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Testing for intraday interdependence and volatility spillover among the euro, the pound and the Swiss franc markets

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ABSTRACT

To examine intraday interdependence and volatility spillover among the euro, the pound and the Swiss franc, we employ the varying-correlation model of multivariate generalized autoregressive conditional heteroskedasticity. Our main findings are (1) return volatility in the euro spills into the pound and the Swiss franc; and (2) these markets are highly integrated with the euro, and the degree of interdependence is state-dependent: euro news has a simultaneous impact on the pound and the Swiss franc, and comovements of these currencies and the euro become much higher in proportion to the arrival of news of the euro.

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1. Introduction

This study examines volatility spillover and the interdependence of the euro, the pound and the Swiss franc foreign exchange spot (FX) markets. *Volatility spillover* between different assets or time zones, which refers to causality in return variance (e.g., Hong, 2001), has been widely tested in the field of financial economics. The term *interdependence* corresponds to any continued market correlation

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at high levels (e.g., [Chiang et al., 2007](#)). While the dynamics of these three currencies, such as the interdependence and volatility spillovers among them, is well observed by and familiar to not only traders but also academic researchers, there is still room for research into the intraday dynamics of these currencies. We may consider such questions as whether the degree of interdependence among these currencies is state-dependent, and what intraday reaction the pound and Swiss franc volatilities show to volatility in the euro volatility.

According to a sort of mixture distribution hypothesis (e.g., [Clark, 1973](#); [Tauchen and Pitt, 1983](#)), return variance (volatility) is an increasing function of arrival information. Given this hypothesis, we can reasonably infer that the volatility spillover effect is attributable to information spillovers between currencies. When we observe volatility spillovers, it also makes sense for us to infer the interdependence between currencies amplified by information spillovers. To put it differently, since interdependence reflects a high level of integration among markets, it is plausible to consider that these markets show a similar reaction to common information that arrives into one of them at its origin. This implies that interdependence is an increasing function of arrival information that is adherent to one market. Unlike in the extant literature, the ultimate goal of this paper is not only (1) to identify volatility spillover effects but also (2) to explore the factor affecting the interdependence. Most of the studies that focus on the volatility spillover effect in the FX market are based on the [Granger \(1969\)](#)-type causality test (e.g., [Nikkinen et al., 2005](#)) or the cross-correlation function (e.g., [Inagaki, 2007](#)) developed by [Cheung and Ng \(1996\)](#). Although these approaches identify volatility spillover, they do not answer the question of what affects interdependence among various currencies. This issue motivates us to explore the factors affecting interdependence. Of course, there exist several papers that have examined interdependence among currencies (e.g., [Patton, 2006](#)). However, to the best of our knowledge, this paper is the first to examine the factors affecting interdependence among currencies. Here, we employ [Chiang et al. \(2007\)](#), who focused on news about the foreign sovereign credit rating of each country as a source of contagion¹ among Asian stock markets during the Asian-crisis period, to examine whether interdependence between currencies is amplified by news about one currency. If this is true, there exists evidence for information integration among these currencies.

This study uses a 10-min high-frequency data set created by the leading electronic broking system for FX dealing, EBS. Unlike most studies, which are based on daily (e.g., [Nikkinen et al., 2005](#); [Inagaki, 2007](#)) or weekly (e.g., [Ng, 2000](#)) frequencies, this data set enables our study to reflect an actual level of market activity. Putting ourselves in dialogue with [Engle et al. \(1990\)](#), who identified meteor shower effects that represent intraday volatility spillovers among major FX markets, and [Baillie and Bollerslev \(1990\)](#), who modeled hourly FX volatility patterns and thereby extended the work of [Engle et al. \(1990\)](#),² we hope our high-frequency data set will tell us more about the details of intraday dynamics of currencies: whether volatility spillovers among different currencies, as observed by several studies, are observed when the data interval is shortened; and if not, whether it is sensible to evacuate before a spillover. To truly understand these dynamics is crucial to the correct implementation of hedging strategies and asset allocation decisions among assets evaluated by those currencies.

This study employs the varying-correlation (VC) model of multivariate generalized autoregressive conditional heteroskedasticity (MV-GARCH) developed by [Tse and Tsui \(2002\)](#) to capture the intraday dynamics of the euro, the pound and the Swiss franc. The virtues of this model are that it (1) estimates fewer parameters than the others (e.g., BEKK, introduced by [Engle and Kroner, 1995](#)); and (2) overcomes the issue of positive definiteness of the variance-covariance matrix, which frequently inhibits proper estimation using the extant models. Related to the first virtue, as shown later, is the fact that the volatility representation of the VC MV-GARCH enables us to calculate the volatility response function³ more easily than that of the BEKK. Related to the second virtue, we can conclude that the VC MV-GARCH model poses a general assumption regarding the coefficient of correlation that is time-variant. This enables us to examine the underlying driving factors in the movement of a coefficient of

¹ In [Chiang et al. \(2007\)](#), this is defined as significant increases in cross-market co-movement.

² [Engle et al. \(1990\)](#) focus on volatility spillover among single currencies (yen/dollar) among different market segments. In [Baillie and Bollerslev \(1990\)](#), volatility spillovers among different currencies were also tested.

³ This function is defined in Eq. (8).

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