Systematic jump risks in a small open economy: simultaneous equilibrium valuation of options on the market portfolio and the exchange rate

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Abstract

The valuation of stock options and currency options has witnessed an explosion of new development in the past 20 years. These models, set up either in a partial equilibrium or a general equilibrium framework, have certainly enriched our understanding of option valuation in one way or the other. However, the main drawback of these models is that stock options and currency options are analyzed in separate contexts. The co-movement of the stock market and the currency market is absent from the option valuation analysis. Such co-movement is extremely important and is best illustrated by the Southeast Asian financial crisis.

To overcome this drawback, this paper uses an equilibrium model to investigate the joint dynamics of the exchange rate and the market portfolio in a small open monetary economy with jump-diffusion money supplies and aggregate dividends. It is shown that the exchange rate and the market portfolio are strongly correlated since both are driven by the same economic fundamentals. Furthermore, options on the exchange rate and the market portfolio are evaluated in the same equilibrium context. The analysis shows that parameters describing the same economic fundamentals have very different effects on currency and stock options © 2001 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Derivatives valuation has witnessed an explosion of new development in the past 20 years. Examples for stock option valuations include Black and Scholes (1973), Merton (1976), Cox and Ross (1976), Hull and White (1987), Bailey and Stulz (1989) and Naik and Lee (1990). Examples for currency option models include Biger and Hull (1983), Garman and Kohlhagen (1983), Grabbe (1983), Chesney and Scott (1989), Amin and Jarrow (1991), Heston (1993), Bates (1996) and Bakshi and Chen (1997). The references listed here are by no means exhaustive. These models, set up either in a partial equilibrium or a general equilibrium framework, have certainly enriched our understanding of option valuation in one way or the other.

However, the main drawback of these models is that stock options and currency options are analyzed in separate contexts. The co-movement of the stock market and the currency market is absent from the option valuation analysis. Such co-movement is extremely important and is best illustrated by the recent Southeast Asian financial crisis, which has swamped small economies like Thailand, Indonesia, Malaysia and Korea.

During the crisis, the dramatic currency devaluations were always accompanied by sharp decreases in their corresponding stock markets. As shown in Table 1, the 1997 average return on Southeast Asia's currency and the stock market is about -45%. The 1998 drastic devaluation of the Russia ruble and Russia's stock market only adds more evidence to the co-movement. Such evidence suggests that the stock market and the currency market are affected by the same fundamental economic factors. Failure to incorporate such simultaneous reactions to changes in the same fundamental economic factors would misguide the derivative valuations.

The second drawback of the existing models is best summarized by Jorion (1988, pp. 427-428):

> Many financial models rely heavily on the assumption of a particular stochastic process, while relatively little attention is paid to the empirical fit of the postulated distribution. As a result, models like option pricing models are applied indiscriminately to various markets such as the stock market and the foreign exchange market when the underlying processes may be fundamentally different.

Table 1
Summary of currency and stock index performance

Country	1997 returns on currency (%)	1997 returns on the stock index (%)
Thailand	−45	−54
Indonesia	−56	−37
Malaysia	−35	−52
Korea	−47	−38
Average	−46	−45