

Crude oil futures to manage the price risk of textile equities: An empirical evidence from India

DOI: 10.35530/IT.073.04.202177

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ABSTRACT – REZUMAT

Crude oil futures to manage the price risk of textile equities: An empirical evidence from India

The textile sector in India is the oldest manufacturing sector. As the raw materials for this sector are sourced from the petrochemical industries, the earnings of Indian textile companies are dependent on the crude oil price. The crude price in the international market has become more volatile and hence, the equity price of Indian textile companies has become more volatile. This study aims to develop two price risk management strategies for Indian textile equities. Using the vector autoregressive (VAR) model, a price forecast model, further the possibility of cross hedge for textile equities with the help of crude futures is examined using the Granger causality test and Pearson correlation statistics. The results of the study showed that crude futures price in India is one of the price determinants of textile industry stock prices.

Keywords: Crude oil futures, textile industry, stock prices, vector autoregressive (VAR) model, Granger causality test, Pearson correlation coefficient

Contracte futures pe petrol brut pentru a gestiona riscul de preț al tranzacționării acțiunilor din industria textilă: Analiză empirică privind India

Sectorul textil din India este cel mai vechi sector de producție. Întrucât materiile prime pentru acest sector provin din industriile petrochimice, câștigurile companiilor textile indiene depind de prețul țițeiului. Prețul țițeiului pe piața internațională a devenit mai volatil și, prin urmare, prețul acțiunilor companiilor indiene din industria textilă a devenit mai volatil. Acest studiu își propune să dezvolte două strategii privind managementul riscului de preț pentru acțiunile din sectorul textil indian. Folosind modelul vector autoregresiv (VAR), un model de previzionare a prețurilor, posibilitatea de acoperire încrucișată (cross hedge) pentru acțiunile din industria textilă cu ajutorul contractelor futures pe petrol brut este examinată folosind testul de cauzalitate Granger și statisticile de corelație Pearson. Rezultatele studiului au arătat că prețul futures pe petrol în India este unul dintre factorii determinanți ai prețului acțiunilor din industria textilă.

Cuvinte cheie: contracte futures pe petrol brut, industria textilă, prețurile acțiunilor, modelul vector autoregresiv (VAR), testul de cauzalitate Granger, coeficientul de corelație Pearson

INTRODUCTION

The textile sector of India is one of the oldest industries in the Indian economy dating back several centuries. The flair for modernization and impact of technological innovation has resulted in the practice of different technologies in this Industry. While the traditional methods of hand spun and hand oven are still in practice at the rudimentary level, the capital-intensive, sophisticated mills, and power looms are also prevalent at the advanced level in this sector. Indian textile and apparel industry employs more than 45 million people across the country and is estimated to be worth US\$ 100 billion in FY19. Indian textile and apparel industry contributed 2% to the GDP, 12% to the export earnings and 7% to the industry output (by value) in 2018–2019. India held 5% of the global trade in textiles and apparel in 2018–2019.

Increasing per capita income of the Indian citizens, penetration of the organized retail, combined with low

manpower and production cost will drive demand for textiles in India. Various government policies favouring the textile industries like the Production Linked Incentive (PLI) Scheme to the tune of US\$ 1.44 Billion, Support to the handloom weavers and entrepreneurs through the MUDRA scheme which provides loans at 6% with a credit guarantee of three years, will fuel the growth of the Indian textile sector. Even though the textile sector has a positive outlook in the medium to long term, investors tend to shy away from these stocks. The volatility in the textile stock prices keeps the investors at bay [1–5]. Instability in the cost of production is one of the key factors for such volatility. Cleveland [6] and Halawani & Al Dabbagh [7] stated that synthetic polymers produced by the petrochemical industries are the major raw material suppliers for synthetic textile industries. The core materials used in the petrochemical industries are the by-products of crude and the crude oil price in the international market are not stable [8–11].

The volatile crude prices have made Indian and Bahrain textile stocks more volatile; this is evident from the previous studies [12–14]. Hence, active price risk management is very much essential to protect the incomes from volatility and price fluctuations of Indian textile stocks. The purpose of this empirical study is to develop a price forecast model using VAR methodology and to examine the feasibility of cross hedge for Indian textile stocks with the help of crude futures.

For this empirical study, the empirical results suggested that in VAR (2) model, 6 out of 10 selected companies showed statistically significant coefficients with crude futures. Further 5 selected companies' stock prices follow Welspun India Company's stock price. For 6 selected companies the granger causality test p-values are less than 0.05, this proved that the crude futures price in India causes the textile equity prices. The Pearson correlation coefficient values of Welspun India, ICLI, KPR and Trident with crude futures are less than -0.50 . This indicates that the textile stock prices in India are negatively correlated with crude oil futures prices. Hence the cross hedge for the Indian textile industry with crude oil futures is feasible.

LITERATURE REVIEW

Price forecasts and cross hedging of equity with the help of commodity futures and vice versa have become the subject of interest today with many academicians and practitioners [15–18]. Crude oil or other energy futures are actively traded derivatives in several economies and cross hedges with these instruments are widely examined by many researchers. However, a future derivative with an active market and a great volume will be the right tool to hedge the risk in the portfolio. A study by Singh & Sharma [19] states that for variables crude oil and Sensex, the long-run equilibrium relationship is evident during and pre-crisis phase [20]. Batten et al. [21, 22] stated that the areas of stock and energy sector integrations are critical to managing the risk. Olson et al. [23] studied that the oil and gas equity index was the most effective cross hedge for energy stocks. The integration of oil market and equity markets in many economies is studied by many researchers, for example [22, 24–30].

Many practitioners and academicians have used econometric models to forecast stock and other asset prices. Meher et al. [1] have used a mixed ARIMA methodology to forecast the stock prices of pharmaceutical companies in India. To forecast the natural rubber demand Khin et al. [31] have used a vector error correction model. To compute the hedge ratio VAR coefficients are used by Gaterek and Johansen [32]. Kumar et al. [33] argued that the ARIMA model represents a very popular methodology in the case of financial and agricultural forecasting. Kumar [34] uses VAR to predict the foreign tourist arrival in India. To understand the impact of interest rates on funding

costs Nkcubeko Nomsobo and Wyk [35], and Citak [36] have used VAR models [37]. The above-cited studies show that the performance of the manufacturing industries is affected by the volatile crude price and many studies have shown the relationship between crude price and equity market movements. Couples of studies have examined the possibility of the cross hedge with crude for equities. However, the study on forecast models or hedging strategies for Indian textile equities is not covered so far in the academic literature.

DATA AND METHODOLOGY

In this empirical study, the daily closing prices of selected textile equities and nearby crude futures (that is crude futures whose expiry is very close to the present date), are used. Based on market capitalisation and the textile stocks for which trading data are available since 2010 in NSE, India websites are selected as sample stocks. For the same period, the nearby expiring crude futures prices are gathered from the official website of Multi commodity exchange (MCX), India. The selected companies are Alok industries (AI), Arvind textile (AT), GAR Fibers (GF), Himatseide (HIM), PR mill (KPR), Page Industries (PI), Raymond (RAY), Trident (TRI), Welspun India (WI) and ICLI.

The linear regression model was applied in the pioneer works of time-series predictions. When the multiple independent variables data were available, the multiple regression models were used to forecast the value of the dependent variable. In the vector autoregressive model, all the variables in the system are treated as endogenous variables. The value of each endogenous variable is the function of its own lagged values and past values of all other endogenous variables in the VAR system. As Brooks [38] and Gujarati et al. [39] have suggested, this study has used Augmented Dickey-Fuller (ADF) test to check the stationarity of a time series.

The following equation shows the general form of the bivariate VAR model.

$$TE_t = \beta_{TE0} + \beta_{TE1}TE_{t-1} + \dots + \beta_{TEk}TE_{t-k} + \alpha_{TEk}CF_{t-1} + \dots + \alpha_{TEk}CF_{t-k} + u_{TEt} \quad (1)$$

$$CF_t = \beta_{CF0} + \beta_{CF1}CF_{t-1} + \dots + \beta_{CFk}CF_{t-k} + \alpha_{CFk}TX_{t-1} + \dots + \alpha_{TEk}NR_{t-k} + u_{CFt} \quad (2)$$

Where TE in equation 1 is the textile equity price, which is dependent on its past values, past values of crude futures price (CF) and u_{TEt} is the white noise error term. Similarly, the CF in equation 2 is crude oil future price, which is the function of its past values and past values of textile equity price (TE) and u_{CFt} is the white noise error term. t in the above two equations is the time index. This study accommodates the above-stated eleven endogenous variables in the model, they are 10 selected Indian textile equities and crude futures price series (table 1).

DESCRIPTIVE STATISTICS							
Panel b: Tyre stock and crude oil future prices							
Indian textile equities	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
Alok Industries	10.66	55.75	1.45	8.78	1.31	4.51	869.68
Arvind	79.39	178.90	15.35	47.78	0.27	1.59	215.03
Crude Futures	4101.68	7201.00	1289.00	1087.39	0.31	2.43	67.63
Gar Fibers	546.70	2250.35	37.70	552.38	0.99	3.18	377.59
Himatseide	147.10	418.40	23.05	114.96	0.67	2.05	255.20
KPR Mill	361.30	924.15	38.60	266.33	0.14	1.49	224.26
Page Industries	12599.68	36005.95	1212.50	8524.70	0.30	2.06	117.12
Raymond	500.16	1132.40	182.70	213.26	0.98	3.00	364.62
Trident	4.19	10.69	0.74	2.72	0.29	1.78	171.38
Welspun India	42.33	117.50	2.25	32.02	0.17	1.71	169.58
ICLI	71.50	243.46	1.18	69.62	0.63	1.98	248.21
Panel B: Textile stock and crude oil future returns							
Alok Industries	0.00	1.58	-0.24	0.05	13.83	434.49	17690006.00
Arvind	0.00	0.18	-0.18	0.03	0.24	7.55	1983.41
Crude Futures	0.00	0.20	-0.33	0.02	-0.65	25.22	46890.56
Gar Fibers	0.00	0.16	-0.18	0.03	0.65	9.20	3790.53
Himatseide	0.00	0.21	-0.30	0.03	0.44	11.41	6767.19
KPR Mill	0.00	0.42	-0.20	0.04	0.97	10.68	5928.46
Page Industries	0.00	0.13	-0.20	0.03	0.13	8.05	2419.97
Raymond	0.00	0.18	-0.11	0.02	0.52	8.00	2470.85
Trident	0.00	0.18	-0.21	0.03	-0.16	8.75	3134.98
Welspun India	0.00	0.28	-0.15	0.03	0.97	9.51	4370.08
ICLI	0.00	0.18	-0.23	0.03	-0.25	9.03	3466.73

Using the V-look up the function of MS excel the missing values are adjusted and 2272 price observations from 1st September 2010 to 31st December 2020 are obtained. The logged returns of crude futures prices and select textile equity prices are computed using the log function $r_{j,t} = \ln \left(\frac{P_{j,t}}{P_{j,t-1}} \right)$,

where $P_{j,t}$ and $P_{j,t-1}$ are the closing prices of crude futures and textile equity returns for day's t and $t-1$, respectively.

ANALYSIS AND DISCUSSIONS

Descriptive statistics for the prices and logged returns of crude futures and textile equity are shown in table 1. The mean daily returns of crude futures and spot textile equities are zero, but the corresponding standard deviations of the daily returns are much higher. The presence of fat tails is evident from the very high kurtosis for all the return series. The negative skewness statistics for Crude futures, Trident and ICLI indicate extreme losses (longer left tail). The right tail or the gain is evident from the positive skewness statistics in Alok Industries, Arvind textile, GAR fibres, Himatseide, KPR mill, Page industries, Raymond and Welspun India return series. The

Jarque-Bera statistics of all the return series signify that the series is not normally distributed.

Table 2 shows the Augmented Dickey-Fuller test statistics for the unit root test. The p-values in panel a of table 2 are not significant at a 95% confidence level. Hence the textile equity and crude futures price series are not stationary in their level form. In panel b of table 2, the p-value is less than 0.05 and the test critical values at 1%, 5% and 10% are greater than t-statistic values. Hence all selected textile equity price series and crude futures price series are stationary after first-order difference or these series are $I(1)$. In this empirical study, EViews 10 package is used, VAR model was estimated by taking a default lag length of 2. Lag length criteria is a post estimation special function available in EViews to identify the optimal lag length using information criteria values. Popular information criteria values presented in many time series works are Akaike information criteria (AIC), Schwarz criteria (SC) and Hanna Quinn (HQ), these values are shown in table 3. In table 3, the optimal lag identified by the model is 2. The AIC and HQ criteria statistics are minimum in lag 2, hence lag length 2 is considered an optimal lag to estimate the VAR model.

AUGMENTED DICKEY-FULLER TEST FOR UNIT ROOT					
Panel a: Textile stock and crude oil future prices					
Prices	t - Statistic	Test critical Values			p-value
		1% level	5% level	10% level	
Alok Industries	-2.218899	-3.433036	-2.862613	-2.56739	0.1997
Arvind	-1.425063	-3.433033	-2.862612	-2.56739	0.5714
Crude Futures	-1.851389	-3.433033	-2.862612	-2.56739	0.3558
Gar Fibers	1.737824	-3.433033	-2.862612	-2.56739	0.9997
Himatseide	-1.221266	-3.433033	-2.862612	-2.56739	0.6674
KPR Mill	-0.204059	-3.433033	-2.862612	-2.56739	0.9355
Page Industries	-0.703031	-3.433033	-2.862612	-2.56739	0.8441
Raymond	-1.487999	-3.433033	-2.862612	-2.56739	0.5398
Trident	-0.948192	-3.433035	-2.862612	-2.56739	0.7731
Welspun India	-1.49303	-3.433035	-2.862612	-2.56739	0.5372
ICLI	-1.054705	-3.433033	-2.862612	-2.56739	0.7354
Panel b: Textile stock and crude oil futures returns					
Alok Industries	-41.9026	-3.433035	-2.862612	-2.56739	0.0001
Arvind	-46.27492	-3.433035	-2.862612	-2.56739	0.0001
Crude Futures	-46.82717	-3.433035	-2.862612	-2.56739	0.0001
Gar Fibers	-49.21685	-3.433037	-2.862613	-2.56739	0.0001
Himatseide	-46.20995	-3.433035	-2.862612	-2.56739	0.0001
KPR Mill	-45.89185	-3.433035	-2.862612	-2.56739	0.0001
Page Industries	-44.73537	-3.433035	-2.862612	-2.56739	0.0001
Raymond	-44.60491	-3.433035	-2.862612	-2.56739	0.0001
Trident	-43.67916	-3.433035	-2.862612	-2.56739	0.0001
Welspun India	-29.48399	-3.433036	-2.862613	-2.56739	0.0001
ICLI	-46.94806	-3.433035	-2.862612	-2.56739	0.0001

Source: Authors computations using textile equity and crude futures price series.

Table 3

VAR LAG ORDER SELECTION CRITERIA			
Lag	AIC	SC	HQ
0	-47.10051	-47.07260*	-46.98997
1	-47.11223	-46.7772	-46.98997
2	-47.11297*	-46.4709	-47.09033*
3	-47.10019	-46.151	-46.75377
4	-47.09085	-45.8346	-46.63236

Source: Authors computations using textile equity and crude futures price series.

The VAR estimate coefficients with standard error and t-statistics are shown in table 4. A total of 253 coefficients are estimated and a total of 42 coefficients are statistically significant with a 95% confidence level. All the significant coefficients are shown in bold letters in table 4. In each cell there are three values given, they are coefficient, standard error and t-statistic. The coefficient statistics for the first lag of crude future is statistically significant for Arvind mills stock price with a p-value of 0.032. The current crude future price will give more influence on the textile equity price after 2 days. Out of 10 selected textile

companies, 6 companies' stock prices follow the $n-2$ price of crude futures and hence, 6 coefficient statistics are statistically significant with the second lag of crude futures. The p-values of such significant coefficients are 0.0004 for Arvind Mills, 0.0221 for GAR Fibers, 0.0186 for Himatseide, 0.0027 for Page Industries, 0.0004 for Raymond and 0.0026 for Welspun. In addition to crude futures, the competitor's stock price is also a major determinant of textile stock prices in the Indian market. Arvind mills, Gar Fibers, Himatseide, ICLI, KPR Mill, Trident and Welspun India companies' stock prices are influencing the prices of other textile companies. Among the above-stated price determinants for Indian textile stocks, crude futures and Welspun India are influencing the stock price of many textile stocks. The equation given by the VAR system to forecast the selected textile stock prices are given in the following equations. Here only significant coefficients are taken into consideration.

$$AI = C(1) \times AI(-1) + C(10) \times HIM(-2) + C(22) \times WI(-2) \quad (3)$$

$$AT = C(28) \times CF(-1) + C(29) \times CF(-2) + WI(-2) \quad (4)$$

VAR (2) REGRESSION ESTIMATIONS											
Variable	AI	AM	CF	GF	HIM	ICLI	KPR	PI	RAY	TRI	WI
AI (-1)	0.10	-0.01	0.00	0.02	0.00	0.00	0.01	0.00	0.02	0.00	0.00
	-0.02	-0.01	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01
	[4.62]	[-0.87]	[-0.27]	[2.15]	[0.05]	[0.16]	[0.80]	[-0.34]	[1.44]	[0.31]	[0.11]
AI (-2)	0.03	0.00	0.01	0.01	0.00	0.00	0.00	-0.01	-0.01	0.00	-0.01
	-0.02	-0.01	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01
	[1.54]	[0.05]	[1.19]	[0.76]	[0.01]	[0.17]	[-0.00]	[-1.18]	[-0.67]	[-0.16]	[-0.70]
AM (-1)	0.02	0.02	-0.01	0.06	0.09	0.01	0.04	-0.01	0.00	0.14	0.05
	-0.04	-0.03	-0.02	-0.02	-0.03	-0.03	-0.02	-0.02	-0.02	-0.03	-0.03
	[0.51]	[0.64]	[-0.60]	[2.81]	[3.46]	[0.30]	[2.07]	[-0.28]	[0.18]	[5.01]	[1.93]
AM (-2)	-0.01	0.00	-0.01	0.01	0.05	0.05	0.03	-0.01	0.07	0.10	0.01
	-0.04	-0.03	-0.02	-0.02	-0.03	-0.03	-0.02	-0.02	-0.02	-0.03	-0.03
	[-0.18]	[0.18]	[-0.48]	[0.67]	[1.97]	[1.38]	[1.51]	[-0.52]	[3.03]	[3.57]	[0.53]
CF (-1)	0.02	0.06	0.02	0.00	-0.04	0.05	0.02	0.01	0.01	-0.02	-0.03
	-0.04	-0.03	-0.02	-0.02	-0.03	-0.04	-0.02	-0.02	-0.02	-0.03	-0.03
	[0.50]	[2.23]	[0.80]	[0.17]	[-1.55]	[1.38]	[0.73]	[0.49]	[0.50]	[-0.66]	[-1.26]
CF (-2)	0.07	0.09	0.05	0.05	0.06	-0.01	0.02	0.06	0.08	0.03	0.08
	-0.04	-0.03	-0.02	-0.02	-0.03	-0.04	-0.02	-0.02	-0.02	-0.03	-0.03
	[1.53]	[3.51]	[2.15]	[2.28]	[2.35]	[-0.16]	[1.05]	[3.00]	[3.54]	[0.94]	[3.01]
GF (-1)	0.05	-0.03	-0.01	-0.07	-0.01	-0.04	-0.02	0.01	0.00	-0.02	0.01
	-0.04	-0.03	-0.02	-0.02	-0.03	-0.04	-0.02	-0.02	-0.02	-0.03	-0.03
	[1.21]	[-0.98]	[-0.49]	[-3.07]	[-0.51]	[-1.08]	[-0.93]	[0.53]	[0.02]	[-0.70]	[0.37]
GF (-2)	0.01	0.04	-0.03	0.00	0.01	0.09	0.09	-0.05	0.02	0.07	0.07
	-0.04	-0.03	-0.02	-0.02	-0.03	-0.04	-0.02	-0.02	-0.02	-0.03	-0.03
	[0.16]	[1.42]	[-1.20]	[-0.06]	[0.32]	[2.29]	[3.70]	[-2.45]	[0.65]	[2.22]	[2.48]
HIM (-1)	-0.03	0.00	-0.01	0.03	-0.01	0.03	0.04	0.02	0.04	-0.02	0.01
	-0.04	-0.02	-0.02	-0.02	-0.02	-0.03	-0.02	-0.02	-0.02	-0.03	-0.02
	[-0.84]	[-0.19]	[-0.59]	[1.51]	[-0.36]	[0.99]	[1.75]	[1.14]	[1.81]	[-0.83]	[0.30]
HIM (-2)	0.10	0.00	0.03	0.05	0.00	0.05	0.00	-0.01	0.00	0.03	0.02
	-0.04	-0.02	-0.02	-0.02	-0.02	-0.03	-0.02	-0.02	-0.02	-0.03	-0.02
	[2.55]	[-0.19]	[1.59]	[2.55]	[0.01]	[1.407]	[0.15]	[-0.37]	[0.22]	[1.29]	[0.83]
ICLI (-1)	0.00	0.01	0.01	-0.02	0.01	-0.03	-0.01	0.01	0.00	0.00	0.01
	-0.03	-0.02	-0.01	-0.01	-0.02	-0.02	-0.01	-0.01	-0.01	-0.02	-0.02
	[0.11]	[0.87]	[0.57]	[-1.77]	[0.31]	[-1.47]	[-0.63]	[0.67]	[-0.29]	[0.09]	[0.48]
ICLI (-2)	-0.04	-0.02	0.02	-0.01	-0.01	-0.03	-0.02	0.00	-0.03	-0.04	0.01
	-0.03	-0.02	-0.01	-0.01	-0.02	-0.02	-0.01	-0.01	-0.01	-0.02	-0.02
	[-1.44]	[-1.35]	[1.78]	[-0.54]	[-0.70]	[-1.41]	[-1.59]	[0.18]	[-2.14]	[-1.99]	[0.59]
KPR(-1)	0.03	0.03	0.02	-0.03	-0.03	0.05	-0.03	0.02	0.01	0.04	0.06
	-0.04	-0.03	-0.02	-0.02	-0.03	-0.04	-0.02	-0.02	-0.02	-0.03	-0.03
	[0.62]	[1.17]	[1.09]	[-1.24]	[-0.99]	[1.21]	[-1.11]	[0.99]	[0.58]	[1.33]	[1.99]
KPR(-2)	-0.02	0.00	-0.04	0.01	0.00	0.02	-0.06	0.04	-0.04	-0.04	-0.02
	-0.04	-0.03	-0.02	-0.02	-0.03	-0.04	-0.02	-0.02	-0.02	-0.03	-0.03
	[-0.54]	[-0.00]	[-1.68]	[0.57]	[-0.12]	[0.53]	[-2.66]	[1.82]	[-1.67]	[-1.18]	[-0.86]
PI (-1)	-0.06	0.03	-0.02	0.02	0.02	-0.01	-0.02	0.06	-0.01	0.00	-0.01
	-0.05	-0.03	-0.02	-0.03	-0.03	-0.04	-0.03	-0.02	-0.03	-0.03	-0.03
	[-1.30]	[0.96]	[-0.94]	[0.80]	[0.53]	[-0.34]	[-0.76]	[2.63]	[-0.42]	[-0.11]	[-0.38]
PI (-2)	-0.02	-0.01	0.01	-0.02	-0.04	0.00	-0.03	0.00	-0.02	0.01	-0.04
	-0.05	-0.03	-0.02	-0.03	-0.03	-0.04	-0.03	-0.02	-0.03	-0.03	-0.03
	[-0.40]	[-0.27]	[0.44]	[-0.95]	[-1.13]	[-0.03]	[-1.04]	[0.00]	[-0.90]	[0.25]	[-1.36]

VAR (2) REGRESSION ESTIMATIONS											
Variable	AI	AM	CF	GF	HIM	ICLI	KPR	PI	RAY	TRI	WI
RAY (-1)	0.06	-0.04	0.02	-0.03	-0.03	0.00	0.04	0.00	0.02	-0.06	-0.06
	-0.05	-0.03	-0.02	-0.02	-0.03	-0.04	-0.02	-0.02	-0.03	-0.03	-0.03
	[1.32]	[-1.39]	[0.75]	[-1.12]	[-0.97]	[0.09]	[1.78]	[0.01]	[0.78]	[-1.92]	[-1.93]
RAY(-2)	-0.02	0.02	-0.01	0.01	0.02	-0.07	0.04	0.04	0.01	0.01	0.00
	-0.05	-0.03	-0.02	-0.02	-0.03	-0.04	-0.02	-0.02	-0.03	-0.03	-0.03
	[-0.38]	[0.59]	[-0.32]	[0.61]	[0.68]	[-1.72]	[1.49]	[1.80]	[0.54]	[0.22]	[-0.02]
TRI (-1)	0.05	0.03	0.01	0.03	0.05	0.09	0.04	0.01	0.03	0.06	0.03
	-0.04	-0.02	-0.02	-0.02	-0.02	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02
	[1.30]	[1.25]	[0.69]	[1.54]	[1.95]	[2.86]	[1.81]	[0.42]	[1.43]	[2.57]	[1.30]
TRI (-2)	0.00	0.01	-0.01	-0.03	0.00	0.03	0.00	0.01	0.00	-0.10	0.00
	-0.04	-0.02	-0.02	-0.02	-0.02	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02
	[-0.07]	[0.47]	[-0.51]	[-1.51]	[0.00]	[1.00]	[-0.15]	[0.40]	[0.01]	[-3.90]	[0.16]
WI (-1)	0.01	0.01	0.01	0.02	0.01	0.06	0.02	-0.04	0.02	-0.02	0.08
	-0.04	-0.02	-0.02	-0.02	-0.02	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02
	[0.40]	[0.56]	[0.44]	[1.04]	[0.49]	[1.77]	[0.80]	[-2.19]	[0.80]	[-0.76]	[3.62]
WI (-2)	0.11	0.06	0.05	0.03	0.04	0.01	0.05	0.03	0.05	0.01	0.05
	-0.04	-0.02	-0.02	-0.02	-0.02	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02
	[2.88]	[2.67]	[2.55]	[1.62]	[1.96]	[0.28]	[2.57]	[1.67]	[2.48]	[0.46]	[2.13]
C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	[-0.03]	[0.43]	[-0.05]	[2.85]	[0.67]	[1.47]	[1.78]	[2.71]	[-0.18]	[0.89]	[1.04]

$$GF = C(70) \times AI(-1) + C(72) \times AT(-1) + C(75) \times CF(-2) + C(76) \times GF(-1) + C(79) \times HIM(-2) + C(92) \quad (5)$$

$$HIM = C(95) \times AT(-1) + C(96) \times AT(-2) + C(98) \times CF(-2) + C(114) \times WI(-2) \quad (6)$$

$$ICLI = C(123) \times GF(-2) + C(134) \times TRI(-1) \quad (7)$$

$$KPR = C(141) \times AT(-1) + C(146) \times GF(-2) + C(152) \times KPR(-2) + C(160) \times WI(-2) \quad (8)$$

$$PI = C(167) \times CF(-2) + C(169) \times GF(-1) + C(176) \times PI(-1) + C(184) \quad (9)$$

$$RAY = C(188) \times AT(-2) + C(190) \times CF(-2) + C(196) \times ICLI(-2) + C(206) \times WI(-2) \quad (10)$$

$$TRI = C(210) \times AT(-1) + C(211) \times AT(-2) + C(215) \times GF(-2) + C(219) \times ICLI(-2) + C(226) \times TRI(-1) + C(227) \times TRI(-2) \quad (11)$$

$$WI = C(236) \times CF(-2) + C(238) \times GF(-2) + C(234) \times KM(-1) + C(251) \times WI(-1) + C(252) \times WI(-2) \quad (12)$$

test whether the residual series of the estimated VAR model are serially correlated; test values are very close to 2. This indicates that the residuals in the series are free from autocorrelation. Hence the estimated VAR are a good fit and these models can be used to forecast the short-run prices of textile stocks in India.

Table 5

FITNESS SUMMARIES FOR ESTIMATED VAR EQUATIONS			
VAR estimation for	Durbin-Watson Stat	R-squared	Adjusted R-squared
ALOK INDUSTRIES	1.9890	0.0348	0.0253
ARVIND	1.9899	0.0202	0.0105
GAR FIBERS	1.9864	0.0261	0.0166
HIMATSEIDE	1.9966	0.0214	0.0118
KPR MILL	2.0028	0.0355	0.0261
PAGE INDUSTRIES	1.9963	0.0195	0.0099
RAYMOND	1.9929	0.0309	0.0214
TRIDENT	1.9957	0.0379	0.0285
WELSPUN INDIA	1.9817	0.0361	0.0266
ICLI	1.9974	0.0236	0.0140

R-squared and adjusted R-squared in table 5 show the goodness-of-fit. Durbin-Watson statistic is used to

Source: Authors computations using textile equity and crude futures price series.

Table 6

PEARSON CORRELATION COEFFICIENTS AND GRANGER CAUSALITY TEST STATISTICS			
Textile company name	Correlation coefficients with crude future		Granger causality test (p-values)
	With price series	With return series	
Alok Industries	0.083	0.096	0.1679
Arvind	-0.315	0.047	0.0001
Gar Fibers	-0.430	0.036	0.0321
Himatseide	-0.420	0.042	0.0111
ICLI	-0.688	0.032	0.3133
KPR Mill	-0.553	-0.008	0.1797
Page Industries	-0.389	0.052	0.0099
Raymond	-0.162	0.050	0.0012
Trident	-0.552	0.015	0.222
Welspun India	-0.651	0.063	0.0027

Source: Authors computations using textile equity and crude futures price series.

The second objective of this empirical study is to examine the feasibility of cross hedge for Indian textile equities using crude futures. Even today the Pearson correlation is widely used to examine the hedging and cross hedge possibility. In this study, Pearson correlation and Granger causality test statistics are shown to analyse the feasibility of cross hedge. Table 6 shows the Pearson correlation for price and return series of textile stocks with crude future prices; all selected companies' prices except Alok Industries are negatively correlated with crude futures prices. Among 10 selected companies, 4 companies show a negative correlation of less than 0.50. The p-values for the Granger causality test are

shown in the last column of table6. The null hypothesis is that the crude futures do not Granger cause selected textile companies. Six out of 10 selected companies show a p-value less than 0.05, indicating that the crude futures price in India is influencing the textile stock prices. As the textile stock prices are negatively correlated with crude futures and crude futures prices cause textile prices, hedging the price risk of Indian textile stocks is possible with crude futures.

CONCLUSIONS

The volatile equity market will adversely affect the investor's portfolio. The volatile crude oil price has adversely affected the performance and market capitalisation of textile companies in India. This empirical study aimed to develop two price risk management tools for textile stocks in India. VAR methodology is used to develop the daily price prediction model for textile stocks in India. VAR (2) multivariate model indicates that the crude oil futures and competitive firms' stock prices will influence the price of textile stocks in India. 6 companies out of 10 have significant coefficients with crude futures in the VAR 2 model. Further 5 selected companies out of 10 have shown significant coefficients in the VAR model with Welspun India Company's stock piece. The Pearson correlation coefficients and the p-values of Granger causality tests proved that the crude oil futures prices and textile stock prices are negatively correlated. One can take the short position in crude futures to minimize the textile stock portfolio risks. Investors and traders in textile stocks can use this VAR model to forecast the daily price and manage the price risk. Further using multivariate econometric models one can find the optimal hedge ratios for these cross hedges.

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