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Research Article

Analyzing Systematic Risks Associated with Financial Engineering Commodities

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Abstract

This study investigates the relationship between systematic risks and future commodity contracts. This study concludes that interest rates, inflation rates, and currency exchange rates have a significant effect on commodity futures contracts (crude palm oil, gold, and tin). Apart from that, this study also includes the latest financial engineering derivatives, which is Futures Bitcoin, to examine the relationship between systematic risks. The results demonstrate that currency exchange rates are the most influential risk on future commodities and bitcoin. This study adds to the current literature of derivatives commodities and alerts regulators to the importance of establishment of fiscal and economic policies, particularly during the Covid 19 pandemic.

Keywords

Crude palm oil, gold, tin, systematic risks, commodity futures

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Introduction

Agriculture and commodities are frequently used in futures contracts as underlying assets. However, agriculture and commodities are subject to boom-bust cycles. This is because history demonstrates how large companies have failed in commodity trading, including Bryan Hunter of Amaranth's natural gas gamble, Liu Qibing, a metal trader for the Chinese government, and Yasuo Hamanaka, better known as Mr. Copper, a Sumitomo Corporation trader. Agriculture and commodities are also important branches of materials science because they are used to bolster Malaysia's economy through the derivatives market. For instance, gold futures (FGLD), tin futures (FTIN), and crude palm oil futures (FCPO) are three significant material futures that together account for a significant portion of the derivatives market. Earlier research established a framework for financial engineering to model commodity prices based on market fundamentals. Due to the high volatility of crude palm oil, it serves as the underlying asset for (FCPO). Previous research has demonstrated the performance of crude oil hedge funds during periods of crisis, such as the Gulf War, the Asian financial crisis, and the Iraq War, when price shocks result in increased volatility (Chun, Cho and Kim, 2019).

Another study, Lee, Hu and Chiou (2010) corroborated the same argument, stating that such significant events increase crude oil volatility, resulting in increased derivatives trading. Similarly, tin is used in a variety of ways in today's world, including the production of several valuable alloys, tin plating of other metals, and as solder. Tin is widely utilized in the construction and electronics industries, and so its demand is closely tied to economic health and business activity, which are reflected and influenced by interest rates, currency exchange rates, and inflation threats. This can be seen in the "tin crisis of 1985" due to the failure of commodity market regulation (Anderson and Gilbert, 1988). In comparison with other commodities, gold is one of the most malleable, ductile, dense, conductive, non-destructive, brilliant, and beautiful metals known to mankind. This unique combination of characteristics has made gold a prized possession for most of human history in almost every civilization, and there have been active gold markets for more than 6,000 years (O'Connor, Lucey, Batten and Baur, 2015). All these commodities have a direct effect on the economy and are traded through more highly developed financial engineering contracts. In fact, these materials also face systematic risks such as interest rates, exchange rates, and interest rate swaps. Previous research has demonstrated that systematic risks have a significant impact on how commodities futures are priced, indicating that if the market rises, future prices should reflect market reaction and economic trends (Alhasan Ahmad, Zain, Noor, Alsaadi and Milhem, 2020). Furthermore, futures prices have a direct impact on a country's economy and contribute significantly to the overall economy. In addition, Malaysia is one of the largest exporters of palm crude oil in the world. This incident demonstrates the importance and effect of future crude palm oil in the country, despite the absence of alternative and complementary financial commodities relating to crude palm oil agreements in the market derivatives (Alwi, Salleh, Malan, Aslam, Alpandi and Daud, 2020). Therefore, the purpose of this study is to investigate the relationship between systematic risk exposure (interest rates, inflation rates, and currency exchange rates) and commodity futures contracts. Commodity futures are centered on crude palm oil, gold, and tin. Additionally, this study contributes to the literature on commodity derivatives by including bitcoin as a new financial engineering contract.

Literature Review

Crude Palm Oil Futures and Systematic Risks

A previous study employed an ordinary least squared method to find the relationship between crude palm oil prices and the Malaysian exchange rate (Aziz and Applanaidu, 2017). The researchers found there is a significant and negative relationship between the actual price of crude oil and palm oil with the exchange rate and interest rate. Additionally, the study confirmed that earlier works of literature indicated that real commodity prices influenced real exchange rates in commodity-exporting nations. This is in line with Ab Rahman (2013) who also found that interest rates and exchange have a negative influence on crude palm oil futures prices, suggesting that policymakers should carefully devise policies (monetary and fiscal) to mitigate

swings in commodity futures prices to safeguard hedgers and investors.
Meanwhile, Nordin and Ismail (2014) find that interest rates and exchange rates are negatively significant for palm oil prices. Prices of palm oil, thus, benefit the stock market index. Additionally, this study also examines the impact of commodity prices on the stock market index, with the palm oil price chosen as a possible market influencer. Apart from that, Aziz and Applanaidu (2017) have established a negative and significant relationship between crude palm oil futures and inflation, implying that the inflation determinant of crude palm oil is critical. On the contrary, Rifin (2010) discovered evidence consistent with a positive correlation between crude palm oil and inflation rates. However, some studies indicate a negative significant relationship between crude palm oil futures price volatility and inflation rates (Ab Rahman, 2013).

Gold Futures and Systematic Risks

Previous research examined the relationship between interest rates and gold prices from 1975 to 2016 across G& countries (Apergis, Cooray, Khraief and Apergis, 2019). The result shows that gold prices and real interest rates are positively related in each of the G7 countries. As a result, one could argue that gold could act as a hedge against changes in real interest rates during a recession. After the Bretton Woods System collapsed in 1971, gold prices were determined by supply and demand in a free-market environment and have been more erratic since then. Because gold's supply is inelastic, gold demand in the short run determines the price of gold. However, the gold price is determined by supply and demand. Political events, uncertainty, and, most notably, macroeconomic monetary variables all have an impact on gold prices. A study reported that previous literature has demonstrated that the gold price is extremely sensitive to monetary factors, most notably exchange rates. Gold prices have fluctuated regularly since the Bretton Woods System was established, due to unpredictable exchange rates (Ozturk and Cavdar, 2021).
Meanwhile, Toraman, Basarir and Bayramoglu (2011) also examined the significant and inverse relationship between gold and the US dollar. Consequently, a study discovered a statistically significant positive correlation between inflation and gold futures (Beckmann and Czudaj, 2013). However, researchers examined the impact of interest rates and gold prices on stock performance during the Covid-19 pandemic and the findings indicated that the gold futures price had a significant negative impact on both stock and interest rate performance (Widjanarko, Suratna and Utomo, 2020).

Tin Futures and Systematic Risks

A study emphasises that interest rates will have no effect on tin prices, but also on currency exchange rates (Munandar, Siregar, Andati and Anggraeni, 2019). This could be explained by the fact that Malaysia's tin reserves are limited. Despite this, it was the second largest producer of tin in the world in terms of raw materials. In addition, Baffes and Savescu (2014) discovered inconsistent evidence for the influence of interest rates on metal prices, including a positive effect on all other base metals except tin. Meanwhile, Khalifa, Otranto, Hammoudeh and Ramchander (2016) examined the relationship between exchange rates and tin volatility transmission. They found a statistically significant positive correlation between South African currencies and tin. This is because the price of white metals contributes to South Africa's currency's volatility. In addition, Hristu-Varsakelis and Kyrtsou (2008) demonstrated that relationship between US inflation and metal returns is nonlinear, owing primarily to positive metal price movements and negative inflation rate changes.

Bitcoin Futures and Systematic Risks

Meanwhile, researchers conducted a study on bitcoin and inflation (Blau, Griffith and Whitby, 2021).Their findings bolstered the notion that bitcoin could be used as a hedge against inflationary pressures, as bitcoin futures tend to produce the inflationary changes predicted from this vantage point. However, Akyildirim, Corbet, Katsiampa, Kellard and Sensoy (2020) stated that the regulatory and macroeconomic unease in the bitcoin futures market had a significant effect on pricing. Additionally, the study stated that bitcoin futures outperform spot markets in terms of price discovery. Nonetheless, there have been a variety of contradictory findings and arguments regarding the correlation between future derivative contracts and risk exposures, whether

positive, negative, or even non-correlation in certain models (Hirtle, 1997; Liu and Pan, 2003; Bali, Hume and Martell, 2007; Joseph, Su, Huang and Lai, 2021). As a result, this analysis aims to provide a better understanding of the role of systematic risks in commodities futures markets, as well as to develop more effective policies for promoting the use of derivatives products in the financial market.

Methodology

This study employs the ordinary least squares (OLS) method to explain the multivariable regression coefficient and gives a minimum variance. The data was extracted from intraday Bursa Malaysia Derivatives observations between January 2020 and January 2021. The macroeconomic data was obtained from Bank Negara Malaysia. This study uses OLS is as popular as it is in the practice of econometrics owing to its relative ease of use in comparison to other methods and the fact that it is theoretically sound because the sum of the residuals is reduced to zero. We then conducted a multicollinearity test to ensure that there are no significant correlations between the study's independent variables, as their presence would diminish the model's relevance. The results show all independent variables are less than 0.8, indicating that all variables are normal multicollinearity. The general formula for the model derived from the OLS regression analysis is as follows:

$$FCPO = \alpha + \beta_1 int + \beta_2 exc + \beta_3\ inf + \varepsilon \quad (1)$$
$$FGOLD = \alpha + \beta_1 int + \beta_2 exc + \beta_3 inf + \varepsilon \quad (2)$$
$$FTIN = \alpha + \beta_1 int + \beta_2 exc + \beta_3\ inf + \varepsilon \quad (3)$$
$$FBCOIN = \alpha + \beta_1 int + \beta_2 exc + \beta_3 inf + \varepsilon \quad (4)$$

Table 1
Correlations analyses
Model 1 Futures Crude Palm Oil

	FCPO	**ER**	**IR**	**INF**
FCPO	1.000	-0.686	-0.414	0.265
ER	-0.686	1.000	0.195	-0.506
IR	-0.414	0.195	1.000	0.539
INF	0.265	-0.506	0.539	1.000

Model 2
Futures GOLD

	FGOLD	**ER**	**IR**	**INF**
FGOLD	1.000	0.245	-0.039	-0.722
ER	0.245	1.000	0.216	-0.485
IR	-0.039	0.216	1.000	-0.146
INF	-0.722	-0.485	-0.146	1.000

Model 3
Futures TIN

	FTIN	**ER**	**IR**	**INF**
FTIN	1.000	0.044	-0.836	-0.617
ER	0.044	1.000	0.246	-0.541
IR	-0.836	0.246	1.000	0.466
INF	-0.617	-0.541	0.466	1.000

Model 4
Futures BITCOIN

	FBCOIN	**ER**	**IR**	**INF**
FBCOIN	1.000	0.433	-0.203	0.040
ER	0.433	1.000	0.584	0.797
IR	-0.203	0.584	1.000	0.470

INF	0.040	0.797	0.470	1.000

Table 2
Ordinary Least Squared Estimation

	FCPO	***FGOLD***	***FTIN***	***FBCOIN***
int	-243.49	-278.00	-263.33	-0.074
	0.000***	0.000***	0.000***	0.045**
exc	-4257.95	-199.47	195.95	13.830
	0.002***	0.000***	0.000***	0.000***
inf	-3075.42	-7348.10	2740.57	-2.196
	0.03**	0.000***	0.000***	0.09**
constant	21164	3066.28	1601.31	0.257
	0.000***	0.000***	0.000***	0.003***
R-squared	85%	73%	77%	51%
F-statistics	732.64***	245.48***	482.95***	96.793***

Variable definitions: *int*=interest rates, *exc*=exchange rate, FCPO = Futures Crude Palm Oil, FGLOD= Futures Gold, FTIN = Futures Tin and FBCOIN= Futures Bitcoin.
p value denoted significance at the 1, 5 and 10% levels, respectively.

Results and Discussions

Prior to evaluating the OLS regression results, we must conduct diagnostic tests to ensure the models satisfy the requisites of a classical linear regression model. Table 1 demonstrates that all models do not have multicollinearity as the correlation values are below 80% (0.8). All models are noncollinear, as the centered variance inflation factors are less than 10 in all models (Hallin, 2014). Based on Table 2, the results show all predicted variables (*interest rates, exchange rates,* and *inflation rates*) have a significant relationship between all future contracts (FCPO, FGOLD, FTIN, and FBCOIN). The results demonstrate that systematic risks have a strong influence on commodities pricing, particularly in futures contracts. Exchange rates are the most influential factor across all futures contracts, highlighting the regulator's critical role in balancing currency movements.

Robustness Test

Table 4
Serial Correlation Tests

	Breusch-Godfrey Serial Correlation LM Test	**Heteroscedasticity Test**	**Durbin Watson**
FCPO	0.24	0.10	1.77
FGOLD	0.16	0.10	1.32
FTIN	0.00	0.10	2.19
FBCOIN	0.08	0.11	2.16

Variable definitions: int=interest rates, exc=exchange rate, FCPO = Futures Crude Palm Oil, FGLOD= Futures Gold and FTIN = Futures Tin.
p value denoted significance at the 1, 5 and 10% levels, respectively.

According to Table 4, the FGOLD value for Durbin Watson (1.32) is outside the desired range, indicating that the model exhibits a weak serial correlation. However, after performing additional serial correlation tests, we discovered that the model passes the LM and heteroscedasticity tests (probability chi square is > 0.05), indicating that it is not serially correlated. As a result, all other models are thoroughly tested, and the results are robust.

Conclusion

This paper examined the effect of currency exchange rates, interest rates, and inflation rates on gold futures, crude palm oil futures, tin futures, and bitcoin futures. The diagnostic tests revealed that the model used in this study is reliable, as it is free of multicollinearity, serial correlation, and

heteroskedasticity, allowing for a more reliable interpretation and regression analysis. The study shed light on the significant antecedents of commodity futures contracts, including the evolution of financial engineering in the financial market, such as bitcoin futures. This study concludes that gold futures are negatively explained by the exchange rate, inflation, and interest rate. Meanwhile, in the case of crude palm oil futures, exchange rates, inflation, and interest rates all contribute significantly to the negative relationship between crude palm oil futures and prices. Meanwhile, for bitcoin futures, only the inflation rate and interest rate significantly explained the price behavior, while the exchange rate had a positive and significant effect on the price of bitcoin futures. Although Futures Bitcoin show significant relationship with all systematic risks, however, the around a 51 percent R-square value reduces the significance of the regression model, as most changes in the dependent variable cannot be explained by changes in the independent variables. This was because bitcoin futures showed little movement during the period examined, remaining constant throughout most of the data entries. To further investigate this, this study recommends selecting a different period or a longer period, using annual data rather than daily data, as the literature demonstrated that systematic risks have a more pronounced effect on futures in the long run. In summarize, additional work and incentives must be engaged in the commodity futures market to ensure that all parties can benefit from its benefits. This study demonstrates the critical role of monetary and fiscal policy in establishing a currency market and stabilizing commodity prices for regulators and policymakers.

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