# Working Paper 272

# Impact of Transaction Taxes on Commodity Derivatives Trading in India

**Saon Ray**
**Neha Malik**

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## Abstract

Commodity derivatives were introduced in India with a dual purpose of promoting price discovery and enhancing risk management in the commodities market. A transaction tax (of 0.01 per cent) on commodity futures trading was introduced in the Union Budget 2013-14. This study examines the rationale behind such a tax. It also checks for the validity of the proposition that such taxes generate additional revenue. We conduct a 50-day and 120-day event study to assess the impact of CTT imposition on the total volume traded of a few select commodity futures as well as on the overall efficiency of the commodity market. Results for the event study suggest a significant drop in traded volumes of commodity futures such as gold, copper, crude oil and menthe oil.



***JEL Classification:*** *G14, G17, G18, G13, G19, L61.*

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***Author Emails:*** *sray@icrier.res.in*

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**Saon Ray and Neha Malik**

## 1. Introduction

Commodity futures in India were introduced with the dual purpose of promoting price discovery and enhancing risk management in the commodities market. Price discovery is best defined as the co-movement between futures and spot price of the underlying commodity. The main participants in commodity futures market are the hedgers, speculators and arbitrageurs.[1] All of them may take long or short positions in a futures contract. The risk management function of the commodity futures market is mainly applicable to hedgers. Price discovery and risk management are closely linked in that if futures and spot prices move in the same direction, losses in the physical market can be fully offset by profits on the exchange and vice-versa, making hedging effective. It is mainly the speculators who assume the risk of hedgers. The former, however, have been increasingly blamed for distorting the process of price discovery by causing an overshooting of prices in some commodities. Against this backdrop and with the additional objective of mobilizing revenues, a Commodity Transaction Tax (CTT) of 0.01 per cent was imposed on non-agro commodity futures trading[2] in the Union Budget 2013-14. The tax was implemented w.e.f. 1st July, 2013. A similar tax with parallel objectives was imposed on trade in securities (Security Transaction Tax (STT)) in the Indian equity market in 2004. Evidence suggests that this tax has not been able to fully achieve its objectives, specifically with respect to revenue generation. This paper argues that imposition of CTT might not augur well for the Indian commodity market as it may sap liquidity and hamper overall efficiency.

The paper is organized as follows: Section 2 discusses the nature of commodity markets in India. Section 3 highlights the experience of India after the imposition of STT and its implications globally. Section 4 presents an overview of studies examining the Indian commodity futures market. Section 5 examines the implications of the imposition of CTT in India focusing on the likely quantity and price effect and also the effect on speculative activities. Section 6 presents a 50-day and a 120-day event study to test for the impact of CTT implementation on trading volume of commodity futures. Section 7 concludes.

## 2. Evolution of commodity markets in India

Commodity trading in India dates back to the 19th century with cotton being the first to be traded on an exchange. This was followed by other commodities such as oilseeds and raw jute during 1910-1930. There were, however, off and on bans on commodity trading in the latter half of the 20th century.[3]

[1] Any party that does not have a position in the physical market is a speculator.

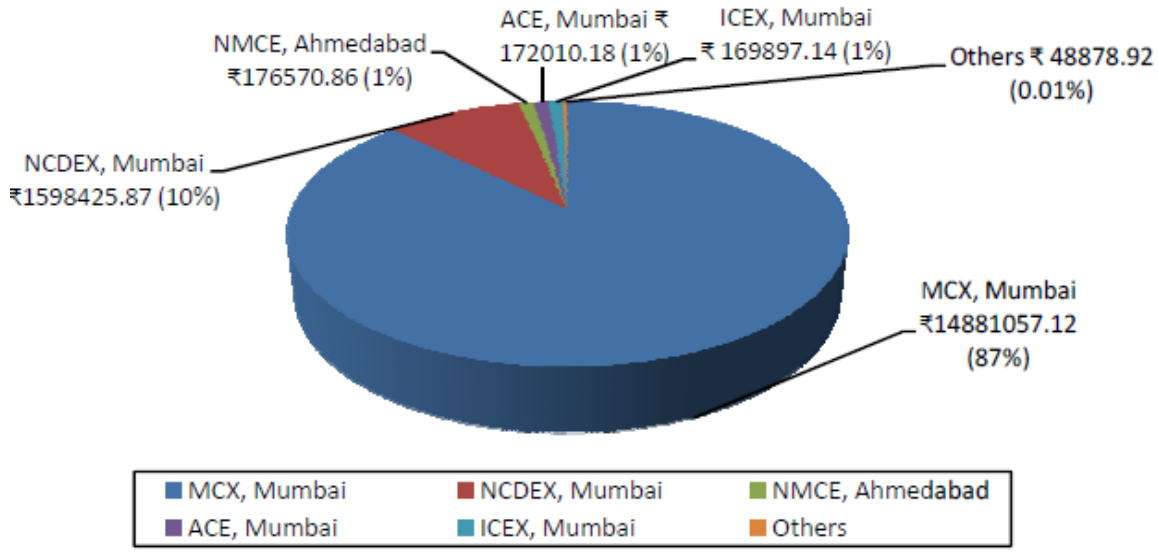
[2] The tax, however, is levied on about 11 processed farm commodities. Some of them are sugar, menthe oil, soya oil and guar gum.

[3] The Expert Committee to Examine the Impact of Futures Trading on Price-rise in Agricultural commodities (2007).

Although trading in some commodities resumed after the 1990s, it was only after the internationalization of Indian agriculture that it was encouraged in a big way. The National Agricultural Policy (2000) recognized the positive role of futures in price discovery. In 2003, a prohibition on futures trading in all commodities was lifted and recognition was granted to three national commodity electronic exchanges, the MCX, NCDEX and NMCE.[4] The only financial product currently traded on commodity exchanges in India is futures. Forward contracts are traded in the Over-the-Counter (OTC) market. There are five national exchanges: the Multi Commodity Exchange (MCX); the National Commodity and Derivatives Exchange (NCDEX); the National Multi Commodity Exchange (NMCE); the Indian Commodity Exchange; and the ACE Derivatives & Commodity Exchange Limited (ACE). Apart from these, there are 16 regional exchanges. The Forwards Market Commission (FMC) is an independent body involved with the regulation of all commodity exchanges. The national exchanges employ advanced technology for trading, and contributed 99.71 per cent of the total value of the commodities traded in 2012-13 (refer to Figure1 below).[5]

Additionally, Table 1 provides a snapshot of the value of trade in commodities from 2004 onwards. It can be seen that value of total trade in commodities has gone up more than 30 times from 2004-05 to 2012-13. Further, the dominance of bullion and other metals as a percentage of value of total trade has increased over the period. Bullion accounted for 72 per cent of the total value of trade (in 2011-12) as against 31 per cent in 2004-05.

**Figure 1: Value in Rs. and percent share of the commodity exchanges to the total value of trade during the year 2012-13**




*Source: Forward Markets Commission, Ministry of Consumer Affairs, Food and Public Distribution, Department of Consumer Affairs, Annual Report 2012-13.*

[4] Forward Markets Commission (2011), Annual Report 2011-12.
[5] Forward Markets Commission, Annual Report 2012-13.

**Table 1: Value of Trade in Commodities in India 2004-13 (Rs. Lakh Crore)**

| Commodity Groups | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2009-10 | 2010-11 | 2011-12 | 2012-13 |
|---|---|---|---|---|---|---|---|---|
| **Bullion and other metals** | 1.8 | 7.79 | 21.29 | 26.24 | 49.66 | 81.82 | 130.79 | 111.2273 |
| **Agriculture** | 3.9 | 11.92 | 13.17 | 9.41 | 12.18 | 14.56 | 21.96 | 21.557 |
| **Energy** | 0.02 | 1.82 | 2.31 | 5 | 15.78 | 23.11 | 28.51 | 37.68409 |
| **Others** | 0 | 0.02 | 0.001 | 0 | 0.03 | 0 | 0 | 1.28E-05 |
| **Total** | **5.72** | **21.55** | **36.77** | **40.65** | **77.65** | **119.49** | **181.26** | **170.4684** |

*Source: For period 2004-05, data has been taken from Sahoo and Kumar (2008) and for period 2008-12, data has been taken from FMC Annual Reports, 2009-10, 2010-11, 2011-12 and 2012-13.*

*Note: Table 1 does not contain data on year 2008-09 as it is not available.*

Bullion includes gold, silver and platinum. The volume of gold and silver trade in 2012-13 was 0.12 and 7.16 lakh tonnes, respectively. The total volume of agricultural commodities has increased over time and totaled 4398.11 lakh tonnes in 2012-13.

By enhancing price discovery, the development of commodity exchanges has benefited mainly farmers who are subject to risks of seasonality. Of late, the FMC has been taking initiatives to better the position of farmers by increasing awareness at the grass roots level, promoting models of aggregation in which cooperatives, NGOs, farmers' associations, etc., will act as investors for a pool of farmers in order to strengthen the link between farmers and the futures market.[6]

It has been argued, however, that with the passage of time, the market has been dominated by speculators who have affected the process of price discovery and caused inflation in some commodities.[7] As a result, futures trading in wheat, rice, tur and urad was banned in 2007.[8] During the period of steep inflation in 2008[9], futures trading in commodities such as chickpea, potato, rubber and soy oil was also banned.[10] Another view is that speculators occupy an important position in commodities market as in their absence, there would be no party to assume the risk of the hedgers. Hence all three market participants, hedgers, speculators and arbitrageurs are essential required for commodity trading. [11]

[6] Forward Markets Commission, Annual Report 2010-11.

[7] Speculators sometimes base their expectations on the behaviour of other speculators. This is normally referred to as 'herding behaviour'. This behaviour might or might not be based on market fundamentals. Since price discovery also involves complete transmission of information from futures price into the future spot price, if the expectations formed do not reflect market fundamentals then the spot price will not be determined by the mechanics of market fundamentals. However, the Abhijit Sen Committee (2008) Report of the Expert Committee to Study the Impact of Futures Trading on Agricultural Commodity Prices finds no conclusive evidence of a link between futures trading and inflation.

[8] The Expert Committee to Examine the Impact of Futures Trading on Price-rise in Agricultural commodities (2007).

[9] "Wholesale prices rose 7.57 per cent in the week ending 19 April, 2008 year-on-year.", Srinivasan, S. (2008).

[10] Srinivasan (2008).

[11] NSE report.

## 3. STT and its implications (Global and Indian experience)

There are different types of Financial Transaction Taxes (FTTs) with STT and CTT being two of them. STT is the tax on transaction of equities as well as their derivatives and accounts for a bulk of transaction cost (at the Indian stock exchanges) after deducting the brokerage fee. Keynes was the first one to propagate such a tax.[12] Over the years, STT has been implemented by countries across the globe such as the UK, Sweden, Japan, etc., with a view to propping up revenue collection. STT was introduced in the Indian financial market in 2004. Since then, it has been subject to various revisions and as of 2013 stands at 0.1 per cent for both buyers and sellers of equity shares and 0.01 per cent for sellers of equity futures.[13]

STT was introduced as a replacement of the long-term capital gains tax (CGT) with the objective of generating additional revenue. However, empirical research shows mixed results regarding the repercussions of STT on the efficiency of the securities market globally. While STT has been successful in raising substantial revenues in some countries, in others it has performed dismally.[14] Revenue from STT as a percent of GDP was 0.22 per cent for the UK and 0.10 per cent for India, in 2008.[15, 16] In most cases, STT has been found to have an adverse impact on the functioning of the securities markets by distorting asset prices, inducing migration of trade volumes, etc.

The impact of STT on asset prices has been a subject of debate. According to its proponents, STT raises asset prices by reducing speculative activity. A reduction in such activities reduces the amount of risk premium accounted for in the calculation of discount rate in the discounted cash flow.[17] Hence, it raises the present value of the asset. The other view is that since STT increases transaction costs which is included in the rate of return for investors, it causes an increase in the latter too, leading to a drop in the price of the taxed asset hence, raising the cost of capital.[18]According to the results in Matheson (2011), the percentage reduction in security value due to an STT of 50 basis points was 24.9 per cent for securities with a holding period of 0.5 years, and 7.5 per cent for securities with a holding period of 2 years.[19]

The impact of STT on the volume of securities traded also remains contentious. The revenue generating potential of STT has been weak in most cases, as pointed out earlier, mainly

[12] Keynes (1936) was one of the earliest proponents of the STT. He strongly condemned speculation and according to him market was not run on fundamentals but by "what average opinion believes average opinion" of the expected price to be. See also Matheson, T. (2011).

[13] STT on equity futures was revised downward from 0.017 per cent to 0.01 per cent in the Union Budget 2013-14.

[14] "Revenue experience of the STT has varied significantly across countries, some being able to raise between 0.2-0.7% of GDP, while others as much as 1-2% of GDP", Matheson, T. (2011)

[15] Matheson, T. (2011).

[16] The point on migration to other untaxed asset classes or international exchanges suggests that for taxation to be successful, it must be approached from a general equilibrium perspective.

[17] Culp (2010) and Baltagi, et al. (2006), op.cit., p. 393.

[18] ibid

[19] Table 4, Matheson (2011).

because STT led to a reduction in the volume traded. In some cases, this happened because of a migration of the volume to other untaxed and lesser taxed assets. For instance, for countries which introduced STT on equities only, the volume migrated to other untaxed assets such as bonds which were devoid of any taxation. Parallel to this, volume also migrated to other untaxed/lesser taxed regions globally. The Swedish case is a classic example of this. Sweden's government introduced STT on equities, other debt and non-debt securities, including government and other securities during the 1980s. The result was a subsequent migration of the volume to the London Stock Exchange.[20] The impact of a transaction tax on the quantity traded or migration of the taxed asset class depends to a large extent on the elasticity of the taxed asset class. For instance, quantity traded of and migration of the taxed equity asset class is a function of its elasticity which is further determined by the substitutes available.[21] The greater the number of substitutes in the form of other similar untaxed assets, the higher the elasticity. A drop in the volume traded, in turn, impacts liquidity in the market. Less liquidity broadens the bid-ask spread, reducing the trading by market participants which further makes trading costlier. Hence, it becomes a vicious circle. Although security instruments are more uniform in nature, there are variations with respect to the overall risk attached, payoffs, maturity period, etc. More importantly, the impact of STT on the overall functioning of the financial market varies according to the market microstructure.[22]

Studies on the impact of STT on speculative activity and volatility have been inconclusive.[23] It has been pointed out that the greater the need for immediacy for selling/buying in a market, the more prominent the role of a market maker or a speculator. Speculators not only assume the 'hedge-load' but also act as providers of liquidity. An increase in transaction costs via an increase in STT results in a withdrawal of such liquidity providers.[24] As far as STT's effect on volatility is concerned, it has been found that although it reduces the velocity of asset prices, it has almost no impact on variability of prices, and volatility is usually defined by the latter.[25] Some studies have found an increase in volatility as a result of the tax. For instance, Baltagi, et al. (2006) examined the impact of a stamp tax rate increase from 0.3 per cent to 0.5 per cent on two stock markets in China in 1997 and found a significant increase in volatility after the increase in the tax rate.[26]

The available evidence for India since imposition of STT corroborates international experience. For instance, the FII in Nifty futures traded on SGX outpaced that on NSE in

[20] In the case of Sweden, Umlauf (1993) reports that "when the STT was increased to 2% in 1986, 60% of the trading volume of the 11 most actively traded Swedish shares classes migrated to London, where there was no transaction tax. This was equal to 30% of the total trading volume."

[21] When the asset class (say equity shares) is taxed and their derivatives are not, the latter also serves as a substitute for the former.

[22] Market microstructure is a field of study that is devoted to theoretical, empirical, and experimental research on the economics of security markets. It includes the role of information in the price discovery process, the definition, measurement and control of liquidity, and transaction costs and their implication for efficiency, welfare, and regulation of alternate trading mechanisms and market structures.

[23] Wang and Yau(2012).

[24] Grossman and Miller (1988).

[25] "According to Merton Miller, "volatility refers to the variability in asset prices and not the speed or the velocity at which prices change".

[26] Culp (2010) and Baltagi et al. (2006).

2012 and this may be attributed mainly to tax arbitrage. There is also some evidence available for migration of volumes from the equity cash segment to substitutable domestic instruments such as options (which is the lower taxed segment). For example, turnover[27] in NSE stock as well as index options (both call and put) has increased at a rate higher than the turnover in the NSE cash segment. The total turnover for NSE stock options has increased from approximately Rs 1.6 lakh crore in 2004-05 to over Rs. 10 lakh crore in 2010-11, that is more than six times. The corresponding figure for NSE index options has risen more than 150 times from approximately Rs 1.2 lakh crore in 2004-05 to over Rs. 183 lakh crore in 2010-11. The turnover for the NSE cash segment stood at around Rs 35.7 lakh crore in 2010-11 which is just triple the turnover of Rs 11 lakh crore in 2004-05. The migration however cannot be attributed to STT alone.

The turnover ratio (Turnover/Market Capitalization) is used by some to indicate the speculative nature of the market: the lower the turnover ratio, the lower the speculation in the market. The turnover ratio for both, the BSE and NSE has fallen from its level in 2004-05 but much of this can be attributed to the rise in the denominator, market capitalization. For example, the turnover ratio in NSE declined from 71.9 in 2004-05 to 53.4 in 2010-11, that is approximately 26 percent, while NSE market capitalization rose by more than 300 in the same period. NSE market capitalization increased from around Rs. 15.8 lakh crore in 2004-05 to over Rs. 67 lakh crore in 2010-11. Hence, the impact of STT on speculation in case of the Indian security market is ambiguous.

Revenue realization from STT in India represents a miniscule percentage of total tax revenue. Absence of migration would certainly lead to higher revenues but plugging all arbitrage opportunities for market participants is an onerous regulatory task. In addition, the impact on speculation and hence, price volatility cannot be ascertained definitely.

Hence, looking at the case of STT and also its effect on overall revenue generation as well on speculative activities, a similar tax for commodity markets may have far wider consequences given the complexities of Indian commodity markets as will be discussed further.

## 4. Literature Review of the Indian commodity market

This section presents an overview of the literature on Indian commodity markets. Literature on international commodity markets has not been considered because they are much more sophisticated than the Indian commodity markets. For instance, most international commodity markets permit commodity index trading while the Indian commodity market involves the use of only one kind of commodity derivative, commodity futures. Most studies in India have focused on the relationship between futures and spot prices of commodities, and determined the direction of causality. Others have tested for the link between Indian commodity markets with international commodity markets as well as with the Indian stock market. Some studies have also analyzed the impact of futures prices on production and

[27] Turnover in Notional Value.

inventory decisions and the effect of transaction cost on the overall efficiency of the commodity market. This section is accordingly divided into three sub-sections: price discovery, other linkages, and cost of trading.

### *4.1 Price discovery*

Sehgal et al. (2013) found that both futures and spot prices move together towards the long run equilibrium. They considered a sample of the twelve most actively traded commodities on the MCX and four MCX indices, from November 2003-March 2011. The commodities were: chana, guar seed, soybean, kapas, potato Agra, gold, silver, zinc, lead, copper, natural gas and crude oil. The four indices included the Comdex and Agri, Metal, and Energy Index. Stationarity tests (both Augmented Dickey Fuller (ADF) and Philips Perron (PP)), for the price series for all commodities as well as the indices suggested that both futures and spot prices are integrated to order one or I (1). Subsequently applied co-integration test results indicated the presence of one co-integration relationship for eight commodities and three indices. They also developed a Vector Error Correction Model (VECM) to determine the relationship between futures and spot price for the eight commodities and the three indices. Results of the VECM indicated a greater magnitude of the error correction term in spot markets for seven commodities and all three indices, suggesting a greater adjustment by spot price to arrive at the equilibrium and a lead by futures prices over spot prices. VEC Granger causality tests suggested a single lead relationship from futures to spot in the Comdex Index, and bi-directional relationships between futures and spot prices for most commodities in the sample, at 5 per cent level.

Srinivasan and Ibrahim (2012) found evidence of price discovery in spot and futures markets of gold traded at NCDEX. They collected daily data on spot and futures prices of gold traded on NCDEX from April 2009 to May 2011. Both price series were found to be integrated in the order I(1), hence, qualifying them for a test on co-integration. Johansen co-integration test results revealed one co-integrating vector between spot and futures prices at the five percent level. They also conducted a VECM analysis whose results suggested that spot prices lead futures prices for the gold market in India

Bose (2008) considered a sample of multi-commodity and agricultural commodities' spot and futures indices[28] from MCX and NCDEX and global indices maintained by Dow Jones and Reuters, to check for correlation, co-integration as well as causality between futures and spot prices for the sample period June 2005-September 2007. The results suggested a high (around 98 percent) contemporaneous correlation between spot and futures prices for the multi commodity indices in the MCX and a lower (around 90 per cent) for agricultural indices in NCDEX Agri. Correlation, however, weakens with the introduction of a time lag. Though lagged correlation was lower than that of contemporaneous correlation, it still remained high, suggesting that futures prices a week or a month ahead are reliable estimators of future spot prices, especially for agricultural indices. Tests for co-integration indicated that daily futures

[28] These are notional indices according to the author.

and spot prices of multi commodity indices were cointegrated while, those of agricultural commodity indices of both MCX and NCDEX were not.[29] In case of agricultural commodities, however, futures prices a week, fortnight and also a month ahead (only for MCX Agri) were cointegrated with current spot prices in case of both MCX Agri[30] and NCDEX Agri. For causality between futures and spot prices, the daily prices for multi commodity indices reflected a bi-directional lead-lag relationship while for agricultural indices futures prices, when included with a lag of a week or a fortnight, led spot prices and not the other way round.

Sahoo and Kumar (2008) conducted a causality analysis between futures and spot prices of five commodities, gold, copper, crude, refined soya oil and chana, traded on MCX. They found that futures price granger leads spot price for all five commodities, at the 1 per cent level. Sen and Paul (2010) also tested for causality between futures and spot prices of chana, soya, potato and wheat. They found that futures prices granger cause spot prices for all four commodities.

Lokare (2007) tested for efficiency of a set of agricultural and other commodities. For agricultural commodities, he found a strong case of cointegration for pepper, sacking, potato, castorseed, mustard and gur, for specific months. Two cointegrating relationships were found to exist for agricultural commodities such as rice, wheat, sugar (grade-S), cotton and sesame seed and other commodities such as gold, copper, lead, tin and brent crude oil, while one such relationship was found for rubber, sesame oil, aluminium, zinc, silver, and furnace oil.

### *4.2 Other linkages*

Kumar and Pandey (2011) checked for any lead-lag relationship between Indian commodity markets and their global counterparts for return spillover. Commodities considered in this exercise were soybean, corn, aluminium, copper, zinc, gold, silver, crude oil and natural gas. Daily prices of near month futures contracts for agricultural commodities were extracted from the NCDEX and those of non-agricultural commodities were taken from the MCX. As regards international exchanges, New York Mercantile Exchange (NYMEX) was considered for gold, silver, brent crude oil and natural gas futures contracts, and London Metal Exchange (LME) for aluminium, copper and zinc contracts. [31] For soybean and corn futures contracts, Chicago Board of Trade (CBOT) was chosen as the counterpart market. Johansen cointegration results suggested that all commodities in question were cointegrated with their international counterparts at the 5 percent level. This held true for even the two agricultural commodities (soybean and corn) in question even though they are otherwise less internationally traded than other commodity groups. VECM results revealed significant error correction terms for Indian futures prices for all commodities (at the 5 percent level) except copper, zinc and natural gas. For world futures prices, the error correction term was found to be significant only for zinc and natural gas. Granger causality tests indicated a lead by world

[29] The author attributes this mainly to the lag with which agricultural spot prices are disseminated.
[30] Bose (2008).
[31]The authors have converted data for all commodities into USD/Unit.

futures prices over Indian futures prices for soybean, corn, gold, and silver. Bidirectional causality is found in case of aluminium. For the remainder of the commodities, Indian futures returns were found to lead world futures prices at the 1 per cent level.

Dasgupta (2004) constructed an expected utility model to establish a linkage between production and hedging decisions of a monopolistically competitive producer. The important assumptions underlying the model were storability of commodities, possibility of production shocks and cost of carry of inventory. He found that since a monopolistically competitive producer always wants to operate on the elastic part of the downward sloping demand curve, there is a disincentive to sell at higher prices in the futures market owing to a consequent fall in revenue. Hence, the futures price does not distort spot price. He also found that the producer accounts for production shocks in the production decision which is in response to the futures price. Another finding was that the futures price responsiveness of inventory is directly proportional to the futures price and inversely related to its marginal production cost as well as carrying cost. These results rejected the possibility of hoarding.

Sen and Paul (2010) tried to find a link between commodity futures and futures in the stock market. They regressed spot prices of commodities such as wheat, rice, potato, urad and soyabean on total stock exchange (both the National and Bombay stock exchange) turnover. Regressions were carried out for two different time periods: May 2008-May 2009 and May 2003-May 2009. For the former time period, a negative relation between the variables for urad, wheat and rice was found. A positive relationship existed between total turnover and spot prices of all commodities for the latter time period. This was attributed to the contagion effect of the financial market boom in that time period.

### *4.3 Cost of trading*

Sahoo and Kumar (2008) developed a simultaneous equation model to check for the impact of an increase in transaction cost on the trading volume and price volatility of the futures of five commodities, gold, copper, crude, refined soya oil and chana, traded on the MCX, for the period May 2006-April 2008. The variable bid-ask spread was chosen as a proxy for transaction cost. Their findings indicated a positive relationship between the bid-ask spread and volatility, as well as between trading volume and volatility, and a negative relation between the bid-ask spread and trading volume for all five commodities.

## 5. Imposition of CTT (Objectives vs. real impact)

While STT has been introduced (and removed) across the globe in various countries, CTT, has only been implemented in Taiwan.[32] The intention of imposing CTT as in the case of the STT is twofold: to mobilize revenue and to regulate the activities of speculators. As pointed out in Section two, speculators in commodity markets are believed to be causing inflation in

[32] Brazil also imposed a 2% tax on all asset classes traded in foreign currency in 2010. The tax, however, was rolled back in December 2011.

certain commodities and hindering the process of price discovery. The question is whether implementation of CTT will help attain the stated objectives. What needs further analysis is whether or not it is at all desirable to drive away speculators from the futures market.

As to the objective of realization of additional revenues, there is a possibility that the actual revenue may fall short of its estimates. This could happen if there is a significant fall in the volume of trade. According to existing literature,[33] CTT may cause a considerable drop in the volume traded. This could happen as the increase in transaction costs may discourage market participants from trading, and hence, force them to withdraw. For instance, it may lead to an increase in losses (if any) for hedgers.[34] For speculators also, trading may become an unattractive proposition since CTT will further the losses in case of a loss on their futures position while profits will be reduced by the amount of tax. Withdrawal of market participants may cause a dip in liquidity levels and consequently higher costs, which may feed back into further withdrawal.

Another factor that could lead to a fall in traded volume is migration to untaxed/lesser taxed substitutes of commodity futures. Apart from migration towards other substitutable global untaxed products, CTT may trigger export of volumes to illegal platforms (*dabba* trading) in India.[35] This will have implications for revenues and also the overall efficiency of the otherwise nascent Indian commodity markets. Actual revenue might therefore, fall short of its estimated potential if the volume of trade declines substantially after CTT is introduced. There is thus, a need for a more holistic framework in order to understand the wider implications of such a tax.

CTT may be able to achieve the second objective of restricting speculation by causing a considerable rise in the transaction costs followed by a likely dip in volumes. Even if CTT is able to correct speculation in the commodity market, it may simultaneously also spur migration of speculative volumes to other financial products with a lower transaction cost. It is, however, argued that speculators, may be desirable because their absence will mean that there is essentially no party willing to assume the risk of the hedgers. Speculation can be price-destabilizing sometimes but not all the time and not for all commodities.

Classical theory suggests that speculation can, perhaps, contribute to a fraction of the movement in prices but cannot, solely, determine the direction of the movement.[36] Whether speculation in futures is price-stabilizing or not is determined by the elasticity of expectations

[33] Pavaskar (2004).

[34] For example: A manufacturer who is a hedger buys a long position in copper futures contracts in March 2013.The expiration of the contract is due in October 2013. Copper is used a raw material in his final product. Futures price of copper in March 2013 is Rs. 500 per kg and each contract is for 5 kgs of copper. The manufacturer expects copper prices to rise in the near future and buys 500 such contracts. Due to global commodity shocks, copper prices dip considerably to Rs. 480 per kg in July 2013 and the manufacturer decides to close his position by selling the futures contracts at the current rate. Over and above the loss of (20*2500) Rs. 50000, the manufacturer will also have to incur the amount of CTT (Rs. 120) while selling futures contracts to offset his position.

[35] Pavaskar and Ghosh (2008)

[36] Kaldor, N. (1939).

(that is, a quantitative change in the expected price of a commodity in response to a change in its current price) and also the elasticity of speculative stocks of the underlying commodity.[37] Most of the time, a speculator forms expectations based on his/her perception of how other speculators would behave or react to information.[38] The elasticity of speculative stocks (which depends on a host of variables)[39], will vary across different classes of commodity. Since an exchange deals with a diversified set of commodities, it is difficult to gauge whether speculation results in overall price stabilization. So, in order to determine the price stabilizing effect of speculation, it is important to arrive at least at an approximate figure for elasticity of speculative stocks for a certain set of commodities or commodity groups (also sub-groups) traded on an exchange such as metals, energy and agriculture. Given that there are several grades of a particular commodity, this is an arduous exercise but needs to be undertaken nonetheless, in order to arrive at a firm conclusion.[40] As regards elasticity of expectations, it is not possible to arrive at a definite figure as it is a function of the price change on a particular day or even an hour and also of the proximity of the future period for which the expectation is formed.[41] An increase in transaction cost (by introducing CTT) may lead to a rise in the risk premium of speculators. This may have a spillover effect on price expectations and hence, equilibrium prices which may not, actually, reflect the true market fundamentals. This is, however, an empirical question and may serve as the subject of a future study.

## 6. Event Study

We conduct two event studies, one of which is for the 50 day period before and after CTT implementation on July 1, 2013 to test for the impact of CTT on trading volume and open interest. The other study is for 120 day period before and after CTT imposition.

### *6.1 50 day event study*

This section provides a brief account of the movement of prices, trading volume and open interest prior to and after (50 days) imposition of CTT for four commodity futures traded on MCX, that is, gold (precious metal), crude oil (energy), copper (base metal) and menthe oil (agricultural). Cardamom, which is a primary agro commodity and not subject to CTT, has also been taken into account in this analysis. Gold, copper and crude oil have been chosen as they are the three most heavily traded commodities (after Silver) on MCX in terms of value. Since the aim was to include all possible commodity groups, menthe oil and cardamom were selected to represent agricultural commodities.

The period considered for the present analysis is May 01, 2013 to August 29/30, 2013. As mentioned earlier, CTT was imposed on July 1, 2013. For comparison, a 50-day period prior

[37] Kaldor, N. (1939).
[38] Kaldor, N. (1939).
[39] One of the many determinants for calculating this elasticity is marginal cost of carrying which is different for different set of commodities. Kaldor (1939).
[40] One view is that even in the absence of futures markets, prices would go up anyway owing to the presence of elements like hoarders etc., see Sahoo and Kumar (2008).
[41] Kaldor (1939)

to and post the imposition the tax has been considered in the event study. The period before and after CTT was implemented is referred to as the pre and post CTT periods in the text that follows. An analysis of the level of liquidity for three commodity futures, copper, gold and crude oil, was also conducted by comparing the impact cost before and after the imposition of CTT.

It needs to be mentioned here that although the trends in the three variables, volume, open interest, and prices, have been analyzed against the backdrop of CTT they are not entirely attributable to the tax. This is because there were other factors at work that determined the movement in these variables after CTT was imposed (for e.g. global and domestic macroeconomic fundamentals, NSEL crisis, investor' sentiments, subsequent restrictions on import of gold etc.). In theory, movements in prices and open interest indicate the strength of the market.

### *6.1.1 Volume and Open Interest*

Figures 1-3 (in the annexure) show movements in trading volume, open interest as well as spot and futures prices from May 1, 2013 to Aug 29, 2013 for the four commodities subjected to CTT. Tables 2 and 3 show a comparison of the mean volume and open interest of these commodities before and after the imposition of CTT: a t-test was applied to see if the difference in mean values of these variables was significant (at five percent level) or not.

**Table 2: Average Daily Open Interest pre and post CTT**

| | **Prior** | **Post** | **t-statistic** |
|---|---|---|---|
| **Gold** | 16804.53 | 15897.49 | 2.26* |
| **Crude Oil** | 54862.86 | 58223.41 | -0.99 |
| **Copper** | 27644.14 | 32360.33 | -5.71* |
| **Menthe Oil** | 4051.02 | 6768.96 | -14.57* |
| **Cardamom** | 5709.88 | 6193.28 | -3.05* |

*Source: Author's calculation*
*Note: * denotes significance at 5 per cent level*

**Table 3: Average Daily Volume pre and post CTT**

| | **Prior** | **Post** | **t-statistic** |
|---|---|---|---|
| **Gold** | 44819.86 | 25646.27 | 5.02* |
| **Crude Oil** | 200448.18 | 115253.47 | 5.56* |
| **Copper** | 102890.86 | 55015.94 | 5.73* |
| **Menthe oil** | 6128.78 | 5083.20 | 2.89* |
| **Cardamom** | 6540.12 | 6364.50 | 0.34 |

*Source: Author's calculation*
*Note: * denotes significance at all levels*
Given below is a commodity-wise analysis:

#### *6.1.1.1 Gold*

As is apparent from Figure A1a), the volume of gold futures fell prominently in the period following CTT imposition. It can also be seen, however, that the volume had already started falling in the latter half of the period before CTT imposition. This is confirmed by the t-test conducted in Table 3. There is also a fall in open interest of gold futures contracts [Figure A 2 a)] in the latter half of the post-CTT period though it is not as prominent as the drop in volume. A comparison of average daily open interest of gold futures before and after CTT implementation (Table 2) suggests a significant fall in the post CTT period. Futures prices of gold have been more or less constant for the entire period, rising sharply in the last quarter of the post CTT period. More importantly, future and spot prices moved in tandem for the entire period [Figure A3 a)]. According to theory, rising prices combined with a falling volume and open interest point towards a weakening market and are usually precursors of a bearish trend.

#### *6.1.1.2 Crude Oil*

Volume for crude oil futures dropped sharply in the post CTT period as shown in Figure A 1b). A significant fall in the average daily volume of crude oil futures is confirmed by the t-test results in Table 3. Open interest for crude oil futures which rose continuously in the pre-CTT period also witnessed a steep decline in the post CTT period. The mean daily open interest was, however, higher in the post CTT period as compared to the pre-CTT period; t-test results suggest a non-significant rise in average daily open interest of crude oil futures post-CTT. Futures prices were on the rise for the whole period and there is a large overlap with spot prices in the given period. Rising prices, falling volume coupled with falling open interest (even if average daily open interest rose in the post CTT period, it was not significant), in theory, indicate a weakening market as in the case of gold.

#### *6.1.1.3 Copper*

For copper futures, daily trading volume and open interest moved in opposite directions after CTT came into effect [Figures A 1c) and A 2c)]. There was a significant drop in average daily volume accompanied by a significant rise in average daily open interest for copper futures in the post CTT period. It needs to be mentioned that the daily trading volume was nearly constant in the pre CTT period. Futures prices were constant for a large part of the period under consideration barring the last quarter of the period post CTT. In this case also, both spot and futures prices moved together very closely and almost coincided during the given period as shown in Figure A3 c). Theoretically, the copper futures market seems to indicate a bullish trend due to rising open interest and rising prices. Since this is also accompanied by falling volumes the market may be vulnerable to a sharp correction.

#### *6.1.1.4 Menthe Oil*

The daily trading volume for menthe oil futures dipped for a large part of the post-CTT period before rising towards the end. The fall in average daily volume post CTT was also

significant (Table 3). Open interest for menthe oil future contracts rose over nearly the entire period. The rate of increase of the open interest, was, higher in the post CTT period. The t-test results also confirmed a significant increase in the average daily open interest in the post CTT period (Table 2). Daily futures prices of menthe oil remained nearly constant for the entire period, dropping marginally in the post CTT period. In theory, falling prices accompanied by rising open interest are suggestive of a bearish trend. Falling volume at the same time indicates vulnerability of the market to a sharp correction. The case of menthe oil stands out distinctly from the other three commodities with respect to the relationship between spot and futures prices. Spot prices for menthe oil lie above its futures prices for the whole period pointing towards a case of backwardation in the menthe oil market.

The case of cardamom also needs discussion. Cardamom, as pointed out previously, is not subject to CTT. Although the mean daily volume declined for cardamom futures in the post CTT period, the fall was not significant (Table 3). The rise in average daily open interest for cardamom futures in the post CTT period was significant. It needs to be emphasized that average daily volumes in the pre CTT period were similar for both menthe oil and cardamom futures (Table 3) and that both are agricultural commodities. In the post CTT period, however, there was a significant drop in the average daily volume of menthe oil futures only. Menthe oil was subject to CTT, while cardamom was not.

Figure A3 shows that for gold, copper and crude oil, futures and spot prices coincide. This is an indication of price discovery in the market for these commodities. Table A1 (in the annexure) provides an overview of the direction of causality of futures and spot prices for the four commodities in question. It can be seen that futures price granger caused spot prices in both, the pre- and post- CTT periods for crude oil and copper. In the case of gold, while there was a bi-directional relationship pre CTT, futures prices were found to granger lead spot prices in the period post CTT. The same result applied to menthe oil post CTT while the results were not significant in the pre CTT period.

### *6.1.2 Liquidity Analysis*

Impact cost is the most reliable measure of liquidity in the stock/commodity market. An increase in the impact cost is reflective of a fall in liquidity levels. Hence, in order to gauge the impact of CTT on liquidity as such, we calculate the impact cost for three commodities, gold, copper and crude oil before and after imposition of CTT. It cannot, however, be said that CTT is the sole determinant of the change in the impact cost.

For the purpose of the calculation of the impact cost, intra-day data and order books of trading gold, crude oil and copper were used for two randomly selected dates – one before CTT (10$^{th}$ June, 2013) was introduced, and one after (10$^{th}$ July 2013). These dates were chosen to control for extraneous variables and their possible impact on volume and volatility. These dates were normal weekdays, without any major announcement or arrival of significant news from India or abroad that could impact the commodity market. A portfolio size of Rs. 1 crore was assumed for all three commodities. Seven data points were taken to represent

different points of time spanning the entire trading day at 2-hour intervals – the first point being 10 AM, i.e. 30 minutes after trading starts, and the last point being 10.30 PM, i.e. 60 minutes before trading ends. Order books for the near month active futures contract for the respective commodities were taken during each of the seven time-points for the two days under consideration.

For each of the time points, the following computations have been performed. With a pre-determined portfolio size and an approximate commodity contract value, the minimum number of contracts required to be bought/sold to attain the portfolio size was calculated. This is followed by a computation of the average weighted price on each of the 'bid' and 'ask' sides based on the size of the order book. Deviation (in percentage) of the average weighted bid price and ask price from the average of best bid and best ask price was calculated individually. These are nothing but 'bid impact' cost and 'ask impact' cost', respectively (Nath, 2006).[42] The average of the bid and ask impact cost is the overall impact cost for transacting a particular value of a given commodity futures contract at a given point of time. The above exercise was carried out for each of the seven time-points. The average of the seven points is taken as an indicative impact cost for transacting a given commodity futures contract during the day.

**Table 4: Percentage change in Impact cost from pre (10th June) to post (10th July) CTT**

| | **Gold** | **Copper** | **Crude Oil** |
|---|---|---|---|
| **10.30 am** | 15.80% | 27.93% | 33.01% |
| **12.30 pm** | 123.12% | - | -0.69% |
| **2.30 pm** | -48.66% | 16.16% | 61.85% |
| **4.30 pm** | 64.68% | -25.41% | 109.32% |
| **6.30 pm** | 36.51% | 208.10% | -59.31% |
| **8.30 pm** | 80.37% | 120.23% | 158.78% |
| **10.30 pm** | 33.54% | 87.45% | 147.11% |
| **Average** | **33.53%** | **54.81%** | **48.74%** |

*Source: Author's calculation based on data from MCX.*

Table 4 shows the percentage change in impact cost from 10th June to 10th July for all seven time-points during the day and also the average for the entire day. It is apparent that the average impact cost for the entire day rose for all commodities and the increase was highest for copper.

A 50 day analysis pre and post CTT imposition shows a clear dip in volumes and liquidity levels for commodities in question. A fall in volume and a dip in liquidity levels may affect the process of price discovery. It may also widen the wedge between actual and potential revenue. There may actually be a gross revenue loss due to a drop in the levels of volume.[43]

[42] Nath (2013).

[43] A rough calculation of the total tax revenue based on the assumptions in Pavaskar and Ghosh (2008) suggests that a drop in the average daily trading volume of 15 per cent can lead to a daily revenue loss (in comparison

### *6.2 120 day event study*

This event study has been conducted particularly to test for the impact of CTT on trading volumes of commodity futures. It is different from the 50 day event study in that we employ an OLS model with the dependent variable as trading volume and a CTT dummy as one of the explanatory variables to examine the impact of the tax.

Some studies have empirically established an inverse relationship between transaction taxes and trading volume. Most of these studies have however, tested for the impact of transaction taxes on securities trading. For e.g. Baltagi et al. (2006) estimated the impact of STT increase from 0.3 per cent to 0.5 per cent in China in 1997 and found that volumes dropped by 1/3$^{rd}$. Umlauf (1993) found that a significant amount of trading activity migrated to the London Stock exchange following the hike in STT in the Swedish stock exchange in 1986. Pomeranets et al (2011) examined the effect of STT changes on NYSE's market share during 1932-81 and found an inverse relationship between the two for five out of nine revisions in the tax in the given period.

A few studies have also looked at the relationship between the bid-ask spread (proxy for transaction cost) and trading volume for commodity futures such as Wang and Yau (2000) and Sahoo and Kumar (2008). Both studies have found that the two variables are negatively related suggesting that an increase in the bid-ask spread (and hence, transaction cost) leads to a decline in trading volume of commodity futures.

Our model is largely based on the work of Hayashida and Ono (2011) who tested for the impact of transaction cost[44] on the turnover rate (total volume of transactions divided by the number of listed shares) on the Tokyo Stock Exchange from April 1995-March 2003. Apart from the transaction cost, other explanatory variables included lagged transaction volume, price increase, presence of institutional investors in the market and return variability.

Since we test for the impact of taxes on commodity futures trading, the variables employed in our model are slightly different from the ones used by Hayashida and Ono (2011). In our model, the dependent variable is volume of futures traded. Explanatory variables include lagged returns and lagged open interest. We do not include the variable on presence of institutional investors as they are not permitted to invest in the Indian commodities market.

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to the total tax revenue in the base scenario i.e. a scenario with no CTT) of Rs.0.75 crore suggesting an annual gross revenue loss of approximately Rs. 170 crore. Annual revenue loss has been arrived at by multiplying the daily revenue loss with number of trading days in the Financial Year. In addition to Pavaskar and Ghosh (2008) methodology, an assumption is also made regarding the revenue loss from collection of service tax due to imposition of CTT. The service tax of 12.36 per cent (including education cess) is assumed to be payable by both exchanges (on the transaction fee collected by members) and by brokers (on the transaction fee collected by end clients). 58 percent of the total trade is assumed to be undertaken by clients through brokers and rest is proprietary trading (self trade by members in their own books). As the brokers pass on the service to the end-clients, they also charge the client a transaction fee of around Rs.60 per lakh, on which service tax must be paid.

[44] Components for the transaction cost were STT, transaction fees and consumption tax on the transaction fees.

Return variability has been replaced by the variable on lagged returns due to the lack of access to the 10-minute interval data for the period under consideration. Many studies have established a lead-lag relationship between returns and volume with causality running from the past values of the former to the latter.

Most importantly, we conduct an event study to check for volumes before and after CTT imposition. Hence, we incorporate an interaction term between the CTT dummy (which takes the value of 0 before its imposition and 1 after it) and lagged volume as another explanatory variable.

We use daily data (from MCX) on volumes, futures prices and open interest for the period running from 120-125 days before the implementation of CTT and 120-125 days after it. The commodities in question are the same as used in the 50 day event study i.e. copper, crude oil, gold and menthe oil. The first three commodities represent top three traded commodities (after silver) on MCX in terms of value. Since the aim of the study was to test for the impact on all commodity types subject to CTT, menthe oil which is a processed agro commodity was also incorporated in the sample. All the variables were found to be stationary except for open interest. First difference of lagged open interest was thus, calculated for all commodities in the sample.

Our model is specified below:

$$Vol_{it} = C + R_{i(t-1)} + D_{it} * Vol_{i(t-1)} + OI_{i(t-1)} + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where;

$Vol_{it}$ and $Vol_{i(t-1)}$ represent trading volume of futures of the $i^{th}$ commodity in period t and t-1 respectively. $R_{i(t-1)}$ and $OI_{i(t-1)}$ represent returns and open interest of the $i^{th}$ commodity futures in period t-1. $D_{it}$ is the dummy variable which takes the value of 0 if $1 \leq t \leq t^*$, where $t^*$ is the date of introduction in CTT. $e_t$ stands for the error term in period t. Results of the model are presented in Table 5.

The results suggest that CTT has resulted in significant drop in the trading volume of all commodity futures considered in the analsyis. This is reflected in the signs and value of the t-statistic of the dummy coefficients for all commodities in the sample. As can be seen, the values are significant at all levels of significance.

**Table 5: Results for the 120 day event study on traded volumes**

| Commodity → | Copper | | Crude Oil | | Gold | | Menthe Oil | |
|---|---|---|---|---|---|---|---|---|
| Variable↓ | Coefficient | t-Statistic | Coefficient | t-Statistic | Coefficient | t-Statistic | Coefficient | t-Statistic |
| **C** | 84664 | 22.97 (0.00) | 166801.5 | 25.22 (0.00) | 37028.59 | 22.42 (0.00) | 6023 | 33.09 (0.00) |
| **$R_{t-1}$** | -241575 | -0.46 (0.64) | 1171018 | 1.3 (0.19) | -176256.4 | -0.85 (0.39) | 29328 | 1.86 (0.06) |
| **$DVOL_{t-1}$** | -0.67 | **-6.34*** **(0.00)** | -0.67 | **-7.05*** **(0.00)** | -0.52 | **-5.38*** **(0.00)** | -0.33 | **-5.77*** **(0.00)** |
| **$OI_{t-1}$** | -1.11 | -1.09 (0.27) | 0.12 | 0.1 (0.91) | 3.25 | 2.01** (0.04) | 1.9 | 3.74* (0.00) |
| **R-squared** | 0.16 | | 0.18 | | 0.13 | | 0.16 | |
| **Adjusted R-squared** | 0.15 | | 0.17 | | 0.12 | | 0.15 | |

*Source: Author's calculations. Note: * denotes significance at all levels*
*** denotes significance at 5 per cent level. Figures in parenthesis represent p-values.*

Though the results suggest a drop in trading activities of all commodity futures, the model however, has its limitations. For instance, the period under consideration is short, as it accounts for only 120 days since CTT was imposed on July 1, 2013. Moreover, the sample, though representative of all commodity types, is inclusive of only four commodities in total. Further, assessment is only made for traded volumes and not for volatility and/or the bid-ask spread. Other limitations are exclusion of demand and supply factors and restrictions imposed on certain commodities. Factors such as the NSEL crisis and discontinuation of trading in non-agro commodities on Saturdays from Sept. 2013 onwards have also not been accounted for.

## 7. Conclusion

The two main objectives of the Indian commodity exchange were price discovery and risk management. More importantly, the Indian commodity market has not yet attained critical liquidity levels. The introduction of CTT (0.01 per cent) may actually end up disturbing the mechanics of the market. CTT has raised the cost of transaction to approximately Rs. 13.25 per lakh (of which the CTT component will be Rs. 10 per lakh) compared to Rs. 3.25 per lakh prior to CTT.[45] Such a spurt in transaction costs may end up affecting commodity futures volumes adversely. Results for the 50-day and 120-day event study already suggest a significant drop in volumes for commodities such as gold, copper, crude oil and menthe oil. All these commodities are subject to CTT.

[45] For the purpose of this calculation, an exchange fee of Rs. 2, stamp duty equal to Rs.1 and a service tax of 12.36 per cent have been assumed.

Even though one of the stated purposes of CTT is to combat speculation, it needs to be seen whether it is desirable or not to do so as speculators might have a role in stabilizing prices rather than de-stabilizing them, at least for certain commodities. Moreover, the process of risk management is facilitated by speculators for if it were not for them, there would be no hedgers. In addition, there is a need to assess the exact composition of traders in the commodity market before arriving at any conclusion. If the market is dominated by those who view futures as a tool for risk-management, then CTT may not augur well for the market.

It needs to be emphasized that a commodity exchange does not function along the lines of a security exchange. Firstly, investment in commodity futures differs from investment in equity futures with the latter being identified mainly with profit-making (capital gains). On the other hand, the purpose of investment in commodity derivatives stems essentially from the need to insure against risks. Secondly, commodities are more heterogeneous than securities. There are various grades and qualities of one commodity. Hence, a commodity futures contract is a lot more complex than a securities future contract. Moreover, the market microstructure for equity asset class is simpler than a commodity asset class in that it is differentiated into various commodity groups and sub-groups.[46] FIIs and banks have not yet been permitted into Indian commodity markets but play a prominent role in the equity markets. There is serious paucity of research on market microstructure[47] related to each asset class i.e. either securities and/or commodities. While it is easier to delve into such issues when it comes to securities given the degree of uniformity pertaining to each asset class, it is much more difficult to conduct the same exercise for commodities given their heterogeneity.

What is thus, of utmost importance is to facilitate research in the market microstructure for commodities traded on an exchange. The heterogeneous nature of commodities can be held responsible for the variance in elasticities; for instance, agricultural commodities are different from metals in terms of their storage, vulnerability to business cycles or vagaries of season, etc.[48] Moreover, within one commodity group, there could be variances in sub-commodity groups such as within agricultural commodities, some are perishable while others are not. Since the current tax has been imposed only on specific commodity groups, it seems that there has been some recognition of the market micro structural setup. The results of the 50-day event study also suggest that the market fundamentals for different commodity groups behave differently at the same point in time.

[46] As mentioned in footnote 22, the importance of information for price discovery is one of the many factors that market microstructure is composed. Information for each commodity group depends on the market fundamentals which are, also in turn determined by the elasticity of each such commodity group and/or sub-groups.
[47] Ghosh (2009).
[48] Bose (2008).

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**ANNEXURE**

## Trading volume

Figure A1a) Gold

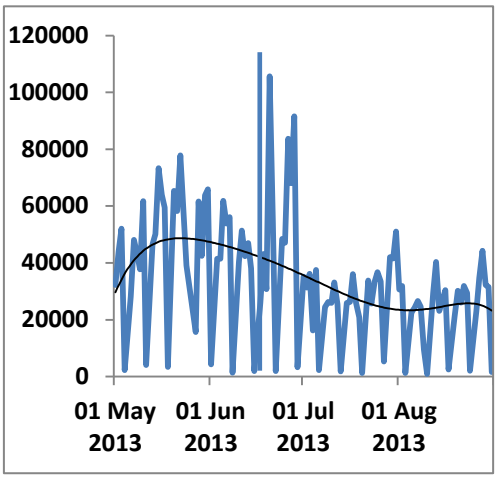



Figure A1b) Crude Oil

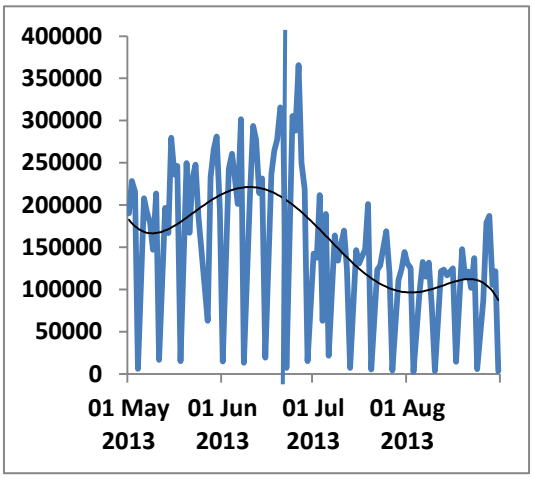



Figure A1c) Copper

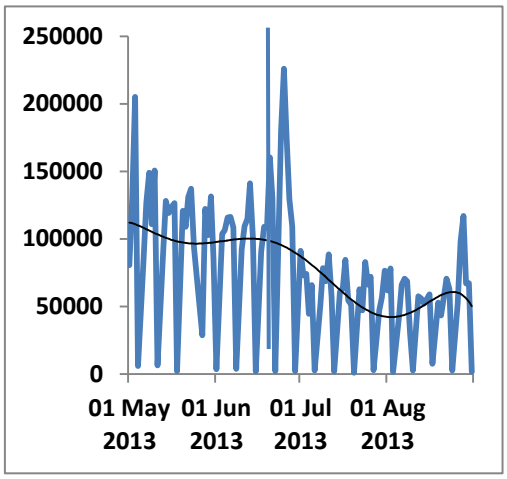
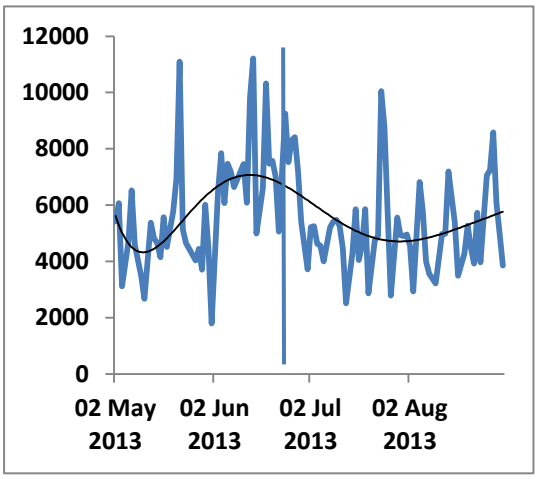



Figure A1d) Menthe Oil




Note: The vertical line in the figures marks the date of imposition of CTT, July 1, 2013

## Open interest

Figure A2a) Gold

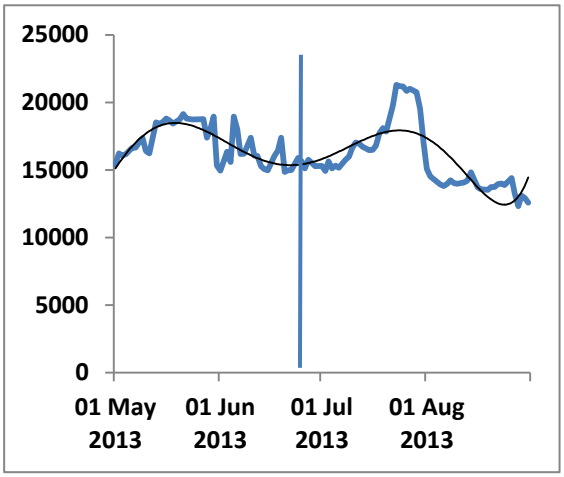



Figure A2b) Crude Oil

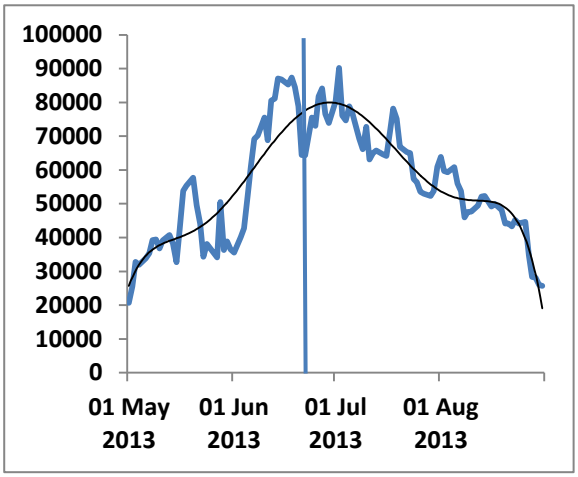



Figure A2c) Copper

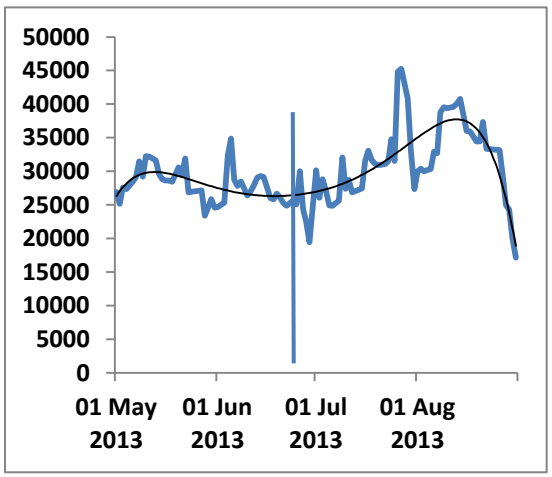
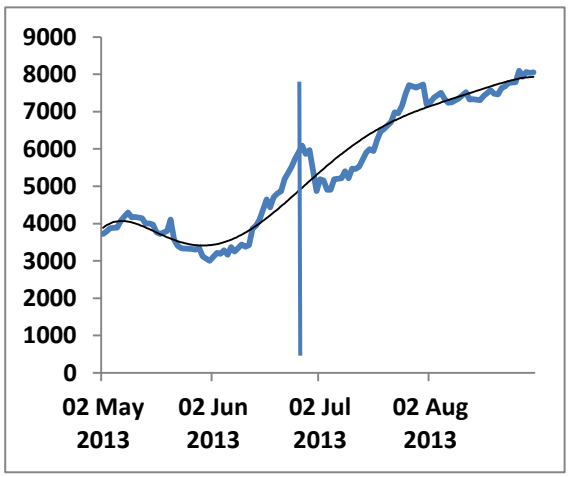



Figure A2d) Menthe Oil




Note: The vertical line in the figures marks the date of imposition of CTT, July 1, 2013

## Price movements

Figure A3a) Gold

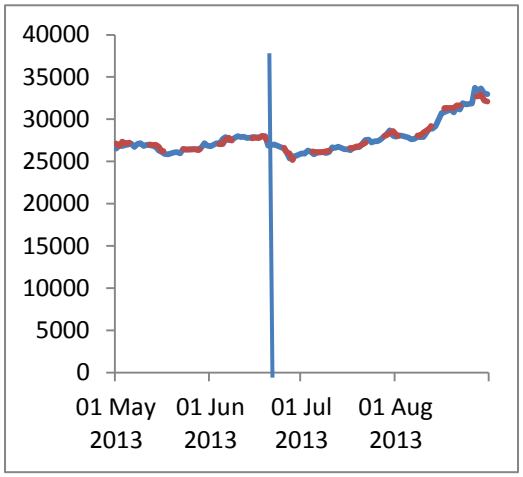



Figure A3b) Crude Oil

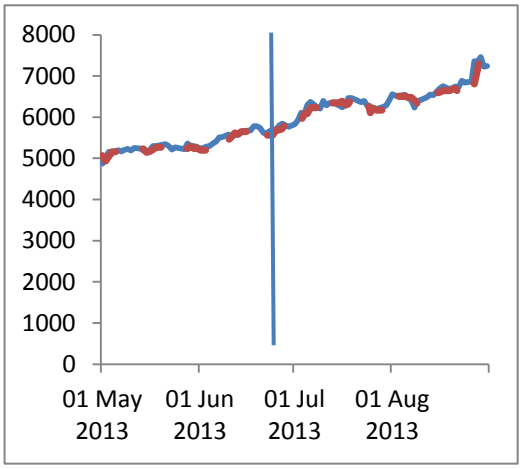



Figure A3c) Copper

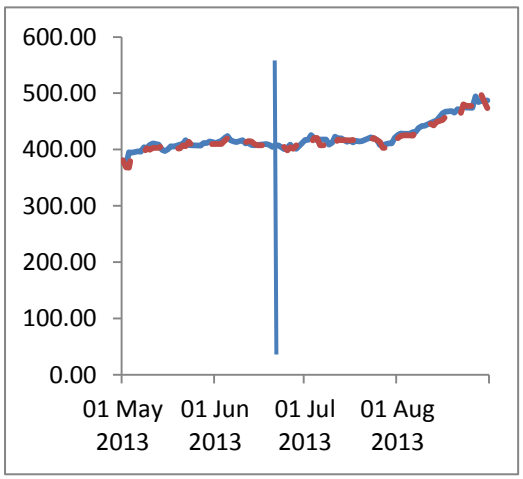
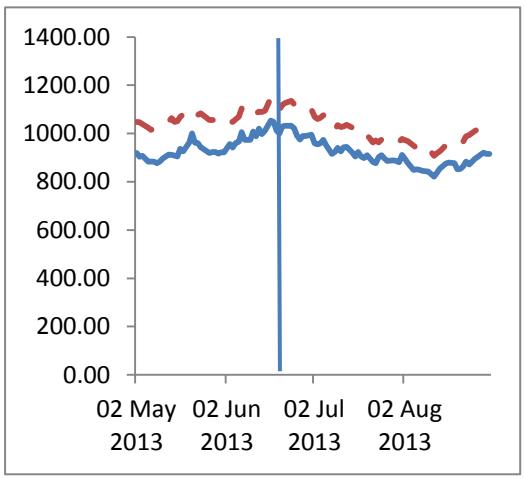



Figure A3d) Menthe Oil




Note: The vertical line in the figures marks the date of imposition of CTT, July 1, 2013. The dashed line represents spot prices and the smooth line represents futures prices.

**Table A1: Granger Causality between Futures Prices and Spot Prices (at 2 lags)**

| | | Prior | Post |
|---|---|---|---|
| **Crude Oil** | SP does not Granger Cause FP | 1.12 | 0.21 |
| | FP does not Granger Cause SP | 22.57* | 28.51* |
| | **Direction of Causality** | **FP Granger Causes SP** | **FP Granger Causes SP** |
| **Gold** | SP does not Granger Cause FP | 2.00* | 1.89 |
| | FP does not Granger Cause SP | 20.39* | 5.43* |
| | **Direction of Causality** | **Bi-Directional** | **FP Granger Causes SP** |
| **Copper** | SP does not Granger Cause FP | 0.48 | 0.05 |
| | FP does not Granger Cause SP | 55.78* | 20.37* |
| | **Direction of Causality** | **FP Granger Causes SP** | **FP Granger Causes SP** |
| **Menthe Oil** | SP does not Granger Cause FP | 0.18 | 0.79 |
| | FP does not Granger Cause SP | 0.69 | 6.01* |
| | **Direction of Causality** | **No Causality** | **FP Granger Causes SP** |

*Source: Author's calculations*

Note: Figures in the columns represent F-statistics. * denotes significance. Both Futures and Spot prices were checked for stationarity. Presence of unit root was found in both variables for all commodities and was corrected using the first difference.

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