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Correlation Coefficient of Indian Oil Market Company equity stocks vis-à-vis the currency exchange rate: a 20-year historical perspective

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Abstract

This is a Correlation Coefficient study of Indian equity stocks in the oil industry sector (“OMC”) with currency exchange rates over the past twenty years. We consider INR/USD, INR/GBP, INR/EUR and INR/JPY currency pairs. India is predominantly an oil importing nation and the inflation, GDP, balance of payments in the Indian economy is closely linked with international crude oil price per barrel, Brent Crude and WTI.

Data used: past twenty years data from 01/01/2000 till 20/05/2020 was used for the analysis of Equity share prices of 145 OMC and oil companies of India.

Objective of the study: In this multi factor regression, I wanted to correlate the oil price and exchange rate of USD/INR which is very strongly correlated with oil price of Dubai mercantile commodity exchange.

Disclaimer: In this analysis/study I used the entire dump of oil sector shares listed in Indian bourses; though some stocks may not have 20-year daily price history.

Keywords: Stock Matrix, Correlation, R-squared, Covariance, Beta, Alpha and Top 10 distribution

Introduction

The objective of this paper is to examine the relationship between the oil prices, exchange rates and the corresponding change in the stock market prices of oil company stocks in an emerging economy, in this case India, which is predominantly an oil importing country. The country's economy, budget, surplus of payments everything is significantly dependent on oil prices.

India imports 1.5 billion barrels of crude oil each year. This comes up to around 86% of its annual crude oil requirement. So, the surge in crude oil prices could increase India's expenditure, thus adversely affecting India's fiscal deficit - the difference between the government's total revenue and total expenditure. Fiscal deficit indicates the amount of money the government has to borrow to meet its expenses. A rise in fiscal deficit could negatively affect the economy as well as markets. The fall in crude oil prices was a major contributing factor in the reduction of India's fiscal deficit between 2014 and 2016. There is a ripple effect in the national economy whenever GOI government of India increase the Petrol and diesel price as cost of living spirals up or increase non-linearly with the change in oil price.

Listed below is a summary of the five primary means by which the crude oil price impacts India.

1. Current account balance

India is one of the largest importers of oil in the world. It imports nearly 80% of its total oil needs. This accounts for one third of its total imports. For this reason, the price of oil affects India a lot. A fall in price would drive down the value of its imports. This helps narrow India's current account deficit - the amount India owes to the world in foreign currency. A fall in oil prices by \$10 per barrel helps reduce the current account deficit by \$9.2 billion. This amounts to nearly 0.43% of the Gross Domestic Product - a measure of the size of the economy.

2. Inflation

Oil price affects the entire economy, especially because of its use in transportation of goods and services. A rise in oil price leads to an increase in prices of all goods and services. It also affects us all directly as petrol and diesel prices rise. As a result, inflation rises. A high inflation is bad for an economy. It also affects companies - directly because of a rise in input costs and indirectly through a fall in consumer demand. This is why the fall in global crude prices comes as a boon to India. Every \$10 per barrel fall in crude oil price helps reduce retail inflation by 0.2% and wholesale price inflation by 0.5%.

3. Oil subsidy and fiscal deficit

The government fixes the price of fuel at a subsidised rate. It then compensates companies for any loss from selling fuel products at lower rates. These losses are called under-recoveries. This adds to the government's total expenditure and leads to a rise in fiscal deficit - the amount it borrows from the markets. A fall in oil prices reduces companies' losses, oil subsidies and thus helps narrow fiscal deficit. However, since diesel was recently deregulated, the fall in oil prices will likely have less effect on the government's fiscal deficit. Moreover, the government still has to pay for previous under-recoveries. Any benefit from the fall will be offset by payments for the past under-recoveries.

4. Rupee exchange rate

The value of a free-floating currency like Indian rupee depends on its demand in the currency market. This is why it depends to a great extent on the current account deficit. A high deficit means the country has to sell rupees and buy dollars to pay its bills. This reduces the value of the rupee. A fall in oil prices is, thus, good for the rupee. However, the downside is that the dollar strengthens every time the value of oil falls. This negates any benefits from a fall in current account deficit.

5. Petroleum producers

The fall in global oil prices may be beneficial to India, but it also has its downsides. Directly, it affects the exporters of petroleum producers in the country. India is the sixth largest exporter of petroleum products in the world, according to media reports. This helps it earn \$60 billion annually. Any fall in oil prices negatively impacts exports. At a time when India is running a trade deficit - high imports and low exports, any fall in exports is bad news.

Moreover, a lot of India's trade partners and buyers of its exports are net oil exporters. A fall in oil price may impact their economy, and hamper demand for Indian products. This would indirectly affect India and its companies. For example, the share prices of Bharti Airtel and Bajaj Auto fell because of the devaluation of the Nigerian currency - Naira. Both the companies have a significant presence in the African country.

Impact on OMC stocks

I have concentrated my study on those OMC oil marketing companies stock prices in India which converts crude oil to value added petroleum products. Many Indian companies depend on healthy crude oil prices. This includes tyre, lubricants, footwear, refining and airline companies. The profitability of these companies is adversely affected due to higher input costs. This could negatively impact stock prices in the near term. On the other hand, oil exploration companies in the country could benefit from a rise in oil prices.

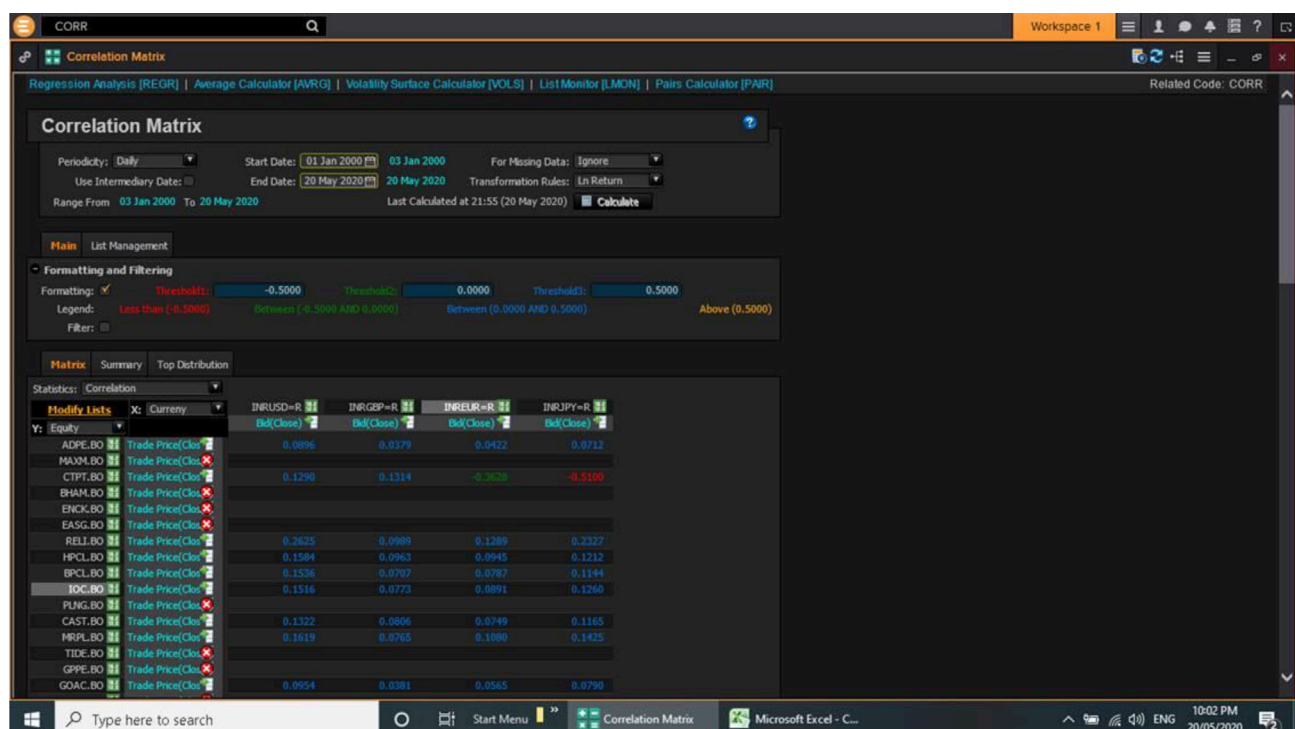
The coronavirus led nationwide lockdown resulted in a sharp fall in consumption of petrol and diesel in April leading to a significant decline in revenues of OMCs.

Rationale for a multi-scale decomposition of the exchange rate and oil prices

Heterogeneous market hypothesis categorizes the traders according to their characteristic time horizons or dealing frequencies. Among the different frequency traders, institutional investors and central banks constitute low frequency traders whereas, speculators and market makers are classified as high frequency traders. These market participants differ in terms of expectations, beliefs, risk profiles, informational sets and many others aspects. The market heterogeneity leads to the presence of different dealing frequencies and thus, different reactions to the same news in the same market. Each market component has its own reaction time to information, related to its time horizon and dealing frequency characteristic.

1. Correlation Matrix

This correlation matrix is the study of the oil industry stocks and the USD/INR exchange rate. As the oil price of futures is in USD. This screen is a supportive screen to show the formulae validations where the value is being populated where data is available from the pricing depository.



¹ Dacorogna et al., 2001

2. Correlation

This correlation matrix analysis shows that 80% of the time the equities market traded price is highly correlated with the futures price in commodity markets. We infer that this is due to OMC firm profits and final dividend pay-outs to shareholders increasing with the amount of crude oil imported. From crude oil via the petroleum refining process converting to value-added finished petroleum products and by-products sold at a premium price in the domestic and international markets.

Regression Analysis [REGR] | Average Calculator [AVRG] | Volatility Surface Calculator [VOLS] | List Monitor [LMON] | Pairs Calculator [PAIR]

Correlation Matrix

Periodicity: **Daily** Start Date: **01 Jan 2000** **03 Jan 2000** For Missing Data: **Ignore**
 Use Intermediary Date: End Date: **20 May 2020** **20 May 2020** Transformation Rules: **Ln Return**
 Range From **03 Jan 2000** To **20 May 2020** Last Calculated at 21:55 (20 May 2020) **Calculate**

Main List Management

Formatting and Filtering
 Formatting: Threshold1: **-0.5000** Threshold2: **0.0000** Threshold3: **0.5000**
 Legend: **Less than (-0.5000)** **Between (-0.5000 AND 0.0000)** **Between (0.0000 AND 0.5000)** **Above (0.5000)**
 Filter:

Matrix **Summary** Top Distribution

Display Matrix Summary Correlation

Min: **-0.5100** CTPT.BO/INRJPY=R
 Max: **0.2625** RELI.BO/INRUSD=R
 Average: **0.0791**
 Median: **0.0952**
 Standard Deviation: **0.1281**

Distribution Bins Interval Size: **25%**

Bins	Counts	Percentages	Ranges
0-25%	2	5.00%	-0.5100 To -0.3169
25-50%	0	0.00%	-0.3169 To -0.1238
50-75%	6	15.00%	-0.1238 To 0.0694
75-100%	32	80.00%	0.0694 To 0.2625

3. R-squared

R-squared (R²) is a statistical measure that represents the proportion of the variance for a dependent variable that's explained by an independent variable or variables in a regression model. The dependent variable here is the oil company's stock price

We infer that this positive correlation is because OMC firm profits and eventual dividend payments increase with net profit after tax. the raw material is the crude oil imported and from crude oil imported to India using the petroleum refining process converting to value added finished petroleum products and by-products selling at a higher price and revenue generation.

Regression Analysis [REGR] | Average Calculator [AVRG] | Volatility Surface Calculator [VOLS] | List Monitor [LMON] | Pairs Calculator [PAIR]

Correlation Matrix

Periodicity: Start Date: For Missing Data:
 Use Intermediary Date: End Date: Transformation Rules:
 Range From To Last Calculated at 21:55 (20 May 2020)

Main List Management

Formatting and Filtering

Formatting: Threshold1: Threshold2: Threshold3:
 Legend: Less than (-0.5000) Between (-0.5000 AND 0.0000) Between (0.0000 AND 0.5000) Above (0.5000)
 Filter:

Matrix **Summary** Top Distribution

Display Matrix Summary

Min: 0.1435 ADPE.BO/INRGBP=R
 Max: 26.0119 CTPT.BO/INRJPY=R
 Average: 2.2667
 Median: 0.9523
 Standard Deviation: 4.4196

Distribution Bins Interval Size:

Bins	Counts	Percentages	Ranges
0-25%	37	92.50%	0.1435 To 6.6106
25-50%	1	2.50%	6.6106 To 13.0777
50-75%	1	2.50%	13.0777 To 19.5448
75-100%	1	2.50%	19.5448 To 26.0119

4. Covariance

Covariance is a measure of the joint variability of two random variables. If the greater values of one variable mainly correspond with the greater values of the other variable, and the same holds for the lesser values, the covariance is positive. Standard deviation and median is also computed

Conclusion: Histogram analysis shows that 38 companies' lies in the 75 -100% bin range; indicating that it is a highly skewed one with majority of the companies in the positively correlated area (at 95% confidence level).

Regression Analysis [REGR] | Average Calculator [AVRG] | Volatility Surface Calculator [VOLS] | List Monitor [LMON] | Pairs Calculator [PAIR]

Correlation Matrix

Periodicity: Start Date: For Missing Data:
 Use Intermediary Date: End Date: Transformation Rules:
 Range From To Last Calculated at 21:55 (20 May 2020)

Main List Management

Formatting and Filtering

Formatting: Threshold1: Threshold2: Threshold3:
 Legend: Less than (-0.5000) Between (-0.5000 AND 0.0000) Between (0.0000 AND 0.5000) Above (0.5000)
 Filter:

Matrix **Summary** Top Distribution

Display Matrix Summary

Min: CTPT.BO/INRJPY=R
 Max: CTPT.BO/INRGBP=R
 Average:
 Median:
 Standard Deviation:

Distribution Bins Interval Size:

Bins	Counts	Percentages	Ranges
0-25%	1	2.50%	-0.000535 To -0.000374
25-50%	1	2.50%	-0.000374 To -0.000213
50-75%	0	0.00%	-0.000213 To -0.000052
75-100%	38	95.00%	-0.000052 To 0.000109

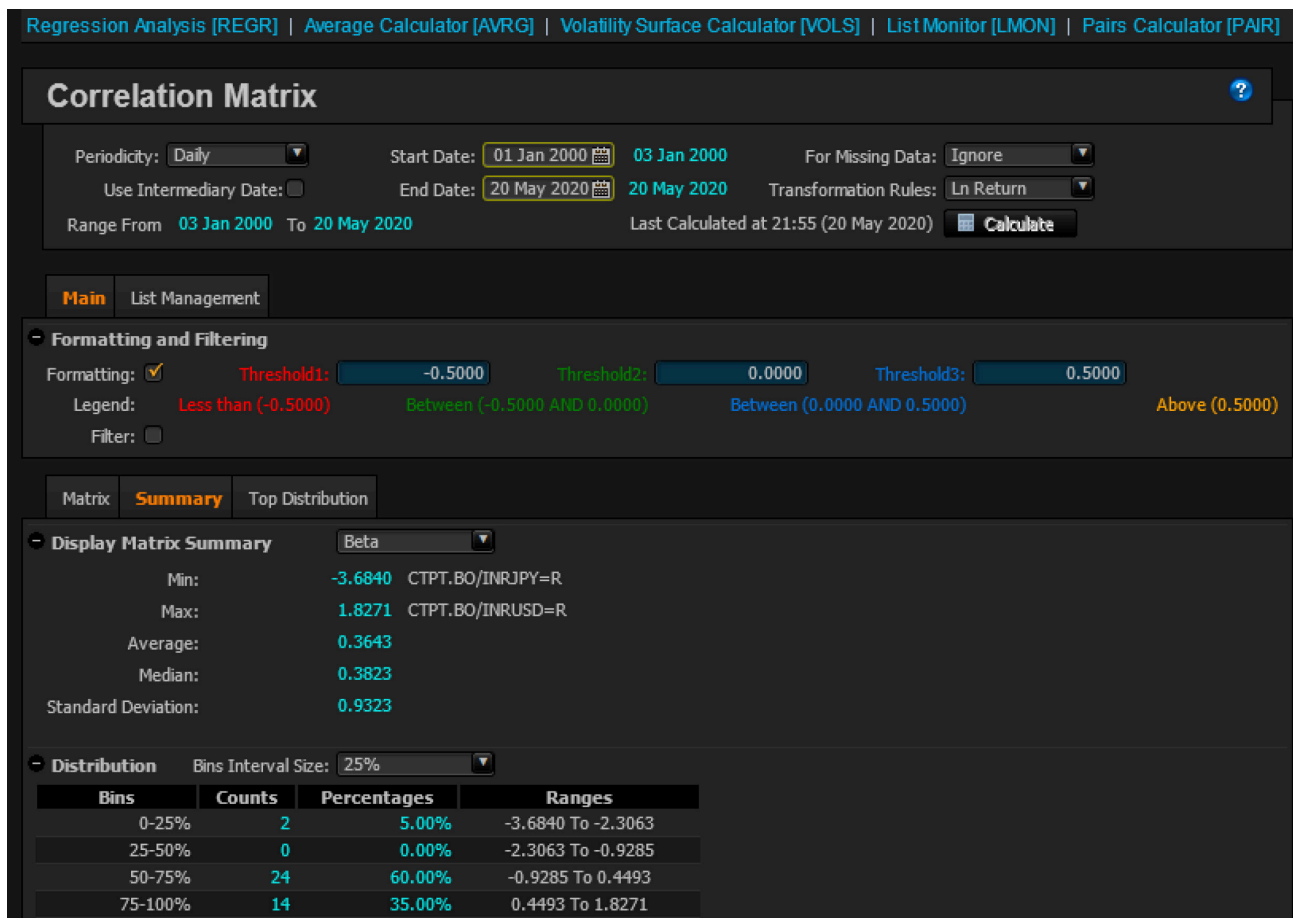
5. Beta

Beta is a numeric value that measures the fluctuations of a stock to changes in the overall stock market.

Beta measures the responsiveness of a stock's price to changes in the overall stock market. On comparison of the benchmark index for e.g. NSE Nifty to a particular stock returns, a pattern develops that shows the stock's openness to the market risk. This helps the investor to decide whether he wants to go for the riskier stock that is highly correlated with the market (beta above 1), or with a less volatile one (beta below 1).

Here the high value of Beta is 1.8271

Conclusion: Histogram analysis shows that 14 companies' lies in the 75 -100% bin range; level. With higher beta value, investors can selectively invest in the equity stock of these companies



6. Alpha

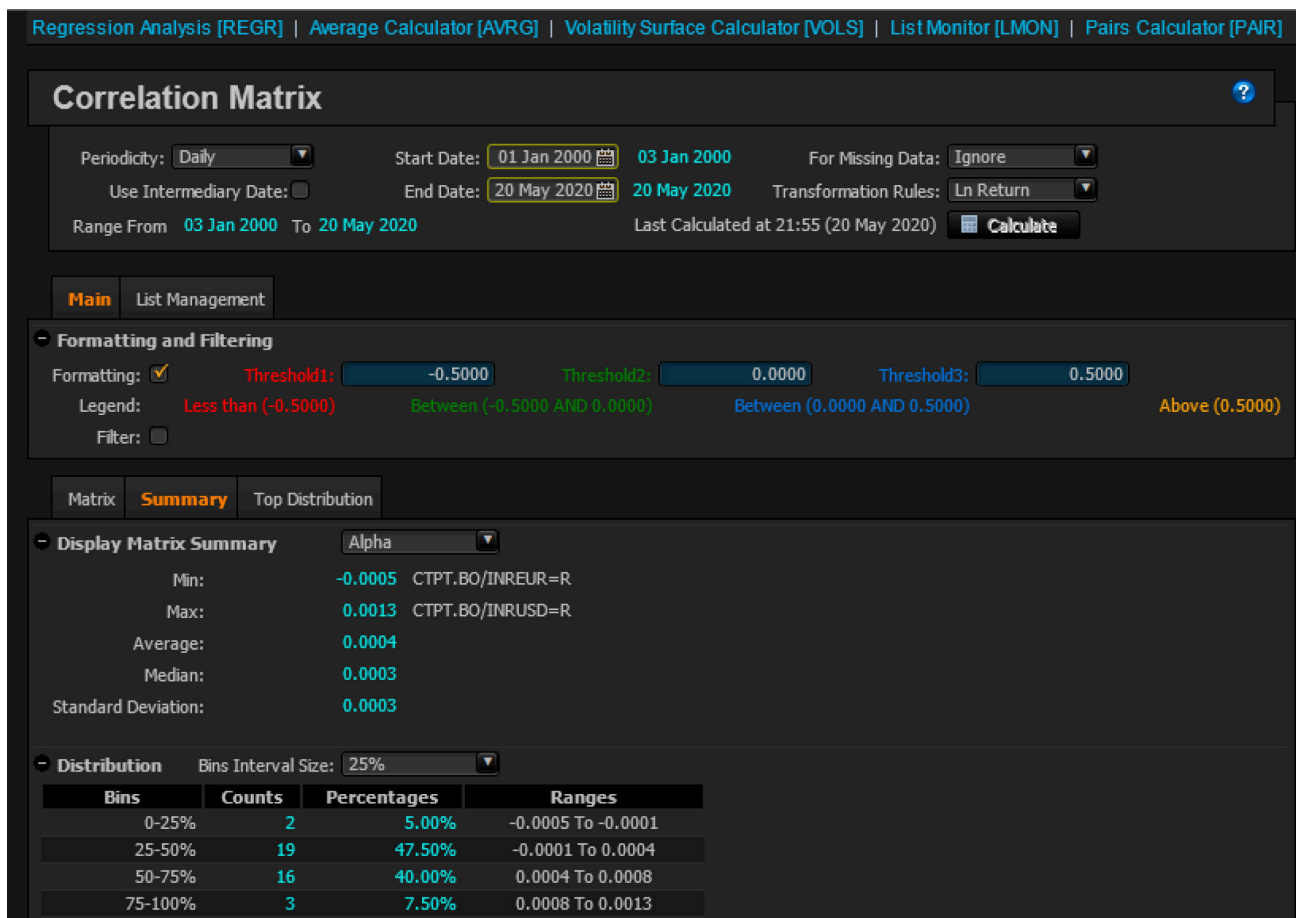
Alpha, one of the most commonly quoted indicators of investment performance, is defined as the excess return on an investment relative to the return on a benchmark index.

Alpha is also a measure of risk. An alpha of zero suggests that an investment has earned a return commensurate with the risk. Alpha of greater than zero means an investment outperformed.

Alpha is one of the five major risk management indicators for mutual funds, stocks, and bonds and, in a sense, tells investors whether an asset has performed better or worse than its beta predicts.

Here Alpha value is greater than zero

Conclusion: Histogram analysis shows that 19 companies' lies in the 25 -50% bin range; higher concentration of 47.5%. With higher alpha value, investors can invest in the equity stock of these companies



7. Top 10 Distribution

The top distribution of the stocks vis-à-vis the oil price commodities implied volatility as follows

Conclusion: Reliance, BPCL and IOC are the major oil company stocks which are highly correlated.

Regression Analysis [REGR] | Average Calculator [AVRG] | Volatility Surface Calculator [VOLS] | List Monitor [LMON] | Pairs Calculator [PAIR]

Correlation Matrix

Periodicity: Start Date: For Missing Data:
Use Intermediary Date: End Date: Transformation Rules:
Range From To Last Calculated at 21:55 (20 May 2020)

Main | List Management

Formatting and Filtering

Formatting: Threshold1: Threshold2: Threshold3:
Legend: Less than (-0.5000) Between (-0.5000 AND 0.0000) Between (0.0000 AND 0.5000) Above (0.5000)
Filter:

Matrix | Summary | **Top Distribution**

Top Distribution

Top: items from:

1	RELI.BO/INRUSD=F	0.2625
2	RELI.BO/INRJPY=R	0.2327
3	MRPL.BO/INRUSD=	0.1619
4	HPCL.BO/INRUSD=I	0.1584
5	BPCL.BO/INRUSD=I	0.1536
6	IOC.BO/INRUSD=R	0.1516
7	MRPL.BO/INRJPY=f	0.1425
8	CAST.BO/INRUSD=	0.1322
9	CTPT.BO/INRGBP=I	0.1314
10	CTPT.BO/INRUSD=I	0.1290

Conclusions

In this paper we investigate linear and non-linear correlation between the real effective rupee exchange returns and oil price returns within time domain framework. And it is established that there exists a positive correlation between the OMC oil marketing company stocks and the oil imports in India which is implied by the INR/USD exchange rate.

The performance of the Indian economy is highly dependent on the consumption of oil. Oil is a major factor of production and when prices are non-sticky, oil price shocks can lead to reduced output, increased inflation, and real exchange rate depreciation. The output losses will depend on the sensitivity of the consumer durables (where oil is a factor of production) to the oil prices. However, for a major economy like India flexible exchange rates produce larger output losses and higher volatility in inflation in the tradable and non-tradable sector vis-à-vis the fixed exchange rates.

The lower exchange rate of rupees to USD is a boon on export income of value added petroleum products exported globally by these OMC companies.

Footnotes

Alpha Vs. Beta: Alpha and beta are two of the key measurements used to evaluate the performance of a stock, a fund, or an investment portfolio.

Alpha measures the amount that the investment has returned in comparison to the market index or other broad benchmark that it is compared against.

Beta measures the volatility of an investment. It is an indication of its relative risk.

References

1. Thomson Reuters for data and statistics
2. The Economic Times and various media reports on oil prices

India's crude oil import bill fell 9% to \$102 billion in 2019-20²

- India's crude oil import bill fell 9% to \$102 billion in 2019-20 though volume remained little changed as prices crashed towards the end of the year. Natural gas import bill shrank nearly 8% to \$9.5 billion as global prices fell, although in volume terms, imports rose 17% to 33.
- 7 billion cubic meters in 2019-20, according to the official data. Imports rose to fill the gap left by a 5.2% decline in domestic output and a similar rise in local gas consumption.
- Imports now make up 52.7% of total gas consumption, up from 47.3% in 2018-19.
- Import dependence in oil has risen to 85% from 83.8% in 2018-19 as domestic output continues to decline despite policy measures to lift production. Crude oil prices have lost nearly two-thirds since the beginning of the year as the coronavirus pandemic has obliterated an estimated 30% of global demand.
- Liquefied natural gas (LNG) prices have crashed to record-lows of under \$2 per mmBtu. Gains from price crash have been slightly offset by currency depreciation for Indian importers. The rupee has depreciated 5.
- 5% against the dollar so far this year to 75.12. In rupee terms, the country's oil import bill shrank 7.
- 8% to Rs 7.2 lakh crore in 2019-20. If the exchange rate shifts by a rupee to a dollar, import bill changes by Rs 2, 792 crore.

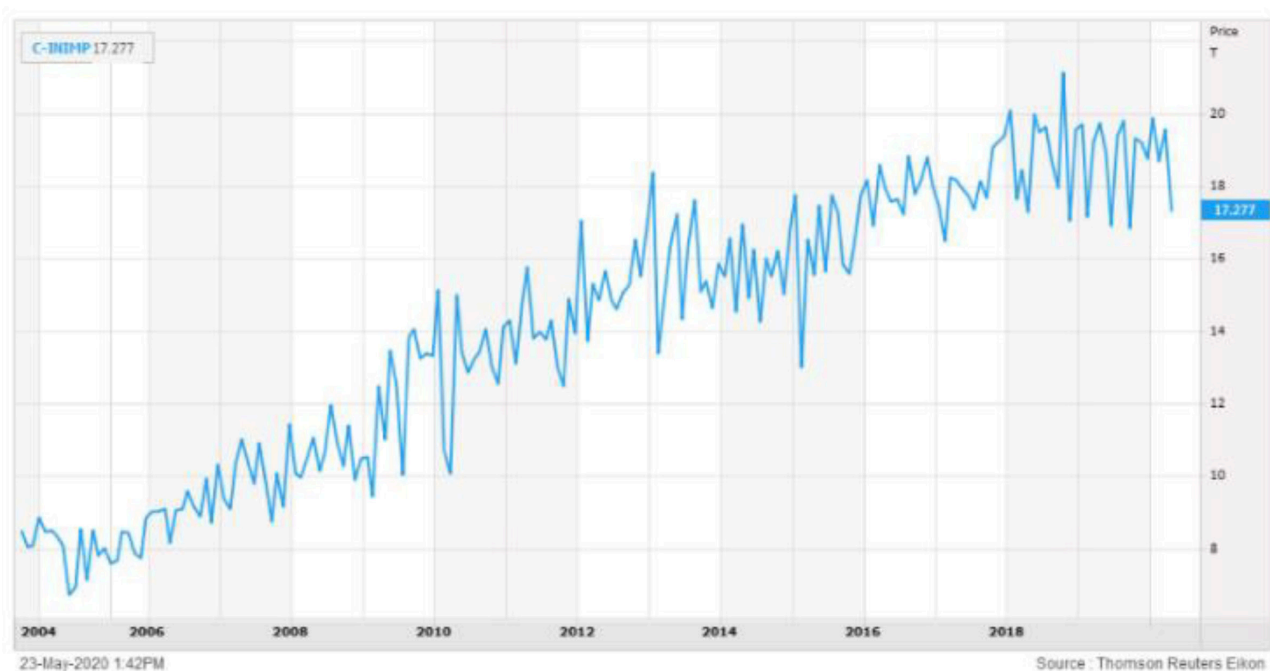
² Source: The Economic Times

- If the crude price falls by a dollar per barrel, India's oil import bill shrinks by Rs 2, 936 crore. The Indian basket crude price averaged \$33.36 per barrel during March 2020 as against \$54.
- 63 per barrel during February 2020 and \$66.74/barrel during March 2019. Import of refined products expanded.
- 5% in volume but only 9.2% in value because of lower prices.
- 7% more in volume but garnered 4% less in value. In 2019-20, imports of refined products were worth \$17.8 billion and exports worth \$36.
- 6 billion. India's crude oil import bill is likely to further shrink in the current fiscal year as domestic demand has sharply fallen in April due to nationwide lockdown. The International Energy Agency has warned that the coronavirus pandemic would cut global energy demand by a record amount in 2020.
- Global energy demand could fall 6% in 2020 and oil consumption is expected to fall more than 9%, as per the IEA.

Tables

Figure 1: C-INIMP Crude Oil Total Imports India

Last: 17.277 Net Change: 2.238, 1000000, TONNE ,IN, Delivery Date : Apr-20 , 22-May-2020



Seasonality Chart



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