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Decision support for foreign investment strategy under hybrid uncertainty

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ABSTRACT

Empirical evidences show that Japan-based companies moved their major operations to the USA due to the currency appreciation of Japanese Yen in 1980s. However, the multinational firms moving their operations abroad still face both the risk of foreign price and the risk of foreign exchange rate. According to the purchasing power parity (PPP) and interest rate parity (IRP), the foreign exchange rate has associations with the relative price and the relative interest rate between two countries. Therefore, when the price and the interest rate evolve stochastically as proposed by many scholars, we can anticipate the randomness of the foreign exchange rate. By integrating these three sources of risks as a hybrid uncertainty, we propose a framework for corporate valuation and investment strategy. We analytically derive corporate value for those multinationals in question and then numerically obtain the real option value by Monte Carlo simulations, based on which we investigate the optimal entry strategy. The sensitivity for corporate value, optimal entry time, and real option value are analyzed. The results suggest a decision support process for foreign investment timing strategy under the hybrid uncertainty. The managerial implication of this work is that the optimal investment strategy for the multinational firms with foreign operations depends on some market and risk factors, as well as correlations among them.

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1. Introduction

Global business community today faces risk exposures not only from volatile product prices but also from foreign exchange rates. Recently, many countries compete with their counterparts for currency depreciation, attempting to gain export advantage. As a consequence, the game of currency arises, making the foreign exchange market more volatile and weakening the profits of multinational firms with foreign operations. For example, Japanese Yen reached its 15 yrs high up to $84 JPY/USD in 2010, causing many Japan-based firms abroad to suffer from losses denominated in domestic currency. Kim and Hur (2009) addressed the importance of foreign exchange management and proposed a model to investigate the effects of foreign exchange on firm performance using genetic algorithm and VaR. Kogut and Chang (1996) found that in order to maintain the exports value of domestic operations under the appreciation of Japanese yen against the US dollar, Japanese companies switched their supporting export-oriented trades to establishing the foreign operations directly in the United States during the period of 1970s through 1980s. Studies of Rangan (1995) found that American firms tend to keep their ex factory dollar prices constant, allowing foreign currency prices to fluctuate with exchange rates. By contrast, Japanese and German firms were found to set foreign prices in a manner sensitive to market conditions. Some researchers also advocated that the volatility of foreign exchange rate is related to the trends towards foreign direct investments. According to the purchasing power parity (PPP), the relationship between the foreign exchange rate and the price has been tested by many researchers, for example by Perron and Vogelsang (1992). Dornbusch (1988) asserts that the movements in the nominal foreign exchange rate between two countries and the movements in their respective price indexes adjust through time to maintain the constant purchasing power. Moreover, the interest rate parity (IRP) suggests that exchange rate is also correlated with interest rates in two countries. We therefore consider the foreign exchange rate, the interest rate and the foreign price as mutually correlated stochastic processes. We aim to formulate a stochastic model to value the multinationals which move the operations to foreign countries.

Regarding the corporate valuation approaches, Seng and Lai (2010) classifies business valuation methods into three categories: market-based, income-based (discounted cash flow, DCF) and asset-based approaches. The asset-based model dates back to the work of Merton (1974), who proposed the stochastic asset value in a call option, whose exercise price is the contingent claim on debt. Based on his option framework, many related models have been developed by Black and Cox (1976), Landes and Loistl

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(1992), etc. More recent study on option-type investment strategy can be found in the work of Yuan (2009), who proposed a framework to investigate expansion strategy under price uncertainty from the aspect of an industry. Both the real option value and the investment timing strategy are obtained through simulation–optimization mechanism in this model. On the other hand, the works employing the DCF to valuate business can be found in the works of Rappaport (1986), and Copeland, Koller, and Murrin (1996). The main theme of these works lies in the discounted present value of all future cash inflows. Casey (2001) computed the discounted value from a series of uncertain future payments until the date of insolvency and then obtained the present value distribution.

Inspired by previous research results, we propose a valuation framework by integrating the foreign exchange rate, the foreign price, and the interest rate as a hybrid uncertainty for those companies with foreign operations. Subsequently, we investigate the entry strategy for the foreign operations and obtain the corresponding real option value.

In the work of Kim, Won, and Bae (2010), corporate value is derived from the present value of future dividend flows. Instead, the corporate value is derived in our work by discounting all future profits. These profit flows evolve as a stochastic process due to the assumption of randomness in interest rate, foreign exchange rate and foreign price, as illustrated in Figs. 1 and 2 based on the historical price quotes for the LCD product denominated in New Taiwan dollar (NTD) and on the quotes for the NTD exchange rate against the US dollar (USD) during the period of January 2000 through June 2009 acquired from the Taiwan Economic Journal (TEJ) database. The sensitivity of corporate value is analyzed to provide readers with more insights into the interactions among the following factors: the drift and the volatility of the stochastic foreign exchange rate and the foreign price, the price elasticity of demand, and the correlation between the exchange rate and the foreign price.

This paper is organized as follows: Section 1 introduces the corresponding valuation models, introduced by previous scholars. Section 2 presents the formulation of corporate value in the context of stochastic price, interest, and exchange rates under an inverse demand function. The analytical solution for the proposed corporate value is then obtained. Based on derived corporate value, Monte Carlo simulations for real option value and optimal entry

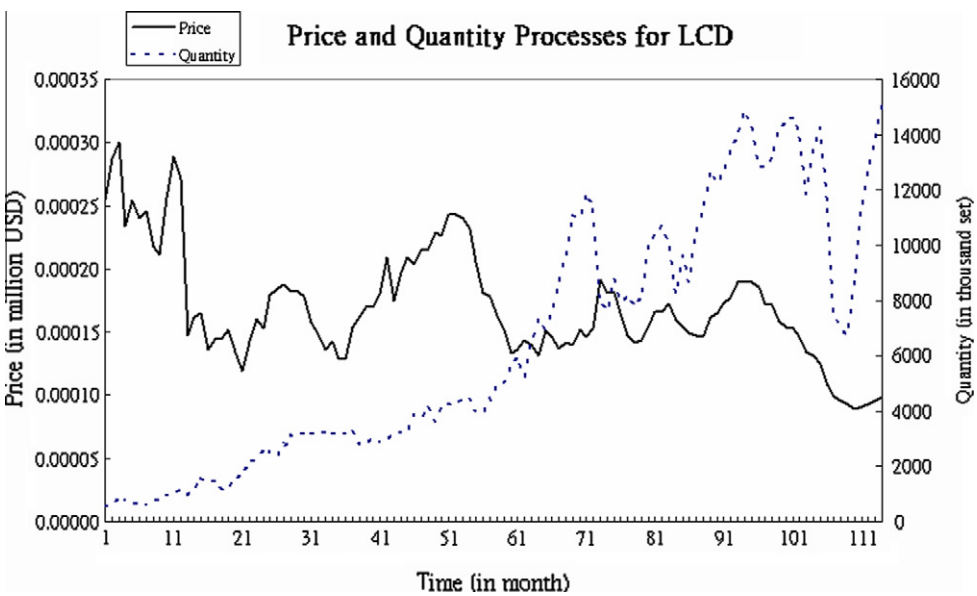

Fig. 1. The monthly price process denominated in US dollar for the LCD product.

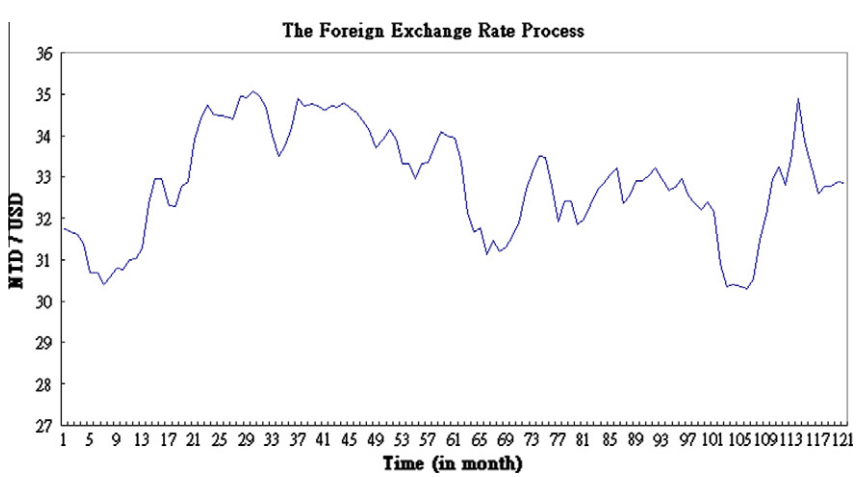

Fig. 2. The monthly foreign exchange rate process quoted as NT dollars against per US dollar.

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