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Magnitudes of Market Inefficiency: Theory and Application☆

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ABSTRACT

This paper conceptually distinguishes the intrinsic value from the fundamental value, though most of previous literatures have implicitly deemed them to be identical. The distinction of the two concepts clarifies the relation between the market efficiency in the sense of Fama (1970) and the over- (under-) valuation for evaluating the stock market. Then, this study proposes an alternative measure of 'magnitude of market inefficiency' for accessing the trading systems and applies this measure to the nine stock markets during the two sub-periods. The trading systems of three markets improve in the second period, while the others become worse. This study also proposes an alternative measure of a fundamental value of stock price based on a macroeconomic model and makes clear the relation of the over- (under-) valuation of the market to the magnitudes of market inefficiency. Thus, the application to the Japanese stock market indicates that the magnitudes of inefficiency are small compared with the net over- (under-) valuations. It is because the magnitude of inefficiency is stationary while the net over- (under-) valuation is non-stationary.

1. Introduction

This paper conceptually distinguishes the intrinsic value from the fundamental value for evaluating the stock market, most of previous literatures have implicitly considered the two concepts to have identical meaning and used them interchangeably. The distinction of the two concepts clarifies the relation between the market efficiency in the sense of Fama (1970) and the over-(under-) valuation of stock market based on the macroeconomic fundamentals. Huge amounts of researches on the behaviors of the stock market prices have been accumulated since the pioneering works of Mandelbrot (1963) and Fama (1965). We recognize that there are mainly two strands of researches on this field.

The first one follows the efficient market hypothesis typically represented by an epoch-making article of Fama (1970), in which the stock prices fully and instantaneously reflect all information available at the present time. His informational concept of market efficiency was realized to explicitly incorporate investor's behavior. Amihud and Mendelson (1987) and Damodaran (1993) propose a partial price adjustment model based on investor's behavior. The basic idea behind these researches is as follows. The intrinsic value (V_t) of a stock follows a random walk process with drift term (i.e.$V_t = a + V_{t-1} + u_t$, where u_t is a white noise shock.). The process of the intrinsic value is consistent with the concept of efficient market in the sense of Fama (1970). The market price is adjusted for the new intrinsic value as a result of investors' response to the shocks to the market. The market is said to be efficient when investors and specialists can instantaneously and fully adjust the market price of a security to its intrinsic value. In contrast, the market is inefficient when the price of its security does not adjust to its intrinsic value. Koutmos (1998, 1999) extend the above mentioned model to an asymmetric partial price adjustment model, where the adjustment speeds are possibly different depending on whether the price increases or decreases. Empirical studies of Pagan and Soydemir (2001), Bahng and Shin (2003), and Nam et al. (2003, 2005) support the asymmetric adjustment model.

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Most of the previous authors study the performance of trading systems in the stock markets in terms of the adjustment speeds of stock price but do not pay attention to intrinsic value itself. This paper pays close attention to the level of intrinsic value for assessing the market inefficiency. The degree of discrepancy between the market price and the intrinsic value can be an alternative measure to the adjustment speed for market inefficiency. We call this measure as magnitude of market inefficiency. It indicates how much the market price deviates from its intrinsic value.

This paper investigates the performance of trading systems or markets in terms of the magnitude of market inefficiency. Our measure is more useful than the previous ones in the following sense. The previous measure accesses the trading system only in terms of adjustment speed of market prices, ignoring the fluctuations in intrinsic values over time: the trading system is better (worse) if the adjusting speed is faster (slower) regardless how vigorously the intrinsic value fluctuates. For example, Amihud and Mendelson (1989, 1991), Amihud et al. (1997), Lauterbach (2001), and Chang et al. (2008) assess whether the trading system of call market method or that of continuous auction method is better in terms of adjustment speed. However, the empirical studies such as Pagan and Soydemir (2001), Bahng and Shin (2003), and Nam et al. (2003, 2005) found the adjustment speeds are asymmetric in upturn and downturn markets. We feel that it is not easy to determine the best trading system based on the adjustment speeds when the speed is higher in upturn market and lower in downturn market.

The second strand of researches relates the stock market to the real economy as a whole. A number of empirical papers including Campbell and Shiller (1987), Cheung and Lee (1998), Lee (1998), Black et al. (2003), and Velinov and Chen (2015) have investigated the relations between the market price of stock and the macroeconomic fundamentals. These literatures analyze the deviations of the stock prices from their values warranted by expected growth in output. Their values are commonly called fundamental stock values. The fundamental values are theoretically derived from some macroeconomic models. The over-(under-) valuation is defined by the difference between market prices and fundamental values.

However, most of previous researchers implicitly assume the two concepts to be the same and use the terms of intrinsic and fundamental values interchangeably. They have not paid much attention to conceptually distinguish between the intrinsic and fundamental values. The distinction between the two concepts is important in order to understand the behaviors of the stock markets and stock prices. This paper provides a theoretical framework to derive the fundamental stock price based on a simple macroeconomic model following the argument of Black et al. (2003). The key idea for our economic model is that the expected value of discounted future profits will be more appropriate for accessing the value of the representative firm than the dividend-discount model, although the dividend-discount model is commonly used in the literature. Black et al. (2003) emphasizes that for the economy as a whole, profits contain more information about fundamentals than dividends do. We also provide a method for measuring how much the market price deviates from its fundamental value in practice. We will show that the over-(under-)valuation of the market price can be decomposed as a sum of the magnitude of market inefficiency and the net over-(under-) valuation. This decomposition clarifies the relationships among market price, intrinsic value and fundamental value.

This study first applies the measure of magnitude of inefficiency to the stock market indices of nine countries (five from the G7 countries and four from the Asian emerging markets) during the two sub-periods from1980 to 2009. The results evaluate that the trading system of the Indian market is the worst (the second worst is the Japanese market) in the first sub-period but Korea's is the worst in the second sub- period. The trading system of Japan, Canada, and India improve in the second period, while the trading systems of the USA, France, Italy, Korea, Singapore, and Malaysia become worse in the second period. Comparing the G7 and Asian markets, the magnitude of inefficiency for the Asian emerging markets is almost the same as that for the G7 in the first sub-period, while the former is far larger than the latter in the second sub-period. Second, this study analyzes the fundamental values and clarifies its relations to the intrinsic values for the Japanese stock market. The magnitudes of market inefficiency are small compared with those of the net over- (under-) valuations in general. The former is about five percent of the latter on average over the sample periods. The intrinsic values fluctuate around the fundamental values on a long period of cycles, while the market prices are shortly but not perfectly adjusted for the intrinsic values. From a statistical point of view, the magnitudes of inefficiency follow the stationary time series process, while the net over-(under-) valuations follow the non-stationary time series with integrated order of one.

The paper is organized as follows. Section 2 outlines the model of describing an adjustment process of the stock market price for the intrinsic value, gives a definition of the magnitude of market inefficiency, and provides an estimation method for unknown parameters and unobserved intrinsic values. Section 3 proposes a simple macroeconomic theory to define the fundamental value of the stock price and states how the over-(under-) valuation is related to the magnitude of market inefficiency. Section 4 reports the results of application of our approach to the stock market indices. Section 5 gives some concluding remarks. All proofs of propositions of this paper are given in Appendices.

2. Market inefficiency

This section proposes an alternative measure of magnitude of market inefficiency useful for accessing the trading systems. The measure simultaneously takes care of the both intrinsic value of stock and adjustment speed. This section also discusses how to estimate the magnitudes of market inefficiency in practice.

2.1. Magnitude of market inefficiency, intrinsic value, and performance of trading system

We essentially follow the model of Koutmos (1998, 1999), which is itself an extension of that of Amihud and Mendelson (1987) by incorporating asymmetric adjustment. This model consists of two parts: the intrinsic value process for a stock and the market price adjustment process. The model distinguishes the unobserved intrinsic value of a stock (V_t) from the observed market price (P_t) of the stock, both expressed in natural logarithms.[1]

The intrinsic value follows a random walk process with drift:

$$V_t = a + V_{t-1} + u_t,\ u_t | I_{t-1} \sim N(0, \sigma_{ut}^2),\ t = 1, \cdots, T, \tag{1}$$

where a is a constant and I_{t-1} denotes the information set up to time $t-1$. We assume that the disturbance term (u_t) has the EGARCH (Exponential Generalized Autoregressive Conditional Hetroskedastic) process proposed by Nelson (1991):

$$\log\sigma_{ut}^2 = \alpha_0 + \alpha_1 z_{t-1} + \alpha_2(|z_{t-1}| - E(|z_{t-1}|)) + \alpha_3 \log\sigma_{ut-1}^2, \tag{2}$$

where $u_t = \sigma_{ut} z_t : z_t \sim N(0,1)$. The asymmetric partial price adjustment process of (P_t) represents that adjustment speeds

[1] This distinction is based on an idea by p. 533).