Original Article

Journal of Social Welfare and Management
Volume 10 Number 3, September - December (Special Issue) 2018
DOI: http://dx.doi.org/10.21088/JSWM.0975.0231.10318.23

Hedging Efficiency of Commodity Derivatives: A Comparison of Spices Futures with Metals Futures in India

Anjana Krishnakumar

Abstract

Commodities including metals and spices are preferred forms of investment in India particularly during post reform period. The prices of commodities are subject to wild market fluctuations due to the presence of wide range of forces ranging from national to global. Writing derivatives against these assets is superior tool to leverage risks from such imperfections at the market places. In this parlance, this study aims to analyze and compare price performance, market volatility and hedging efficiency of spices and metals futures in India. A secondary data based study was conducted by taking daily closing prices from both future and spot markets of four metals and three spices for a period of five years from 2013 to 2018. The study examines the hedging efficiency of the metals and spices market by formulating GARCH model. The study shows some level of divergence in the price volatility across commodity markets. However, the study could not find much difference in hedging efficiencies of metals and spices future markets in India.

Keywords: Commodity Market; Metals ; Spices; Price Volatility; Price Discovery; Hedging Efficiency.

Introduction

Indian economy, emerged as one of the fastest growing economies in the world, provides ample opportunities for investors to earn reasonable return from their capital outlays. With the globalization of financial sector, the Indian financial system was redesigned, where the Government undertook significant initiatives to bolster the economic credentials of the country. As a more liberalized environment affords greater scope for financial innovation, at the same time financial markets are by nature, extremely volatile and hence the risk factor is an important concern for financial agents (Pithadia & Patidar 2005). Here comes the vitality of issuance and trading of derivatives, a milestone in financial innovation ever seen by India, which subjects to alleviate the risks arising out of a volatile global economic climate.

Author's Affiliation: Master of Commerce, Sri C. Achutha Menon Government College, Kuttanellur, Thrissur, Kerala 680014, India.

Coressponding Author: Anjana Krishnakumar, Master of Commerce, Sri C. Achutha Menon Government College, Kuttanellur, Thrissur, Kerala 680014, India.

E-mail: anjanakkumar25@gmail.com

Received on 28.11.2018, **Accepted on** 31.12.2018

An agrarian economy like India, always witnessed the problem of instability in commodity prices, which has been a major concern of the producers, traders and investors. Commodity derivative markets help the farmers and other stock holders to manage their activities in an environment of price variability. Commodities including metals and spices are preferred forms of investment in India particularly during the post reform period. Further, these markets cater to the needs of hedgers who want to mitigate risk arising out of exposure to the underlying asset (Edward & Rao, 2013). At this juncture, it is very important to look into the price performance of two commodity segments, spices and metals in Indian context which provides valid information to investors in devising apposite hedging tools for minimizing their risk. A hedge is an investment position intended to offset potential losses that may be incurred by a companion investment. The main purpose and benefit of hedging on the futures markets is to minimize possible revenue losses associated with adverse cash price changes. The risk of price variability of an asset can be managed by the mechanism of hedging. The hedging activity can be considered as exchanging price risk for basis risk (Yaganti & Kamaiah, 2012). Roy and Kumar (2007) analyzed the hedging effectiveness of wheat

futures in India using least square method and found that the hedging effectiveness provided by futures markets is low (15%). Kumar & Pandey (2008) estimated dynamic and constant hedge ratio for S & P CNX Nifty index futures, Gold futures and Soybean futures and they imply that for managing risk, understanding optimal hedge ratio is critical for devising effective hedging strategy.

Objectives of the study

1. To analyze the price volatility of spice and metal future markets in India
2. To empirically examine the hedging efficiency of spice and metal future markets in India.

Methodology

1. ***Sample & data***

   The sample for the study consists of 4 metals (Aluminum, Copper, Nickel, Zinc) and 3 spices (Pepper, Turmeric, Coriander). Daily closing prices from both future and spot markets for a period of five years from 2013 to 2018 were selected from various databases including official websites of NCDEX and NMCE. Data availability and the proneness to recent database are the rationale for the selection of sample period.

2. ***Tools of analysis***

   The study uses both descriptive and econometric analysis for deriving needed empirical findings that fulfill the objectives framed. GARCH model has been formulated for comparing the hedging efficiency of future markets of each of the commodity items included in the sample.

Generalized Autoregressive Conditional Heteroskedasticity (GARCH)

GARCH process is the versatile model to estimate volatility in financial markets. GARCH process is often preferred in financial modeling as it is able to provide a more real-world context than other forms of econometric models when one is trying to predict the prices and rates of financial instruments. Financial institutions typically use this model to estimate the volatility of returns for stocks, bonds and other investment assets. This model has wider applications in price forecasting, hedging, asset allocations and portfolio optimization decisions. Since the price volatility in commodity futures markets impact the price behavior of underlying commodities in spot market, a measure to gauge such relation helps the traders to hedge their risks in cash markets in advance. The traders and investment professionals adopt GARCH processes, which is autoregressive and depending on past squared observations and past variances to model for current variance in spot market prices. In other sense, the GARCH modeling is an appropriate measure to compute hedge ratios that is, the number of future contracts are required to cover the risk of exposures in spot market. Existing literature throws light on the empirical validity of GARCH models in designing hedging strategies. Hence, this study proposes to use GARCH modeling to compute hedge ratios in commodity market trading.The conditional variance equation is shown below.

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon^2{}_{t-i} + \sum_{j=1}^{p} \beta_j h_{t-j}$$

The parameter p therefore represents the Generalized (or "AR") order, while q represents the regular ARCH (or "MA") order. If p is non-zero, q must also be non-zero otherwise the model is unidentified. However, one can estimate a regular ARCH model by setting q to a positive value and p to zero. The sum of p and q must be not greater than 5.

Results and Discussion

The data analysis and the relevant findings are structured under two headings,

1. Price growth and volatility of selected metals and spices in future & spot market in India
2. Hedging efficiency of metals and spices futures in India.

CAGR of future and spot prices of selected metals and spices in India.

Table 1: Compound Annual Growth Rate of metals.

	Metals							
	Aluminium		copper		Nickel		Zinc	
	Future	Spot	future	Spot	Future	spot	Future	spot
2013-14	0.002	0.0021	-0.0008	-0.0004	0.0032	0.0047	0.0129	0.0143

2014-15	0.0046	0.0061	-0.006	-0.0043	-0.0184	-0.0154	0.0086	0.0067
2015-16	-0.0108	-0.0119	-0.0148	-0.0153	-0.0326	-0.0294	-0.009	-0.008
2016-17	0.0191	0.0227	0.0163	0.0163	0.0133	0.014	0.0355	0.0392
2017-18	0.0028	-0.3711	0.0133	0.011	0.0252	0.0242	0.0187	0.0165

Source: compiled from MCX database Figures in parenthesis indicate negative growth.

Table 2: Compound Annual Growth Rate of spices

	Spices					
	Pepper		Coriander		Turmeric	
	Future	Spot	Future	Spot	Future	Spot
2013-14	0.0211	0.024	0.0277	0.0269	-0.0053	-4.98E-05
2014-15	0.0362	0.0382	-0.0107	-0.0097	0.0172	0.0193
2015-16	0.0402	0.0434	-0.0196	-0.0128	0.0057	0.0117
2016-17	-0.0102	-0.006	0.0054	-0.003	-0.0249	-0.031
2017-18	0.0383	0.0348	-0.0381	-0.0283	0.0043	0.0064

Source: Compiled from NCDEX database figures in parenthesis indicate negative growth

The table 1 and table 2 respectively show the CAGR of future and spot prices of selected metals and spices during 2013 to 2018.On observing the CAGR , rising as well as declining trends of growth rate are visible in every commodities during the period of study. The growth rate of future and spot prices of almost all commodities are unidirectional. Every commodity faced a decline in the growth rate during 2015 to 2017. Comparatively metals show a better growth during the end years, whereas spices present a fluctuating trend of growth rate.

On observing the market volatility of metals and spices , it is visible that the metals are less volatile than spices. During 2013-2018, both future and spot prices of metals show same direction of volatility, except in the case of spot price volatility of Nickel in 2017-18. In the case of spices, both future and spot prices of pepper showed high volatility in 2017-18. Comparatively prices of metals show an overall stability in future and spot prices.

Price volatility of future and spot markets of selected metals and spices in India.

Table 3: Price volatility of future and spot markets of metals.

	Metals							
	Aluminium		copper		nickel		zinc	
	Future	Spot	future	Spot	future	spot	future	spot
2013-14	1.2409	1.2115	1.2268	1.3103	1.2472	1.0330	1.1654	1.2600
2014-15	1.0358	0.9888	1.1407	1.1127	1.8291	1.2098	1.0518	1.1517
2015-16	1.1933	1.1804	1.2885	1.3504	1.9958	1.5067	1.7130	1.7775
2016-17	0.9734	1.0380	1.2450	1.2338	1.7953	1.0185	1.6277	1.3213
2017-18	1.0021	0.9865	1.1203	1.0476	1.7922	4.3588	1.4149	1.2151

Source: compiled from NCDEX database.

Table 4: Price volatility of future and spot markets of spices.

	Spices					
	Pepper		Coriander		turmeric	
	Future	spot	Future	Spot	future	spot
2013-14	2.4873	2.0753	2.0787	1.2765	2.5459	1.0096
2014-15	1.6448	1.1557	2.9650	1.5272	2.7072	1.0372
2015-16	1.7459	1.1554	2.7070	1.3117	2.1649	0.9199
2016-17	1.3574	0.6981	1.9970	1.2092	1.6959	0.6217
2017-18	9.7347	8.7623	2.2295	1.2286	1.8694	0.9031

Source: compiled from NCDEX database

Hedging Efficiency of Metal and Spices Futures in India

The hedge ratio compares the value of a position protected through the use of a hedge with the size of the entire position itself. A hedge ratio may also be a comparison of the value of futures contracts purchased or sold to the value of the cash commodity being hedged. Optimal hedge ratio is the number of future contracts that one should be tailored adequately to cover his risk of holding asset in spot market.

The study examines the hedging efficiency of Indian commodity future markets through estimating a GARCH model taking future prices as exogenous construct and spot prices as endogenous variables under the assumption of conditional variance. The research estimates seven GARCH equations separately to find out the sensitive behaviour of spot prices towards the price volatility of future contracts that are written in the respective future markets. Table 5 reports the GARCH findings of Metal markets, while Table 6 indicates the hedging efficiency of three spices future markets in India.

The hedging efficiency of metal futures in India was analyzed at the price level (Table 5). The fitted GARCH models estimate almost similar pattern of relationship between metal spot and future prices in India. Equal number of future contracts is needed to be written by the metal traders in India for covering their risk exposures in spot markets. Both ARCH and GARCH terms are statistically significant for all the four metal commodities which establish the time varying characteristics of their price volatility. Conditional volatility of prices of these commodities could be the function of both the lag of the squared residuals and lagged variances. The statistically significant relationship between risk (lag variances) and price performance provide the evidence for the hedging efficiency of metal future markets in India irrespective of the commodities traded there.

Table 5: Hedging Efficiency of Indian Metal Futures: GARCH Results.

Zinc	**Coefficient**	**Std. Error**	**Z**	**p-value**	
Constant	-0.890421	0.259769	-3.4277	0.00061	***
Zinc future	1.00433	0.00190411	527.4521	<0.00001	***
alpha(0)	2.19336	0.305697	7.1750	<0.00001	***
alpha(1)	0.160343	0.0328374	4.8829	<0.00001	***
beta(1)	0.467929	0.0623072	7.5100	<0.00001	***
Aluminum	**Coefficient**	**Std. Error**	**Z**	**p-value**	
Const	-1.51183	0.427129	-3.5395	0.00040	***
Aluminum future	1.00873	0.00372455	270.8317	<0.00001	***
alpha(0)	0.319506	0.114192	2.7980	0.00514	***
alpha(1)	0.109225	0.0271173	4.0279	0.00006	***
beta(1)	0.730014	0.0749864	9.7353	<0.00001	***
Nickel	**Coefficient**	**Std. Error**	**Z**	**p-value**	
Const	2.76687	1.63132	1.6961	0.08987	*
Nickel future	0.991946	0.00196372	505.1361	<0.00001	***
alpha(0)	108.107	4.95599	21.8133	<0.00001	***
alpha(1)	0.290695	0.0379749	7.6549	<0.00001	***
beta(1)	6.81003e-05	0.009288	0.0073	0.99415	
Copper	**Coefficient**	**Std. Error**	**Z**	**p-value**	
Const	0.956708	1.14724	0.8339	0.40433	
Copper future	0.990809	0.00293271	337.8473	<0.00001	***
alpha(0)	1.00238	0.331349	3.0252	0.00248	***
alpha(1)	0.0787137	0.0126815	6.2070	<0.00001	***
beta(1)	0.89803	0.0171289	52.4278	<0.00001	***

***significant at one per cent level

Table 6 : Hedging Efficiency of Indian Spices Futures: GARCH Results.

Pepper	**Coefficient**	**Std. Error**	**Z**	**p-value**	
Const	38773.6	232.01	167.1206	<0.00001	***
Pepper future	0.67931	0.0099	68.6171	<0.00001	***
alpha(0)	19932.1	2073.1	9.6121	0.00001	***
alpha(1)	0.14694	0.0270593	5.4303	<0.00001	***
beta(1)	0.85306	0.0260586	32.7363	<0.00001	***
Turmeric	**Coefficient**	**Std. Error**	**Z**	**p-value**	
Const	2723.24	64.1062	42.4802	<0.00001	***
Turmeric future	0.678097	0.00882452	76.8424	<0.00001	***
alpha(0)	2349.33	410.34	5.7253	<0.00001	***
alpha(1)	0.618883	0.0448446	13.8006	<0.00001	***
beta(1)	0.381117	0.0382111	9.9740	<0.00001	***
Coriander	**Coefficient**	**Std. Error**	**Z**	**p-value**	
Const	238.186	35.8125	6.6509	<0.00001	***
Coriander future	0.971374	0.00529921	183.3056	<0.00001	***
alpha(0)	4354.57	688.579	6.3240	<0.00001	***
alpha(1)	0.716775	0.0584069	12.2721	<0.00001	***
beta(1)	0.241234	0.0502564	4.8001	<0.00001	***

***significant at one per cent level

As in the case of metal markets, both ARCH and GARCH terms are statistically significant for all the three spice commodities that again prove the time varying characteristics of the commodity price volatility in India. From the results of GARCH reported in Table 6, we can see that the spices futures against pepper and turmeric in India are exposed to relatively lower amount of risk compared to coriander during the study period. For these two spices average hedge ratio, that is regression weight of price change in spot contract on a unit price change in future contracts, is relatively low and is around 0.67, which imply that almost two third number of future contracts are only needed to cover the risk exposures in spot markets. However, the declining trend in the coriander prices amidst of larger price volatility found the risk of holding such commodities higher that forces the traders to write almost equal number of contracts in future markets simultaneously while holding commodities in spot markets. Hence, the hedging effect of future contracts relatively different across the spices markets of India.

Conclusion

The study, collecting price data on metals and spices, assessed the hedging efficiency of commodity derivatives in India under the time series econometric framework. The study found some level of divergence, particularly in price volatility between commodity markets. However, the econometric analysis performed in the study has captured the hedging efficiency of derivatives in all segments of commodities selected. The traders in commodity markets in India should make use of futures in hedging price risks. More awareness campaigns and training session on future trading strategies should be arranged for different players of commodity markets in India.

Limitations of the study

Only short run causality between spot and future prices has been assessed in the study. The validity and scope of the study could have been enhanced if the time period of the study extended. The study used data relates to Indian context only. If we select data from other leading commodity exchanges across the world, the result will be more reliable.

References

1. Gupta Choudhary & Agarwal DT. An Empirical Analysis of Market Efficiency and Price Discovery in Indian Commodity Market. Sage Journals, 2018;19(3):771-89.
2. Sridhar LS., Sumathy M., Sudha N., & Ambrose A. Price Discovery in Commodity Market – An

Empirical Study on the Silver Market. IOSR Journal of Economics and Finance (IOSR-JEF), 2016;7(2):88-95.

3. Aggarwal Jain & Thomas. Do futures markets help in price discovery and risk management for commodities in India? 2014. Retrieved May 25, 2018, from http://www.igidr.ac.in/pdf/publication/WP-2014-020.pdf.
4. Armstrong A, Zapata & Fortenbery T. Price Discovery in the Futures and Cash Market for Sugar. 2003. Retrieved May 28, 2018, from https://api.aae.wisc.edu/pubs/pdf/sps/stpap469.pdf.
5. Thomas & Karande. Price discovery across multiple spot and futures markets. 2001. Retrieved May 28, 2018, from https://pdfs.semanticscholar.org/84be/2830f8cd67e7030e21894efc3a88ed4ada21.pdf.
6. Yaganti C & Kamaiah B. Hedging Efficiency of Commodity Futures Markets in India. The IUP Journal of Financial Risk Management, 2012;9(2): 40-58.
7. Srinivasan P. Price Discovery and Volatility Spillovers in Indian Spot-Futures Commodity Market. 2011. Retrieved May 27 2018, from https://mpra.ub.uni-muenchen.de/47412/1/MPRA_paper_47412.pdf.
8. Acharya & Panchal. Commodity Futures Market In India: Price Behaviour & Hedging Efficiency. 2014. Retrieved May 15, 2018, from https://www.gtuelibrary.edu.in/E-Book/Repository/CCFS/5.pdf.
9. Sehgal. Price Discovery in Indian Agricultural Commodity Markets. International Journal of Accounting and Financial Reporting, 2012;2(2):34-54.
10. Mahalik, Acharya & Babu M. Price Discovery and Volatility Spillovers in Futures and Spot Commodity Markets: Some Empirical Evidence from India. 2009. Retrieved May 12, 2018, from http://www.igidr.ac.in/pdf/publication/PP-062-10.pdf.
11. Sehgal, Rajput & Florent. Price Discovery And Volatility Spillover: Evidence From Indian Commodity Markets. The International Journal of Business and Finance Research. 2013;7:57-75.
12. Edward J & Rao TV. Price Discovery Process and Volatility Spillover of Chilli spot and Futures Prices Evidence from National Commodity and Derivative Exchange Ltd (NCDEX). IJEMR, 2013;3(12):1-2.
13. Kenourgios. Price Discovery in the Athens Derivatives Exchange: Evidence for the Ftse/Ase-20 Futures Market. Economic and Business Review, 2004;6(3):229-243.
14. Easwaran RS & Ramasundaram P. Whether commodity futures market in agriculture is efficient in price discovery? An econometric analysis. Applied Economics Research Review, 2008;21:337-44.
15. Iyer & Pillai. Price discovery and convergence in the Indian commodities market. 2010. Retrieved May 12, 2018, from https://www.emeraldinsight.com/doi/abs/10.1108/17538251011035873.
16. Pithadia & Patidar. Financial Derivatives Market and its Development in India. 2005. Retrieved May 12,2018, from http://www.indianmba.com/Faculty_Column/FC135/fc135.html.
17. Kumar Singh & Pandey. Hedging Effectiveness of Constant and Time Varying Hedge Ratio in Indian Stock and Commodity Futures Markets. 2008. Retieved May 10, 2018, from http://vslir.iima.ac.in:8080/jspui/bitstream/11718/121/1/2008-06-01AjayPandey.pdf.