



The impact of multinationality on firm value: A comparative analysis of machine learning techniques



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ABSTRACT

In this study, the impact of multinationality (as measured by foreign sales ratio) and fourteen other financial indicators on firm value (characterized by market capitalization and market-to-book ratio) for the period of 1997–2011 was investigated using two popular machine learning techniques: decision trees and artificial neural networks. We divided the time period of 1997–2011 into two periods; 1997–2004 and 2005–2011 to investigate the robustness of results pre- and post-IFRS implementation. To determine the relative importance of factors as the predictors of firm value, first, a number of classification models are developed; then, the information fusion based sensitivity analysis is applied to these classification models to identify the ranked order of the independent variables. Among the independent variables, multinationality was found to determine firm value only moderately. In addition to multinationality, other financial characteristics such as firm size (as measured by natural logarithm of assets), leverage, liquidity, and profitability were consistently found to be affecting firm value.

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1. Introduction

In recent years, value relevance studies have attracted considerable attention from researchers of diverse backgrounds [1,13,31,38,39,65,87]. Those studies generally dealt with investigating how certain firm characteristics affect firm value. Financial characteristics and non-financial characteristics (e.g., voluntary disclosures, adoption of financial reporting standards, auditor type, ownership structure, multinationality, and corporate governance) were among the fundamental dimensions that these investigators had focused on.

Beside directly addressing the firm value, a large number of research studies focused on analyzing and potentially predicting bankruptcy as a means to identify characteristics (in term of financial ratios) of successful/unsuccessful firms and their potential values [54]. A simple search on the topic “bankruptcy prediction” returns tens of thousands of studies. A vast majority of these studies differentiate themselves from those of others by using a somewhat unique set of financial characteristics and/or employing a different set of prediction models (statistical or machine learning based) [2,42,57,64,72,89]. Though many of these studies are successful in predicting bankruptcy, they often fall short on identifying and explaining the characteristics that can be used as determinants of the firm value.

This study aims to address specifically the value relevance of international operations of multinational companies. Previously, some studies tested the influence of multinationality on firm value albeit most of them were in developed countries [35]. While these works have examined the impact of multinationality in various countries, they may not fully capture the extent to which the degree of internationalization affects firm value in emerging/developing countries. Lee et al. [58] argue that the capital markets are less developed and ownership concentration is higher in the emerging markets, thus the studies for firms headquartered in emerging countries could offer a different result for the relationship between international diversification and firm value. Berrill and Mannella [11] state that there is an increasing interest in studies that relate to emerging markets and multinational corporations. Emerging markets are attracting the attention of the whole world due to their current high growth rates and potentials for the future. They are ideal markets for goods and services with large populations and increasing incomes [11]. Turkey is one of those emerging countries with its fast growing economy and young population. Thus, this study extends the prior work by examining the impact of multinationality along with certain firm characteristics on firm value in the emerging market context. Moreover, the present paper also differentiates itself from previous studies in the literature wherein they utilized data mining and/or text mining in financial reporting area focusing primarily on detection of financial statement fraud [93–97]. However, this study analyzes the impact of multinationality on firm value by using data mining technique and a broad set of financial data.

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In prior work, regression analysis has been frequently and primarily used tools to investigate the association of internationalization with firm value [31,35,58,82]. This study utilizes advanced analysis techniques of decision trees and artificial neural networks. The data sample used in this study includes Turkish non-financial firms over the period of 1997–2011. Within this time period, Turkish firms are mandated to adopt International Financial Reporting Standards (IFRS). Therefore, we conduct the analysis for the sub-periods of 1997–2004 and 2005–2011; doing so, we aim to examine whether the adoption of IFRS has any impacted on the firm value characteristics.¹

The remainder of the paper is organized as follows. Next section provides the literature review and makes the case for novelty and importance of this study. Section 3 presents the methodology used for the study; Section 4 documents the findings of the study. Finally, Section 5 concludes the paper and explains the implications of the study.

2. Literature review

The information of whether multinationality affects firm value is an important piece of information for decision makers for a number of reasons. Firstly, this information provides managers with guidance in relation to whether and in which way to expand operations of the business beyond the borders of their own home country [31]. Secondly, present or potential investors of a firm also want to know which characteristics are value-relevant so as to determine the direction of their investments. Finally, financial analysts also wonder which factors impact firm value so that they can make the best investment decision on behalf of their customers.

Fauver et al. [35] state the motivations behind increase in foreign investment as improved communications, lower transaction costs, and increasingly integrated foreign markets. However, they also argue that many firms incur additional costs and risks such as exchange rate, political instability, the agency costs, and coordination costs. Thus, the key question to be answered is whether the internationalization reduces or increases firm value. In this context, more evidences are needed, since the existing evidence regarding the benefits of international diversification has yielded inconclusive results [35].

Some of the previous studies have dealt with the relationship between multinationality and firm value; however, their findings were inconsistent. For example, Eckert et al. [31] conducted their study on German firms and concluded that multinationality is not a value itself, but through either having intangible assets or realizing economies of scale. Eckert et al. [31] proved that leverage and size have a significant negative impact on shareholder value, whereas profitability and capital intensity (as a proxy for economies of scale and as measured by capital expenditures per sales) exert a significant positive effect. Riahi-Belkaoui [78] conducted a study on U.S. firms and confirmed that there is a positive relation between the degree of internationalization and the market value of the firm. Fauver et al. [35] empirically proved that corporate international diversification is value reducing for U.S. firms on average, but has no significant valuation influence for German or U.K. firms. Schmid and Walter [82] used the percentage of sales from non-domestic operations to measure the impact of geographic diversification, and they indicated that geographic diversification is not associated with a significant valuation discount in financial intermediaries.

Machine learning (ML) as well as artificial intelligence methodologies have been used extensively to handle financial decision making problems [5,6,19,21,37,74]. Furthermore, it has been proven that ML algorithms such as support vector machines (SVM) demonstrated increasingly important performances in financial time series analysis [48,68].

¹ Beginning from 2005, Turkish listed companies have been required to adopt IFRS by the Capital Markets Board.

ML is the subfield of artificial intelligence concerned with development of algorithms that allow computer programs to learn from experience [56]. These algorithms are used in a variety of applications. ML algorithms are appropriate in scenarios where the applications involve large databases, making it difficult to establish models [66], where financial data sets are large, as in our case. Various studies have shown that machine learning techniques such as neural networks and decision tree algorithms can be employed as an alternative method to resolve classification problems instead of the traditional statistical methods [6,9,10,14,19]. Traditional statistical methods use restrictive assumptions such as normality, linearity, and independence among predictor variables. Deakin [26] demonstrated that violations of these important assumptions of independent variables frequently happen in financial data. As a result, these conventional statistical methods might produce limitations in terms of validity and effectiveness. Decision trees (DT) algorithms and neural networks (NN) are among the most popular machine learning algorithms. Several of these algorithms such as decision trees algorithms, support vector machines (SVM), neural networks were developed for application in financial and accounting applications [43,53,66,76]. Therefore, ML algorithms are the most appropriate for this study.

ML algorithms were employed successfully in some studies that focus on firm value. Chaehwan et al. [18] studied dividend policy forecasting using ML approaches discovering that comparing ML algorithms was one of the most important managerial decisions affecting the prediction of firm value. Also, Chih-Fong et al. [22] used popular ML algorithms such as decision trees, genetic algorithms and neural networks to determine the most important features impacting firm value.

In this study, machine learning (ML) techniques were applied as the data driven approach. While various studies compare the machine learning algorithms in general [98–101] such as SVMs, neural nets, logistic regression, naive bayes, memory-based learning, random forests, decision trees, bagged trees, and boosted trees, the comparison of machine learning algorithms versus classical statistical techniques was studied as well. A literature driven argument for the use of ML techniques in this context, and a comparative analysis of traditional statistical methods versus ML are summarized in Table 1. According to Breiman [102], statistics really starts with data and the main goals of it: prediction (estimation) and information (detection). Breiman [102] claimed that higher predictive accuracy is associated with more reliable information about the underlying data mechanism, therefore weak predictive accuracy can lead to questionable conclusions. Moreover, he valued the importance of algorithmic models since they can give better predictive accuracy than data models, and therefore provide better information about the underlying mechanism. In the light of Breiman's [102] valuable study, the ultimate goal in this study is to obtain accurate information.

3. Theoretical background

Four theories are proposed to explain the links between multinationality and firm value: the internalization theory [67]; imperfect world capital markets [33,67]; managerial objectives [67]; and tax avoidance and low-cost inputs [33,67]. According to the first theory, internalization theory, which was developed initially by Caves [17], a firm can enhance its value by internalizing markets for its intangible assets (i.e. superior production skills, managerial skills, marketing abilities, patents, or consumer goodwill). According to this view, internalization brings buyers and sellers of information-based assets together [30], and firms can then maximize their revenues through selling or licensing their assets to firms in other countries [71]. The second theory regarding the imperfection of world capital markets might prevent investors from optimally diversifying their portfolios internationally; therefore multinational firms provide shareholders with an opportunity to diversify their investments [67,71]. The third theory, managerial objectives, also plays an important role in the internationalization decision, eventually

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