



Analysis of decision making factors for equity investment by DEMATEL and Analytic Network Process

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ABSTRACT

Existing methodologies of equity investment, such as fundamental analysis, technical analysis, and institutional investor analysis, explore important factors of stock price behaviors. However, the interdependent relationships of the key factors have not yet been fully studied. This paper provides the first analysis on the interactive relationships among the factors in incorporating the methods of Decision Making Trial and Evaluation Laboratory (DEMATEL) and Analytic Network Process (ANP). The empirical results show that factors from the existing analytical methodologies have significant interactive and self-feedback dynamics. Among the key factors, profitability is the most important one affecting investment decision, followed by growth and trading volume. In addition, due to the complexity of the ANP, this study proposes a new methodology to simplify the process, and empirical evidences indicate that the approach is effective and efficient.

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1. Introduction

Equity stock is the most popular financial asset in capital markets. Academic researchers, industrial practitioners, and investors have employed various techniques to analyze the dynamics of stock prices. In particular, different methods have been developed to set certain selection criteria in choosing individual stocks with promising returns, and three methodologies have been broadly applied: the fundamental analysis, technical analysis, and institutional investor analysis. These methods are used to explore key factors that yield significant impacts on stock prices and the effectiveness of the factors are often individually and independently analyzed. This study, on the other hand, employs the Decision Making Trial and Evaluation Laboratory (DEMATEL) and Analytic Network Process (ANP) to focus on the analyzes of interdependent relationships among the factors. Through the understanding of the interactions between key factors, this study seeks to provide more efficient and effective investment decision making process.

Fundamental analysis studies key elements of financial conditions such as earnings and dividend prospects along with overall market conditions such as interest rates to predict the movements of stock price. The method is based on the key assumption where stock performance of a firm could fully reflect its operating condition. Recent researches have adopted the method include Tang and Shum (2003), Fama and French (2006), Wu and Xu (2006), Edirisin-

ghe and Zhang (2007), Girard and Omran (2007), Chen and Zhang (2007), Cole, Moshirian, and Wu (2008), Samaras, Matsatsinis, and Zopounidis (2008), and Benjamas, Riza, and Ramesh (2008) and others.

Technical analysis studies for recurrent and predictable patterns in stock prices such as return momentum and herding behaviors, and consequently, seeks to forecast future trends of stock movements. Recent examples with application of the approach are Lee and Rui (2002), Darrat, Rahman, and Zhong (2003), Wang and Chan (2006), Avramov, Chordia, Jostova, and Philipov (2007), Yamawaki and Tokuoka (2007), Zarandi, Rezaee, Turksen, and Neshat (2009), and Li and Kuo (2008).

Institutional investor analysis investigates the relationships between stock price and trading activity of institutional investors such as the institutional buy/sell signals. Recent studies applying this methodology include Griffin, Harris, and Topaloglu (2003), Darrat et al. (2003), Wang and Cheng (2004), Cai and Zheng (2004), Avramov, Chordia, and Goyal (2006), Bohl and Brzeszczyński, (2006), Chiyachantana, Jain, Christine, and Robert (2006, and Hirose, Kato, and Bremer (2009) and among others.

These prior researches mainly investigate the unidirectional impacts of each individual factor on the dynamics of stock price rather than explore the interdependences and feedback effects among the factors and their relative marginal strengths. Consequently, due to lack of analyzes on these quantitative interdependences between factors, above approaches do not provide direct assessments and proper comparisons on the economic significances of these factors.

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This research accordingly applies two quantitative methods, the DEMATEL and ANP, to evaluate the level of interdependences among those factors and to add on the understandings of dynamics of stock return. DEMATEL is one of tools on decision making of multiple criteria and is able to transform qualitative issues into quantitative tasks for analysis. ANP can be applied to analyze the interactive relations between factors with proper measurements of the weight for each factorial criterion. Consequently, each alternative in the decision making would be evaluated and prioritized to determine the length and area of improvements. By selecting the proper critical value in the process, the optimal combination of decision making can then be determined.

Tzeng, Chiang, and Li (2007) applied the method of DEMATEL into multiple criteria decision making (MCDM) model, and Ou Yang, Shieh, Jun-Der Leu, and Tzeng (2008) proposed the application of both DEMATEL and ANP methods as the hybrid MCDM model. Cheng and Li (2007) used ANP to find out key selecting criteria for a strategic partner and further to identify the relative importance among the criteria. Lee, Kim, Cho, and Park (2009a) uses ANP to analyze the problem of network technology, to consider the related technology network required, and to seek out the core technology and the characteristics of network technology. Additional recent researches adopted DEMATEL or ANP are Lin, Lee, and Chen (2009a), Hsieh, Lin, and Lin (2008), Lin, Chiu, and Tsai (2008), Lin, Tsai, Shiang, Kuo, and Tsai (2009b), Lee, Tzeng, Hsu, and Huang (2009b), Tzeng, Chen, Yu, and Shih (2009), and Li and Tzeng (2009) and others.

This study contributes to literature in several ways. First, this paper provides the evidence in applications of ANP and DEMATEL on stock market dynamics, particularly the process of investment decision making. Second, the relations of interdependences among key factors in stock investment are quantitatively analyzed through investigations of experts' perceptions. Third, theoretical analyzes are confirmed with empirical applications of recent data. Based on the empirical outcomes, the paper finds the methodologies are able to produce robust analyzes in generating valuable and practical investment strategy.

The rest of this paper is organized as follows. In Section 2, key existing models of stock investment decision making are reviewed, and in Section 3, the application of ANP and DEMATEL is introduced. In Section 4, empirical outcomes are presented, and Section 5 concludes the research.

2. Factors in stock investment strategy

Through literature review, this section discusses findings of previous literatures regarding factors that affect investment strategy of equity stock. The factors were traditionally studied through three techniques: the fundamental, technical and institutional investor analyzes. The identification of the key factors provides theoretical supports to the empirical applications of this study.

2.1. Key factors under fundamental analysis

Factors with impacts on stock return under fundamental analysis are basically the key variables of financial statement of the underlying firm such as profit, operational management, leverage, account balances and so on. Macroeconomic variables such as GDP growth, unemployment rate, and interest rate are often controlled under the analysis. Recently, Fama and French (2006) examined the relationships between stock returns and equity ratio, expected profitability, and expected investment and concluded that expected profitability is most significantly correlated with expected and average future stock returns. Wu and Xu (2006) studied stock markets of China with empirical data between 2000 and 2006 and constructed a stock price prediction model that consisted of profitability, risk, growth, liquidity, and asset management. Their findings showed

that these fundamental analysis factors can be applied successfully in prediction of stock price fluctuations. Edirisinghe and Zhang (2007) studied the quarterly financial statements of 230 US high-tech companies and provided 18 analytical categorizations including profitability, asset utilization, liquidity, leverage and growth, to construct representative indicators of financial performance.

Girard and Omran (2007) employed samples of five emerging markets in Middle East to show that the political risk is a major factor influencing movements of stock market. This result was similar to that of Tang and Shum (2003) which documented significant relationship between political shocks and stock returns. Chen and Zhang (2007) concluded that factors related to profitability have the most significant impact on individual stock, and Cole et al. (2008) documented that stock market return leads economic growth where the two dimensions are also interactive to each other. In a study of Sweden stock market, Samaras et al. (2008) adopted the multicriteria decision support system and portfolio management to evaluate the strength and weakness of individual stocks based on method of fundamental analysis. Benjamas et al. (2008) surveyed Thailand stock market between 1975 and 2006 and concluded that key factors of fundamental analysis are level of dividend payout and earning changes.

2.2. Key factors under technical analysis

Technical analysis studies the historical data surrounding price and volume movements of the stock by using charts as a primary tool to forecast future price movements. Brock, Lakonishok, and LeBaron (1992) researched Dow Jones index stocks and used variable-length moving average (VMA), fixed-length moving average (FMA), and trading range break (TRB) as indicators to evaluate the effectiveness of technical analysis. The study showed that investment returns under VMA and TRB are significantly better than a strategy of buy-and-hold. Mizuno, Kosaka, and Yajima (1998) applied data of Japanese stocks and utilized VMA and relative strength indicators (RSI) of technical analysis to construct a stock prediction model with empirical findings robust to the alternative methods. Wong, Meher, and Chew (2003) studied stock price changes in Singapore Stock Exchange with technique of technical analysis to distinguish the events of market entry and exit. The authors discovered that the performance of technical indicators positively related to investment returns.

Wang and Chan (2006) surveyed Microsoft, Intel, and IBM and employed decision trees integrated with RSI to study timing points of stock purchase. The research showed this method can accurately predict optimal buying timing and enhance returns of investors. Yamawaki and Tokuoka (2007) used key stocks of companies in retail, PC, automobile, and petroleum industries from New York Stock Exchange and classified technical indicators into trend-type moving averages, volatile-type RSI, MACD, and momentum-type indicators, and showed that MA is the most effective performance indicator. Liu and Kwong (2007) studied factors that influence stock market of Hong Kong. Using PXtract algorithm and technical analysis information such as daily highs and lows and daily opening and closing prices, the study found that a combination of PXtract and technical indicators can successfully predict price changes of stock.

Li and Kuo (2008) used knowledge exploration as the basis and incorporated the K charts of technical analysis to successfully predict short-term trends of stock price changes. With data on stocks of Asian automobile companies, Zarandi et al. (2009) incorporated a type-2 fuzzy rule based-expert system with technical indicators of RSI, moving average convergence-divergence (MACD), and other moving averages. The authors developed the fuzzy multi-objective model for stock prediction/analysis and found that the model works successfully in anticipating stock price movements.

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