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Dynamic transmission effects between the interest rate, the US dollar, and gold and crude oil prices

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ABSTRACT

This paper shows that in the short term both gold and crude oil prices positively influence each other. Interest rates have a negative influence on the future gold prices and a positive influence on the future crude oil prices. In the long run, a relationship exists whereby interest rates influence the US dollar, which in turn influences international crude oil prices. When the Federal Reserve Board (Fed) lowers interest rates to boost the economy, market expectations for oil demand change and, as a result, crude oil prices fluctuate. In addition, there is a price transmission relationship from interest rates to gold prices. A reduction in interest rates influences investor expectations with respect to depreciation of the dollar. Investors then move their capital to the gold market for capital preservation or speculation. Finally, international gold and crude oil prices have feedback effects on interest rates. This paper infers that crude oil prices increasing to a certain level trigger inflation, at which juncture the Fed may tighten monetary policies to downturn the bloom economy.

1. Introduction

International oil prices have always been a leading indicator in the global economy. When oil prices rise, corporations suffer from surging costs and declining profits. Such increases also indirectly change consumer spending. Prices shoot up and, as a result, disposable income declines and inflation occurs. All of this is bad news for economic growth. Nevertheless, looming inflation boosts gold prices because investors believe gold preserves its value.

The US dollar is the major denomination currency for the international crude oil market and fluctuations in dollar exchange rates make it even more difficult to predict the international purchasing power of oil-exporting countries. In the short term, oil-exporting countries may be worried about the US dollar weakening, since they benefit from it being strong. However, overestimation of the US dollar can result in a reverse demand shock over the long run. When the outlook for the US dollar is dim, a large portion of capital goes to the crude oil markets and pushes up oil prices. In contrast, if a large amount of capital flows out of the crude oil market, fluctuations in the US dollar will be fairly noticeable. As long as the denomination and settlement currency for the international crude oil market is the US dollar, this correlation will continue to hold.

Gold and other commodities trend up following the lead of crude oil prices, all under the influence of macroeconomic factors such as inflation, interest rates, and industrial production. Rising commodity prices increase the anticipation of inflation among investors. As a result, the government will likely tighten monetary policies by hiking interest rates. Since interest rates influence the returns of investments on commodities, changes in interest rates indirectly affect returns for gold holders.

In the international market, gold is denominated in US dollars and is the best commodity to preserve capital and to combat recessions. The US dollar is under the direct influence of the interest rate policies set by the Federal Reserve Board (Fed), which depend on the recovery of the global economy. Investors develop certain anticipations regarding the future boom or bust of the economy based on adjustments to interest rates, with rising rates boosting their confidence. If the interest rates in the US are higher than in other countries, appreciation of the US dollar will suppress gold prices. In the meantime, signs of economic recovery also boost oil prices. It is possible for international crude oil and gold prices to move in opposite directions. Rising oil and gold prices both have an important influence on the international financial markets and the global economy.

This paper examines the short- and long-term dynamic interactions between interest rates, oil prices, gold prices, and the US dollar. It explores the following issues. First, what are the short-term interactions between interest rates, the US dollar, gold prices, and oil prices as paired variables? Second, what are the long-term causal relationships between interest rates, the US dollar, gold prices, and oil prices as paired variables? Third, do interest rates and oil prices have opposite influences on international gold prices?

This paper consists of five parts. Section 1 describes the motivations and purposes of the research. Section 2 examines the relevant

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literature. Section 3 outlines the research methodology. Section 4 presents the empirical analysis. Finally, Section 5 offers conclusions.

2. Literature review

Chaudhuri and Daniel (1998) suggest that since Bretton Woods, there has been cointegration between real US dollar-denominated production prices and real oil prices in most industrial nations. This means that the instability of real US dollar exchange rates is, in essence, a reflection of the instability of real oil prices. Chen and Chen (2007) analyze data on G7 countries, world oil prices, and intermediate oil prices and find that real oil prices may be the major factor contributing to fluctuations in real exchange rates.

In addition, there is cointegration between real oil prices and real exchange rates. Regression estimates based on cross-sectional data indicate that real oil prices have significant predictability over real exchange rates. Using monthly data on the effective real exchange rates of the US dollar and real oil prices in the US, Amano and van Norden (1998) demonstrate cointegration between the two. The authors suggest that in the post-Bretton Woods era, oil prices may be the main source of long-lasting impacts. They also indicate that the causal relationship is from oil prices to exchange rates alone and not vice versa.

Holding all other variables constant, Benassy-Quere et al. (2007) argue that from 1974 to 2004, a 10% rise in long-term oil prices resulted in a 4.3% appreciation of the effective exchange rate of the US dollar. Zhang et al. (2008) analyze the impact of US dollar exchange rates on international crude oil prices and results find a significant cointegration relationship in the long-term equilibrium, with one-way mean spillover effects of the US dollar exchange rates on crude oil prices. The depreciation of the US dollar is a major factor determining international crude oil prices and the US dollar exchange rates are one of the main determinants of oil prices in the long run.

Since international gold prices are denominated in US dollars, the dollar's depreciation decreases gold prices for investors compared to other hard currencies. To preserve capital, investors will purchase gold and thus push gold prices up. In addition, given rising economic uncertainties and inflation, gold is considered a safe haven. An empirical study of Sjaastad and Scacciavillani (1996) on the international gold markets from 1982 to 1990 supports the efficient market hypothesis. Goldman (2000) validates the efficient market hypothesis based on US dollar and British pound exchange rates from 1890 to 1906, with findings supporting the weak form of efficiency. Capie et al. (2005) use weekly data over the past 30 years to reveal an inverse relationship between gold prices and exchange rates between British pounds and US dollars, as well as between gold prices and exchange rates between US dollars and Japanese yen.

Gold prices show such relationships with exchange rates because gold is a hedge against exchange rate fluctuations and is thus used to preserve capital. According to Hammoudeh and Yuan (2008), fluctuations in crude oil prices have negative impacts on fluctuations in some metal prices and managers of commodity portfolios can benefit from such volatility in the metal markets with options pricing. The volatility of crude oil prices therefore presents an opportunity to switch to commodity markets to diversify portfolios.

Bernanke and Blinder (1992) suggest that short-term interest rates are predictive of the future economy. Because call rates are almost instant, the impulse on short-term interest rate spreads is regarded as an external impulse on the interest rates set by the Fed. As a response to the impulse on the Fed rates, market participants trade currencies based on their expectations of the future economy. A continued impulse on the Fed rates results in varying interpretations from traders due to unexpected transactions. Meanwhile, traders change their expectations over time. Therefore, high trading volumes in response to exchange rate changes last only a few days.

An empirical study by So (2001) demonstrates that changes in interest rates affect changes in future exchange rates, but that changes in exchange rates do not directly affect future interest rates. This is because interest rates reflect the fundamentals of an economy and this information is transmitted through the exchange value of the US dollar. The empirical study of Kanas (2005) uses a test based on the MS-VAR model to identify a causal relationship from the real interest rate spreads of the lag periods to changes in the real exchange rates. Besides, the causal relationship generated from the spreads of the real exchange rates occurs only in high-volatility periods.

According to Kitamura and Akiba (2006), the external impulse of short-term interest rate spreads influences exchange rates via two trading channels. Changes in short-term interest rate spreads result in changes in exchange rates through uncovered interest-rate parity conditions. Market participants generally acknowledge that unexpected changes in exchange rates should be reflected in short-term interest rate spreads.

Cologni and Manera (2008) employ simulations to estimate the total effects of crude oil impulses in 1990. They suggest that part of the influence of crude oil price impulses in certain countries (e.g., the US) is the result of monetary policy. For other countries (e.g., Canada, France, and Italy), the total effects are at least partly offset by monetary policies.

Hammoudeh and Yuan (2008) consider how sensitive commodities are to good news versus bad news and find that gold is not sensitive to bad news, which is why it is a good investment during bad times, such as crises, wars, and times of high inflation, particularly in the short term. Meanwhile, rising interest rates have dampening effects on metal markets. Economic policymakers should tighten monetary policies to suppress instability.

3. Methodology

3.1. Threshold co-integration

This paper examines the long-term equilibrium relationship among the four variables by using the threshold co-integration technique developed by Enders and Granger (1998) and Enders and Siklos (2001) because of the non-linear relationships involved. It follows a two-step technique. First, this paper estimates the co-integration equation as follows:

$$Y_{1t} = \alpha + \beta Y_{2t} + u_t \tag{1}$$

where Y_{1t} and Y_{2t} are the first-difference stationary I(1) series for interest rates, US dollars, oil prices and gold prices. α and β are the estimated parameters, and u_t represents the interfering items that may result in series correlation. The second step involves validating whether the residual item u_t of the long-term equilibrium regression equation shows stationary convergence. The least minimum square method is applied to estimate $\hat{\rho}_1$ and $\hat{\rho}_2$. The ordinary least squares (OLS) estimates are calculated using the following regression equation:

$$\Delta u_t = I_t \rho_1 u_{t-1} + (1 - I_t)\rho_2 u_{t-1} + \sum_{i=1}^{l} \gamma_i \Delta u_{t-i} + \varepsilon_t \tag{2}$$

where ε_t is a white noise-interfering item. The residual item u_t is obtained in Eq. (1) and again estimated in Eq. (2). I_t is the indicator function. If $u_{t-1} \geq \tau$, then $I_t = 1$, but if $u_{t-1} \leq \tau$, then $I_t = 0$. Let τ be a threshold. The required condition for μ_t to be stationary is $-2 < (\rho_1, \rho_2) < 0$. If the variance of ε_t is sufficiently large, the value of ρ_j may fall between -2 and 0, assuming that other values are equal to zero. Enders and Granger (1998) and Enders and Siklos (2001) indicate in their case studies that under the null hypothesis $H_0: \rho_1 = \rho_2 = 0$, there is no convergence, the F statistic has a non-standard distribution. The critical values of non-standard F statistics are listed in their papers. Enders and