

Dependence Structure between Oil Prices, Exchange Rates, and Interest Rates

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Executive summary

Oil is one of the most important commodities in an economy. Low oil prices could be beneficial to major crude oil importing countries' economies, but they could also severely shake the economies of major crude oil exporting countries. In particular, falling or rising oil prices could significantly affect world economic activity through exchange rate fluctuations.

The purpose of this article is to unveil dependence structures of financial return series: WTI and Brent crude oil prices, the U.S. interest rates, and nine major oil-dependent countries' exchange rates that are not elliptically distributed. Thus, dependence measures assuming joint normality can be misleading and incorrectly yield market risk. In risk hedging and asset diversification, the dependence structure should be well specified.

In order to estimate dependence, we examine the possible asymmetric tail dependence and spillover effects across markets. We begin with specifying the marginal models for the returns as ARMA(p,q) T-GARCH(1,1) or ARMA(p,q) APARCH(1,1) with Student-*t* errors and generate the standardized residuals from the marginal models. The generated residuals are used in the analysis of the copula dependence structures. The Granger causality test is employed in this study to detect the causal relationship. In addition, we use one of the multivariate GARCH models, BEKK representation, for testing the spillover effect among our financial return series.

We mainly find that oil, exchange rates, and interest rates weakly co-move over our sample period. The dependence intensity in oil-currency markets for oil-exporting countries is slightly higher than for oil-importing countries. We also find that there is a negative relationship between the U.S. interest rates and crude oil prices. Oil-exchange rate linkages become stronger for most of the oil dependent countries considered in this article in the aftermath of the global financial crisis. The results for tail dependence reveal that dependence between the WTI crude oil prices and Canada, Russia, India, and Korea exchange rates during bull markets is higher than during bear markets. Using the Granger causality test, we show that there exists a unidirectional spillover effect: each exchange rate of the major oil importing countries is significantly affected by crude oil prices. Lastly, the BEKK representation provides strong evidence of bidirectional spillover effects in volatility between the Euro exchange rate and the WTI oil prices, whereas there is significant unidirectional spillover from WTI to the U.S. interest rates. Such effects do not occur between Saudi Arabian Riyal and the oil prices.

This study provides important policy implications for policymakers faced with an oil shock and a need to stabilize exchange rates and for investors adopting hedging strategies and risk management. For example, we can infer from our empirical findings that the effects of both the U.S. oil policy and monetary policy are transmitted through the

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foreign exchange markets of major oil exporting countries. The market risk caused by an oil price shock can be hedged by understanding tail dependence and volatility spillovers across markets. Since volatility is a typical proxy of risk, our finding also suggests that the volatility spillovers across markets negatively affect risk-averse investors.

Keywords: dependence structure; GARCH; copula; BEKK representation.