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Financialization – Evidence from Dynamic Connectedness among Agricultural Index Futures

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Abstract: *The introduction of index futures was a landmark event for global commodity markets. It has been blamed by regulators and academicians for its role in food price surges from time to time. This paper examines the price discovery and volatility spillover relationship among agricultural index futures globally. Results from the study reveal that index futures play a dominant role in contributing to price discovery. The price leadership of the futures market, although found to be strong, is diminished in the presence of stringent regulatory trading curbs that were put in place as a response to the crisis.*

Furthermore, an improved Diebold & Yilmaz method based on TVP-VAR-SV model was used to analyze dynamic connectedness between the index and standalone contracts of agriculture commodity markets. The results show that the impacts on the net spillover of various indices are different. However, the evidence fails to support the argument that volatility is induced due to spillovers among the indices.

1. INTRODUCTION

Over the last decades, the market environment of commodity trading has undergone vast changes. With trade barriers diminishing, the need for modern risk management and measurement has become crucial. The spillovers among markets can be measured through connectedness relating to systemic risk and systematic risk. Understanding the systemic risks helps to determine the contribution of financial markets to the overall financial system and acts as an early warning system.

Bulk commodities mostly listed on organized futures markets, form an important part of the industry chain and transmit superimposed demand. Financialization is the transformation of a segmented market into an asset class for portfolio investors that has distorted commodity pricing in the futures market. The financialization of commodities is linked to the market developments in the mid-2000s period. Financialization of the futures market has been linked to diminishing hedging mechanisms and increasing speculative behavior. In times of geo-political tensions, there is an increase in such exuberant behavior. Agricultural commodities have a vital strategic influence on most countries. The consequence of high agricultural prices is more dramatic for emerging and developing economies characterized by major expenditure spent on food consumption.

2. LITERATURE REVIEW

Using Markowitz's (1952) portfolio setting, Bodie and Rosansky (1980), Jensen et al. (2000) and Edwards and Liew (2013) concluded that the presence of commodities enhances the portfolio

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return, while Cao et al. contested that the inclusion of commodities is not advisable and evidenced that their contribution is a placebo effect (Bodie & V.I., 1980; Cao et al., 2012; Edwards & Liew, 2013; Jensen et al., 2000).

Post-2003, the increase in open interest of commodity futures markets has increased cross-linkages among markets as hedge funds and commodity index funds are used for risk management reasons. Sharp downward movements in equity markets have led to financial investors liquidating their stakes in commodity markets in order to raise cash for margin calls or safeguard investments (Büyüksahin et al., 2010). Events of the global financial crisis of 2008 and the subsequent commodities super-cycle that lasted up to 2011 provide an opportunity to study such scenarios (Cargill, 2021; Clapp & Helleiner, 2012; Singleton, 2014). Academicians and practitioners have pressed for substantial allocations to commodities as an asset class for the purpose of diversification and return generation (Carter et al., 2017; le Pen & Sévi, 2018; Naeem et al., 2021).

Basak & Pavlova (2016) conclude that the effects of financialization are only on storable commodity prices (Basak & Pavlova, 2016). In the presence of institutions, the prices of storable commodities and their inventories are higher than in the benchmark economy and the effects are more pronounced for commodities that are part of an index. Irwin and Sanders (2012) observe largely unrelated regressions and the limited result of Granger causality from index trading to returns (Irwin & Sanders, 2012).

Asymmetry between the costs of going long and short restricts the ability of some investors to trade pessimistically on new information. However, such behavior has limited evidence of inducing volatility. Boyd et al. (2016) find consistent evidence, documenting that herding behavior by speculators across 32 futures markets was limited in scope and serves to stabilize markets—speculators herd by buying (selling) into falling (rising) markets (Boyd et al., 2016). Index investments having agricultural contracts as their underlying asset are more adaptive to informational disclosures relating to global supply and demand forecasts (Balcilar et al., 2021)

Index investments having agricultural contracts as their underlying asset are more adaptive to informational disclosures relating to global supply and demand forecasts. The introduction of commodity index funds is targeted as a driver of creating global liquidity imbalances. The question stands - Has speculative trading in agricultural futures markets led to increased volatility, leading to a global food security crisis?

There is a greater need of understanding the factors that lead to speculation and volatility. The price discovery function of agricultural products is ambiguous in the current literature. The paper attempts to discuss how futures prices adjust to demand-driven changes in commodity prices and by gradual entry and exit of index investments. The ambiguity of what classifies as a shift of demand and supply and what as bubble formation remains to be detangled.

3. METHODOLOGY

TVP-VAR model enables us to capture a possible time-varying nature of underlying structure in the economy flexibly and robustly. All parameters in the VAR specification are assumed to follow the first-order random walk process, thus allowing both temporary and permanent shifts in the parameters (Balcilar et al., 2017). Dependence among commodity price co-movements helps to extract information related to risk management & hedging. With comparatively fewer

parameters compared to other econometric models and simplicity of comprehending solutions, the method is suitable to broaden our understanding of financialization through the lens of agricultural futures indices.

The connectedness approach introduced by Diebold and Yilmaz is used to explore complex nonlinear transmission mechanisms in networks across areas of finance and economics (Diebold et al., 2009; Diebold & Yilmaz, 2012, 2014). It allows the comparison of different impacts that a shock in one variable has on the ability of another variable to forecast error variance while considering the feedback loops. The joint spillover index enables a natural depiction of spillover along with measuring the goodness-of-fit measure.

The stochastic volatility model is a generalized version of Black-Scholes model to allow analysis of stochastic volatility, assuming that there exists the price of the underlying factor, two risk factors and a price volatility factor (Xu & Gong, 2022). The risk neutral state can be denoted as:

$$D\,S = (r-\delta)\,S\,dt + \sqrt{v}S\,d\,z_1$$

And

$$Dv = \kappa\,(m-v)\,dt + \sigma\,p\,\sqrt{v}S\,dz_1 \;\; + \sigma\;\sqrt{1-p^2}\,\sqrt{v}\,dz_2$$

where

Κ = Rate of mean reverting,

m = Long run mean.

Mean reversion is an assumption of the model. Volatility process can be associated positively or negatively correlated to the price discovery process, dependent on the sign p denotes. Previous studies have concluded that indices or equity securities exhibit negative correlation between prices and price volatility while the converse holds true for commodities.

The arbitrage equation for V (S,v,t) is:

$$rv = V_t \; + (r-\delta)\,SV_S \; + = \kappa\,(m-v)\,V_v \;\; + \frac{1}{2}vS^2V_{ss} \; + \sigma \;\; pv\,SV_{Sv} + \;\; \frac{1}{2}\sigma^2(1-p^2)vV_{vv}$$

On conversion of the prices into logarithm scale, s = ln(S). Applying Ito's Lemma, the equation is represented as:

$$Ds = (r-\delta)\,dt + \sqrt{v}d\,z_1$$

Arbitrage equation for V (S,v,t) in the reduced form can be expressed as:

$$rV = V_t \; + (r-\delta)\,V_S \; + = \kappa\,(m-v)\,V_v \;\; + \frac{1}{2}vV_{ss} \; + \sigma \;\; pv\,V_{Sv} + \;\; \frac{1}{2}\sigma^2(1-p^2)vV_{vv}$$

The underlying state process that is expressed in form of s and v is a form of affine diffusion. Stochastic Volatility models refer to the stochastic and time varying specification of the variance evolution. In particular, the assumption of following AR(1) process is made for log-variance.

4. DATA

The selection criteria for the data were covering agricultural indices that were frequently traded, had agricultural futures contracts majorly as underlying assets and covered key commodity markets. The data was extracted from Bloomberg Terminal and covers the period from 17 February 2009 to 20 May 2022.

Daily index futures data from Bloomberg Commodities Sub Index Australia (BCOMAU), ICE Futures Europe - Index Future Contract on MSCI BRIC Index in USD (MBRI), S&P GSCI Agriculture Enhanced Euro Index (SGCUEGE) and Bloomberg Commodities Sub Index US (BCOMAG) are considered. BCOMAU is represented as AUS, MBRI as BRIC, SGCUEGE as EURO and BCOMAG as US based on the geographical location or group of countries and their underlying markets.

The descriptive analysis is presented in Table 1. All the series had significantly leptokurtic distributions indicating that the tails were fatter than a normal distribution. This supported the Jarque-Bera normality tests of the distributions not being distributed normally. Hence, the squared returns were used to employ TVP-VAR-SV approach.

5. RESULTS

The section covers the dynamic and average connectedness measures. The average value of the Total Connectedness Index predicting the entire dataset is depicted across time in Figure 2. It is useful to evaluate the response of TCI to various economic factors prevailing during the period. During 2020, vast disruptions were experienced by commodities across the board. Table 2 illustrates the joint spillover index that enables comparisons across the dataset. NPT represents Net Pairwise Total that evaluates interrelation among the indices over the evolution of time and their potential roles. It should be noted that for the indices under study, a positive value indicates the net transmitting role while negative values refer to the net receiving role.

Table 1. Descriptive Statistics

	EURO	BRIC	AUS	US
Mean	500.0232	84.7479	99.47631	60.53626
Median	473.6545	79.30025	100.2998	57.30335
Maximum	843.387	163.8554	146.1163	97.6683
Minimum	212.023	55.9502	70.9493	34.1523
Std. Dev.	108.2023	16.20589	14.32732	15.7856
Skewness	0.626714	1.49555	0.31073	0.402672
Kurtosis	3.175581	5.978568	2.422268	2.235013
Jarque-Bera	214.3889	2384.715	96.35812	165.1214
Sum	1606075	272210.2	319517.9	194442.5

Source: Own research

It can be seen that the US index BCOMAG (US) and European index MBRI (Euro) assume the role of both net transmitters and receivers at the same time; however, the effect of spillover does not appear to be de-stabilizing. From the impulse response table, figure 2, the time varying behavior of active portfolio management is undermined as the volatility having a contagion effect is underscored.

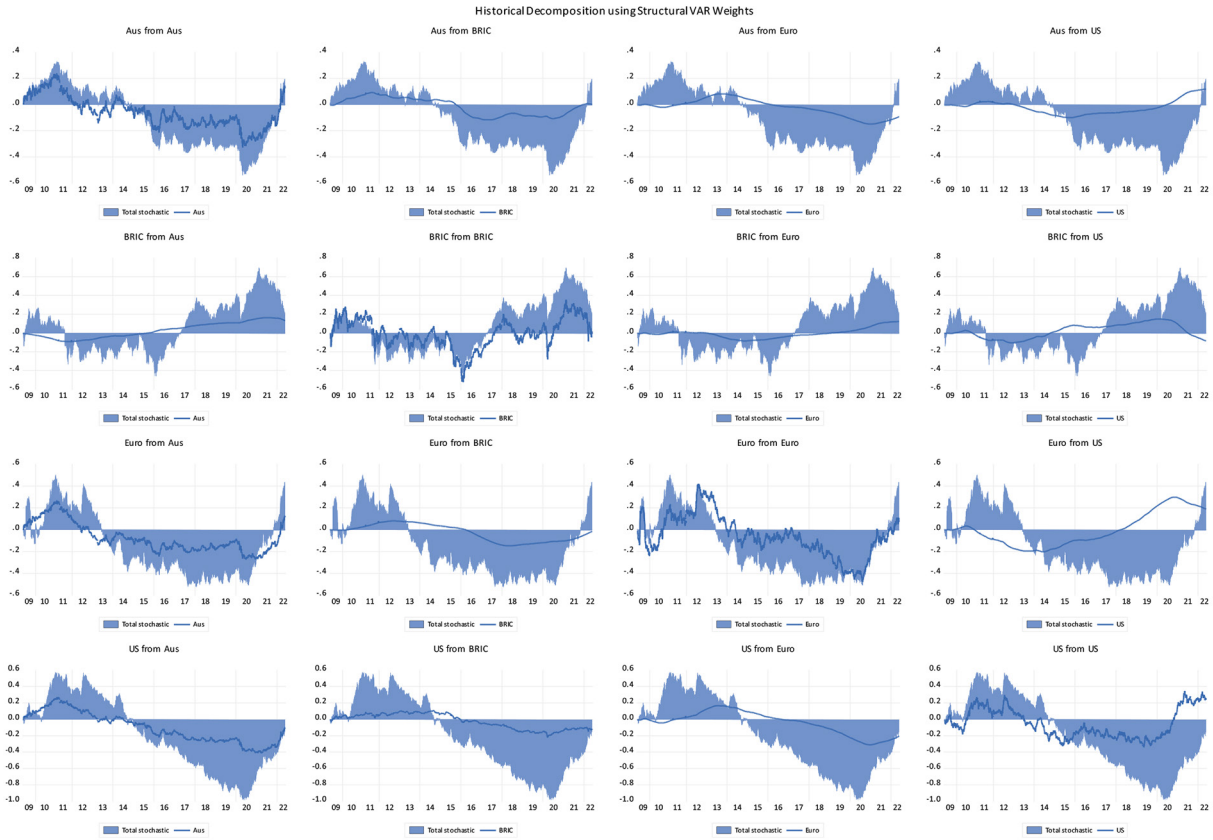

Figure 1. Historical decomposition structural VAR Table

Source: Own research

The MBRI index (BRIC economies) and BCOMAU (Australian index), in the stated order exercise influence in term spillover effect. An argument for the same is that during times of increased market uncertainty and risk, there is an effect on government interventions that leads to increasing volatility connectedness of agricultural markets. In the case of rising markets, the volumes of investors diversifying or switching their investments from bonds and equity to commodity markets increase, leading to high volatility. Another argument relates to the lead-lag relationship between information transmission and price discovery. As developed markets such as US and Eurozone have wider participation from institutional and retail investors in their indices, and their agricultural futures markets are deep, these markets are dominant in determining the price vis-à-vis the developing markets.

Table 2. Dynamic Net Connectedness Table

	Aus	BRIC	Euro	US	FROM
Aus	63.44	2.24	17.14	17.19	36.56
BRIC	4.48	81.17	5.09	9.27	18.83
Euro	9.89	2.37	53.65	34.09	46.35
US	10.85	3.3	35.65	50.21	49.79
TO	25.22	7.9	57.87	60.54	151.53
Inc.Own	88.66	89.07	111.52	110.75	cTCI/TCI
NET	-11.34	-10.93	11.52	10.75	50.51/37.88
NPT	1	0	3	2	

Source: Own research

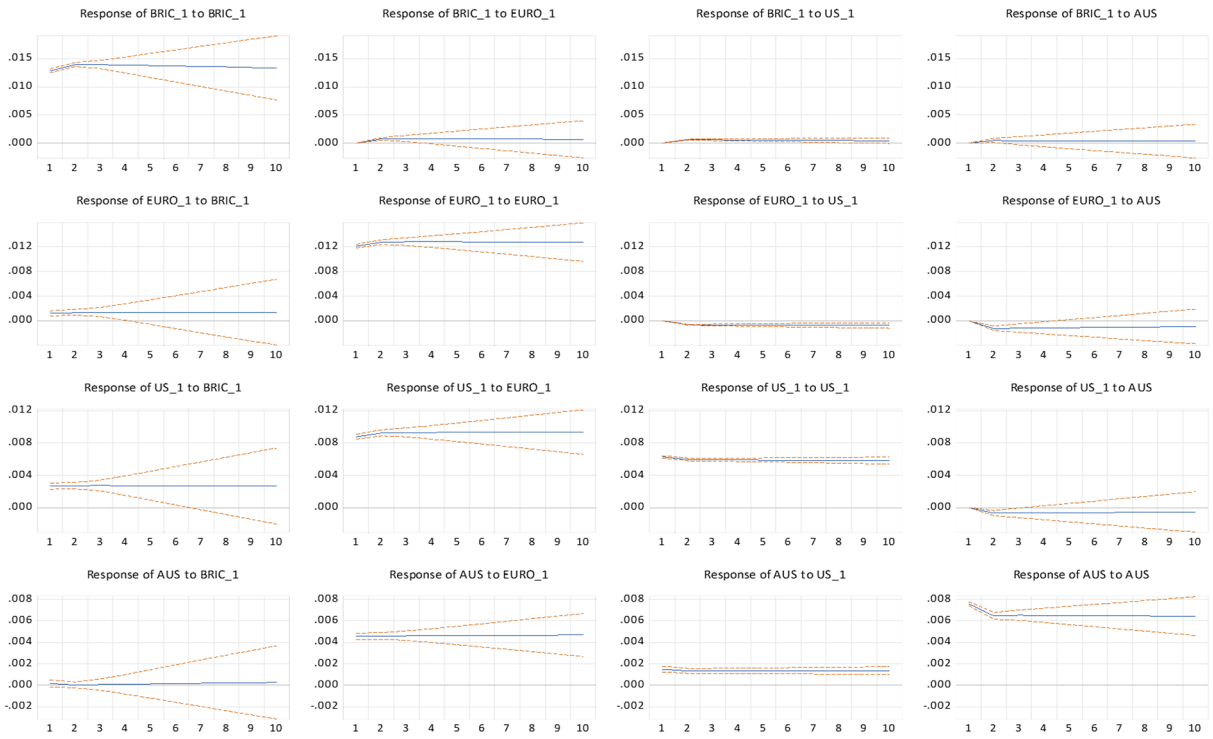

Figure 2. Impulse Response Table for Stochastic Volatility

Source: Own research

6. CONCLUSION

The volatility spillover based on information transmission is marginally high in American & European Markets. It indicates the price discovering role for these markets. There is no strong evidence of financialization having a direct impact on the 4 indices.

We can envisage agricultural commodities indices have an informational transmission in the long run so that the results of the correlation test provide that at least one co-integrating equation exists between two variables, that is, two global indices. The patterns are essential in order to capture the movement of the volatility trend. It can be straightforwardly envisaged that the trend of responses occurred by different exogenous shocks in different periods. The impulse response function suggests that there is no significant effect of shocks on the global indices.

The findings are crucial for portfolio and risk managers aspiring to design an optimal risk-return strategy. The connectedness effect can act as an early warning system for potential spillover. Understanding the key factors driving spillovers in agricultural commodities can help determine the future macro-economic environment as well. This will help in maximizing the welfare objectives for the investors.

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