Therefore, any changes in the automotive industry deeply affect the entire economy. The global automotive industry produces approximately 70 million units each year, playing a vital role in the world economy and making important contributions to the well-being of societies (Ülengin, Önsel, Aktas, & Kabak, 2010). Enhancing the competitiveness of the automotive industry is of

crucial importance for both developed as well as emerging economies such as China (EC, 2012, Lin & Wu, 2011).

The success of a specific industry in a country depends strongly on the national competitiveness of that country (Porter, 1990). Thus, the institutions, the infrastructure, the macroeconomic environment and the facilities for health care and primary education greatly affect the competitiveness of a nation's industries (Sala-i-Martin et al., 2012). For instance, a well-developed transportation infrastructure and communication network may be a prerequisite for having access to core economic services and activities. Therefore, the infrastructure is highly likely to influence the success of a specific industry. Additionally, because the macroeconomic environment influences the related microeconomic and firm-level operational conditions, it plays an important role in the success of any industry (Choi & Jeon, 2011). Business investment is also critical to productivity. Therefore, economies with sophisticated financial markets can make capital available for private-sector investments (Sala-i-Martin et al., 2012). By this logic, it is also possible to demonstrate that the level of the primary and higher education, the labour market efficiency and the financial market development influence the industrial competitiveness in a country. Consequently, there is a strong link between the competitiveness of a country and the competitiveness of its industries. This linkage necessitates development of a framework for deci-

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sion making to analyse these links and to identify policies to support industries that face major foreign competitors.

In the automotive industry, this type of policy analysis is performed using a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis (EC, 2006; TRMSIT, 2012) or PESTLE (Political, Economic, Social, Technological, Legal and Environmental) analysis (Niewenhuis & Wells, 2003). However, a SWOT analysis highlights only the principle concepts and does not provide a holistic perspective on the interrelationships among all factors. It is therefore not possible, for example, to specify the level of the improvement that can occur when a certain policy is followed to reduce a given threat. Similarly, it is not possible to estimate the value of all the related variables that are included in the analysis. For this reason, Bayesian Causal Networks (BCNs), which allow the modelling and the analysis of interdependent causal relationships, are used in this study. BCNs are probabilistic inference engines that enable analysts to answer queries or perform what-if analyses about the variables in a network. Using a BCN, the impact of changing the value of one or more variables on the remaining variables in the network can be analysed by estimating the values of those variables and providing the associated probabilities (Lauria & Duchessi, 2007). However, this type of analysis cannot be conducted using SWOT-like methods.

The purpose of this study is to analyse the effects of the factors that provide a national competitive advantage to the automotive industry through a comprehensive analytical model based on BCNs. This study aims to facilitate selection and prioritisation of policies to improve the competitiveness of the automotive industry in a country. The Turkish automotive industry is selected as a case study because it is sensitive to global developments and, according to Turkish Automotive Industry Strategy Document (TEMIT, 2012) prepared by the Ministry of Industry, has an urgent need for support to benefit from post-crisis opportunities.

The primary contribution of the study is a novel three-stage methodology based on BCNs for analysing the competitiveness of the automotive industry. The use of BCNs gives direct information to decision makers in the automotive sector. The methodology is based on an analysis of all factors of the national competitiveness that influence the competitiveness of automotive industry. Because these factors and their relationships are revealed through successive workshops conducted with experts from the related field, this approach provides a credible, accessible and “owned” model. The BCN-based model is transparent to all stakeholders. This model acknowledges and describes uncertainties. To the best of our knowledge, the three-stage methodology is the first attempt to provide a structured roadmap to the policy makers for the automotive industry.

This paper is structured as follows: Section 2 provides a literature review on national, industrial and automotive industry competitiveness. Section 3 explains the proposed methodology developed for analysing the competitiveness of the automotive industry. Section 4 provides policy suggestions developed to enhance the competitiveness of the Turkish automotive industry. Finally, Section 5 presents the discussion and conclusions.

2. Literature review

National competitiveness is a measure of the relative ability of a nation to create and to maintain an environment for businesses to operate and, consequently, to improve the level of prosperity (Kao et al., 2008). The national competitiveness level is an important stimulus that shapes the international competitive position of the firms operating in that country (Artto, 1987; Oral, Cinar, & Chabchoub, 1999). Therefore, this literature review consists of three sections, (1) national competitiveness, (2) industry

competitiveness and links with national competitiveness, and (3) competitiveness in the automotive industry.

2.1. National competitiveness

Porter (1990)'s well-known “Diamond” model is one of the earliest and most frequently cited studies on the competitiveness of nations. According to this model, a nation's position in factors of production such as skilled labour or infrastructure is critical for that nation to compete in a given industry.

Several international organisations, such as the World Economic Forum (WEF) and the Institute for Management Development (IMD), have made great efforts to measure national competitiveness. These organisations apply several hundred objective and subjective indicators to assess the wealth created by the world's nations and subsequently publish rankings of national competitiveness. The IMD World Competitiveness yearbook has measured 59 countries on the basis of 329 criteria since 1989 (IMD, 2012). Since 2005, the WEF has published global competitiveness reports for more than 100 countries on the basis of over 100 criteria. These rankings serve as benchmarks for policy makers and other interested parties to judge the competitive success of their countries within a global context (WEF, 2012).

Wang, Chien, and Kao (2007) suggest a model that uses technology development, economic performance, human resources, and management capability to explain national competitiveness. Furthermore, Hamalainen (2003) creates an extended model that incorporates technological innovation and diffusion, international business activities, and the role of government into earlier models of national competitiveness.

Edwards and Golub (2004) use econometric models and time series to analyse the international cost competitiveness of South Africa. Their results indicate improvements in cost competitiveness but do not explain national competitiveness. Zanakis and Becerra-Fernandez (2005) predict the competitiveness of countries by analysing four knowledge discovery methods: (1) stepwise regression models, (2) weighted nonlinear programming models, (3) neural networks, and (4) classification and regression trees. According to their research, two independent variables have major effects on the competitiveness of a nation: international risk rating and computers per capita based on the data of 1999.

Kao et al. (2008) measure the national competitiveness of Southeast Asian countries by deconstructing their national competitiveness into four factors, economy, technology, human resources and management, and combining hard (published) and soft (expert opinions) data. These authors present suggestions to the governments of analysed countries that highlight opportunities to improve their competitiveness at the national level. These surveys show that the measurement of national competitiveness is a complicated concept because it involves many aspects of data collection and problem structuring. Similar problems are also encountered in the measurement of industry competitiveness, which is discussed in the following section.

2.2. Industry competitiveness

An early attempt to quantify industrial competitiveness defines the competitiveness of a manufacturer as a function of its industrial mastery, cost superiority, and political–economic environment (Oral and Reisman, 1988). This model can be applied to support strategic decisions about technology selection, productivity management, or investment planning.

Lipovatz, Mandaraka, and Mourelatos (2000) consider labour productivity, vertical integration, technological innovation, and firm size to be critical factors for industrial competitiveness and apply multivariate analysis to assess these factors in the Greek

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