Assessing the economic impact of a commodities transaction tax

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Abstract

The paper analyses the outcome of imposing transaction taxes on commodity derivatives in India from 1 July 2013. The outcome is measured as the change in market quality measures of traded volumes and other liquidity measures, market efficiency including basis and basis risk, and market volatility. Consistent to similar papers in the literature, there is a significant decrease in liquidity with traded volumes dropping by more than 50 percent. But there was little change in market volatility in the one-month period after the tax was imposed. The consistency of this with the international evidence about the effect on markets of a transaction tax, raises concerns about the lowered competitiveness of domestic markets with respect to their global counterparts which gain market share that the domestic markets lose out on.

JEL classification: G13, G32

Keywords: transaction taxes, revenue collection, impact assessment, liquidity, efficiency, volatility.

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1 Introduction

In this paper, we empirically assess the impact of a transactions tax on market activity and market quality. Unlike typical taxes, which are charged on revenues out of an economic activity, transaction taxes are charged on all transactions, irrespective of whether it is profitable or not. These taxes are typically charged on financial transactions and are motivated by the idea of "excessive" trading in financial markets. Trading which appears to not be driven by the arrival of news and information is considered both unproductive and likely to generate elevated volatility of prices (Summers and Summers 1989). Thus, proponents of a transactions tax expect that it will deliver two benefits: reduce "excessive" trading and lower market volatility. In contrast, Kupiec 1996 predicts that when informed traders are disincentivised to trade, prices will respond to information with a lag. The paper predicts that transactions taxes will lead to lower traded volumes and higher market volatility.

In the empirical literature assessing the impact of transaction taxes on market characteristics, there is consensus that it reduces market liquidity. However, there is no consensus about changes in market volatility changes after the imposition of transaction taxes. Several papers show that there is no change in market volatility after the imposition of transactions taxes, while some papers show an increase in volatility.

Indian financial markets have seen several instances where transactions taxes have been imposed. In this paper, we analyse the impact of one such tax which was imposed on commodities derivatives trading in 2013. The tax was imposed on trades in non-agricultural commodities and some processed agricultural commodities derivatives. We analyse market quality measures for futures on four non-agricultural commodities traded at the Multi-Commodity Exchange (MCX): copper, crude oil, gold and silver. For each of these commodity futures, we analyse two questions. The first is whether volatility of the commodity derivatives market dropped after the imposition of the transaction tax. The second is whether there was a significant decrease in traded volumes after the imposition of the transaction tax. In each case, we try to set up a research design to establish how much of the observed change was due to the transaction tax, or whether other factors contributed to the observed change as well.

In order to assess the impact of the tax on market quality, we use an event study framework to statistically test for a change in market volatility, after the imposition of the tax. We broaden the analysis beyond measures of

market volatility to include market efficiency (basis, basis risk, variance ratio) and liquidity (traded volume, open interest, Amihud's illiquidity ratio). In each case, we analyse the impact of the transaction tax in a short period (one month), as well as over a longer period (one year) around the event.

We find that there is no significant changes in market volatility over the short-term (one month) period after CTT. There is some *increase* in market volatility in the one year period for the bullion contracts (copper, gold and silver). We find no change in basis, and an increase in basis risk for the bullion futures in the long term. An examination of the macro-economic volatility, as measured by the market wide implied volatility index for India and the U.S. shows an increase in Indian market volatility but a decrease in the U.S. market volatility in the same one year period. This suggests that there was an increase in the overall volatility of the Indian economy which may have caused the higher volatility observed in the one-year risk of the gold and silver futures contracts.

For all the futures, we find that there has been a significant drop in liquidity. Traded volumes and open interest have systematically dropped for all the commodity futures for both the short-term and the long-term. The above results together suggest that some of the results are in line with what is believed to be the benefits proposed by the proponents of the transactions taxes, but some of the results are counter to these expectations.

We carry out a more detailed analysis of the change in traded volumes in four of the large, liquid commodities futures in an attempt to establish the counterfactual on the behaviour of the traded volumes. In order to do this, we attempt to estimate what the traded volumes would have been without the tax. For this, we use the fact that most commodities markets are globally correlated, and there is a long-run relationship between traded volumes on domestic and international markets. We estimate the long-run relationship between the traded volume of gold on MCX and the Chicago Mercantile Exchange. Using this relationship, we predict what the traded volumes on the MCX would have been based on its correlation between the traded volumes on the CME, which is estimated as three times larger compared with the actually observed traded volumes.

Thus, our analysis leads us to infer that transaction taxes led to lower traded volumes and some evidence of higher volatility over the longer term of one year after the CTT imposition. This suggests that the behaviour of the Indian commodities markets is more consistent with what was proposed by Kupiec 1996.

The paper is organised as follows: Section 2 describes the economic motivation for transaction taxes in financial markets, as well as predicted and observed outcomes from other countries that have imposed such taxes in their financial markets. Section 4 presents the data that has been used in the analysis.

2 Transaction taxes in financial markets

Transaction taxes have become a popular policy instrument to use in financial markets. Several countries have contemplated putting in place a securities transactions tax as a means to achieve more stable financial market outcomes, particularly after the financial crisis of 2008. The motivation for transaction tax has been driven by the observation that the number of transactions in financial markets tend to be high, and appears to be independent of news and information that can a change in prices to reflect this information.[1] This "excessive" trading was assumed to be unproductive, and was assumed to lead to higher volatility levels than would have been observed otherwise. It was proposed that a tax[2] placed on transactions would then *reduce excessive trading* and as a consequence, *reduce volatility*. Table 1 shows that several countries have imposed such transaction taxes on financial market transactions through their history.

[1]Pomeranets and Weaver 2011 provides a good description of the literature on the history and justification for transactions taxes in financial markets.

[2]This is frequently referred to as the Tobin tax.

Table 1 Transaction tax regimes in the world

Country	Tax rate and structure	Year of introduction	Present status
Austria	0.15%		Removed in 2000
Belgium	0.09% on bonds	2007	Present
	0.27% on shares	2007	Present
China	0.1% on shares		Present
Cyprus	0.15% - 0.6% on shares	1963	Present
Finland	1.6% on trades off HEX	1997	Present
France	Between 0.15% to 0.3%	2012	Present
Germany	Between 0.01% to 0.25%		Removed in 1991
Ireland	0.5% on shares of foreign registered firms		Present
	1% on shares of firms registered in Ireland		Present
Italy	0.1% on shares of EU firms to 0.2% otherwise on shares of Italian firms	2013	Present
	0.02% on high frequency trades	2013	Present
	0.00075% to 0.2% on derivatives trades	2013	Present
Malta	2% on all securities	1993	Present
Poland	1% on shares and bonds		Present
Sweden	0.5% on shares, bonds, derivatives trades	1984	Removed in 1991
Switzerland	0.15% on domestic and 0.3% on foreign securities		Present
Taiwan	0.3% on shares		Present
	0.1% on corporate bonds		Removed in 2016
	0.002% on equity index futures	2013	Removed in 2015
	0.00125 bps on interest rate futures		Present
	0.0125 bps on govt. bonds		Present
	0.1% on options		Present
	0.025 bps on gold Futures		Present
UK	0.5%	1986	Present
US	0.2% on securities	1914	Removed in 1966
	\$0.0042 Section 31 fee on equity futures	2004	Present
	0.002 bps as Section 31 fee on equity	2004	Present

Studies have examined the impact of securities markets transaction taxes from the primary objective of testing whether these taxes have helped reduce market volatility. Most papers find little or no change in volatility as a consequence of transactions taxes. One of the early papers to question the effectiveness of transactions tax was Roll 1989. In an analysis of stock return volatility in 23 countries from 1987 to 1989, Roll 1989 found no significant correlation between volatility and transaction taxes. Similarly, Umlauf 1993 found no decline in volatility due to the introduction of a transaction tax on Swedish equity markets, while Hu 1998 found that there was no significant effect of transactions tax on volatility in the stock markets of Hong Kong, Japan, Korea and Taiwan, on average. More recently, Chou and Wang 2006 found no evidence that transaction taxes reduce return volatility.

Another common focus in these empirical studies is the direction and magnitude of the change in market liquidity. Several papers found that market liquidity decreased after a transaction tax was imposed (Baltagi, Li, and Li 2006; Chou and Wang 2006; Liu 2007; Phylaktis and Aristidou 2007; Pomeranets and Weaver 2011). This is consistent with the view that transactions taxes are like a charge on trading, leading to lower liquidity compared to market liquidity when there is no tax. Few studies have gone beyond these measures and examined the impact of transactions taxes on market efficiency. Most of these papers neither carry out a robust analysis of the changes, nor attempt to set a counterfactual against the observed behaviour.

2.1 Transaction taxes in India

In India, transactions taxes were first introduced on equity and equity derivatives in 2004, which are referred to as the STT (securities transaction taxes). When STT was introduced, the government simultaneously dropped the long term capital gains taxes to zero.[3] Under this combined change in policy, there was no visible negative impact on the size and volumes of the equity market.

Alongside the equity markets which were liquid and deep by 2004, the only other derivatives trading on exchanges were commodity futures. Currency futures and interest rate futures started trading in India much later, in 2008 and 2009 respectively. By 2004, there was also a lot of activity on commodities futures, with the Multi Commodities Exchange mostly trading non-agricultural commodities futures and the National Commodities Derivatives Exchange (NCDEX) mostly trading agricultural commodities. Volumes on

[3]Long term is defined as being one year or beyond.

commodity futures were low in 2003 at around USD 39 billion, but grew significantly over the next five years to reach around USD 1019 billion in 2008. This was an increase in size of more than 30× in five years (Aggarwal, Jain, and Thomas 2014). In comparison, the equity spot and derivatives markets reached traded volumes of around USD 4 trillion in 2008, from USD 220 billion in 2003, which was an increase of more than 20× in five years.

In order to remove the inconsistency between the taxation of equity and commodity derivatives markets, a commodity transactions taxes or CTT was proposed first in 2008-2009 and then later in 2013. In the budget speech on 28 February 2013, the Finance Minister announced a transaction tax on commodity futures transactions. The rationale for imposing the CTT was presented as follows:

> There is no distinction between derivative trading in the securities market and derivative trading in the commodities market, only the underlying asset is different. It is time to introduce CTT in limited way. Hence, I propose to levy CTT on non-agricultural commodities futures contracts at the same rate as on equity futures, that is at 0.01 percent of the price of the trade. Trading in commodity derivatives will not be considered as a speculative transaction and CTT shall be allowed as deduction if the income from such transaction forms part of business income.

The budget announcement was translated into real tax policy. It was notified by the Department of Revenue, at the Ministry of Finance, on 19 June 2013 and it came into effect from 1 July 2013. The CTT of 1 basis points (bps) was imposed on the seller of derivatives on all non-agricultural commodities and 11 processed farm commodities, with about 61 agricultural commodities exempt from this tax.

In the analysis that follows, there are two distinct dates that are important – the first is the date of the announcement which is 28 February 2013 and the implementation date which is 1 July 2013. Another important date is 19 June when the Government notified the CTT. In India, not all announcements in the budget are implemented. Typically, there is political jostling and negotiations between the government and market participants on what is presented in the budget. For example, the CTT announced in the 2008 budget was finally not imposed. After the CTT was notified by the Government, implementation of the CTT was certain. Table 2 presents the dates relevant for the analysis.

Table 2 Timeline of events

The table below summarises the timeline of events related to commodities transactions taxes in India.

Date	Event	Status
28 Feb 2013	Announcement in Budget 2013-14	Passed
19 June 2013	Notified by the Government	Passed
1 July 2013	Date of effective implementation	Implemented

2.2 Research questions

We construct a hypothesis of the effect of the CTT on market quality by understanding how traders respond to the transaction tax. Such a tax is an additional cost on trading in the market. This cost acts as an additional charge on all transactions, unlike income tax which applies only on profitable trades.

When an additional charge is imposed, transactions become more expensive. For example, in Table 3, we present the transaction costs that the trader faces when taking a Rs.500,000 (or Rs.5 lakhs) position on a derivative in any segment in India, with and without transaction taxes. When transaction tax is not applicable, the transaction costs are the same in both the columns. When there is a transaction tax applicable, the costs increase significantly. It is useful to observe that these costs are much higher for the equity markets than the commodities markets. In response to such an increase in the transactions costs, the rational response for a trader would be to do fewer transactions, leading to lower traded volumes on the market.

Table 3 Costs of trading Rs.500,000 on derivatives in India

The values below are the Rs. charges incurred by a derivatives trader in India for a *sell* position worth Rs.500,000 across different derivatives contracts. We include transactions in equity futures and options, currency futures and options and commodity futures, on both agricultural and non-agricultural commodities.
In computing the charges we have included *brokerage fees*, which is taken to be 1.00 basis points (bps), *Regulatory (SEBI) charges*, at 0.02 bps, *Stamp duty* at 1.00 bps, *Transaction tax* , *Transaction charge* and *clearing charge*, which varies across exchanges and segments, and *Goods and Services Tax (GST)* at 1800 bps.
The numbers marked in **bold** are the higher tax paid when the transaction has TT applicable on it. For example, the equity futures transaction on BSE and NSE have increased by around Rs.50 to Rs.112.70 and Rs.120.22 respectively with TT compared to Rs.62.70 and Rs.70.96 without TT. In comparison, the currency derivatives markets do not have any TT and thus, the values remain the same.
* On options trades, costs and charges are imposed on the value of premium. We assume a 1% premium on notional turnover.

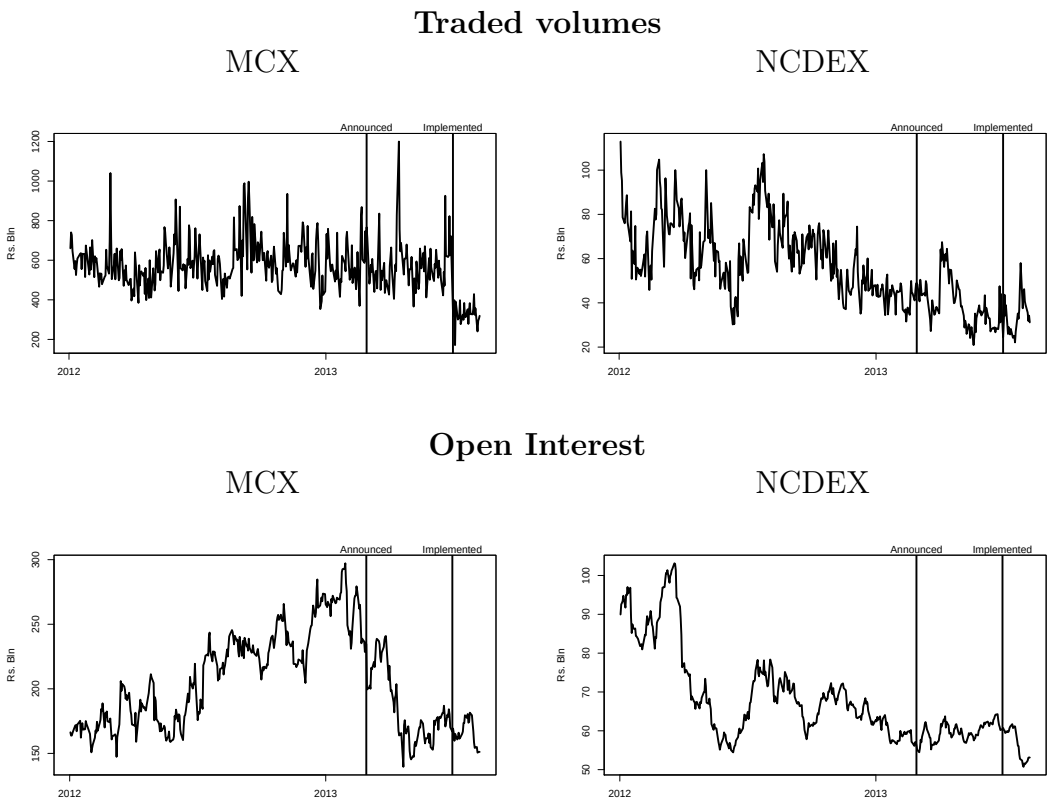
(All values in Rs.)

	With TT	Without TT
Commodity futures		
MCX, non-agri futures	**125.09**	75.09
MCX, agri futures	70.075	70.075
NCDEX, non-agri futures	**110.34**	60.34
NCDEX, agri futures	83.35	83.35
Currency derivatives		
BSE futures	61.05	61.05
NSE futures	66.24	66.24
BSE options*	60.93	60.93
NSE options*	62.11	62.11
Equity derivatives		
BSE futures	**112.70**	62.70
NSE futures	**120.96**	70.96
BSE options*	**63.73**	61.23
NSE options*	**65.20**	62.70

A visual examination in Figure 1 of the traded volumes on the two large commodity derivatives exchanges shows that these effects are seen in this period, around the announcement and implementation of the taxes. The volumes on the NCDEX are presented as a benchmark since a larger fraction of the transactions on the NCDEX came from futures on agricultural commodities which are not affected by the transactions tax.

Figure 1 Trends on two commodity derivatives exchange around the imposition of transactions taxes

The graphs below show the daily Traded Volumes (TV) and Open Interest (OI) of commodity futures traded on two of India's largest commodity derivatives exchanges in the six month period after the CTT was announced in the Budget speech of February 2013. As a comparison, we also include the daily numbers for TV and OI for more than a year before the budget announcements.
The date of the announcement is 28 February 2013, and the date of implementation of the CTT is 1 July 2013. The CTT is applicable on non-agricultural commodity futures and a few processed agricultural commodity futures.



The graphs show that the level of traded volumes at MCX drop sharply on the day of implementation. More interestingly, volumes in Open Interest drop earlier, immediately after the budget announcement about the transaction tax. In contrast, there is no similar change on the traded volumes at the NCDEX where the transactions taxes do not apply. It appears that the CTT has an adverse impact on traded volumes and the open positions built up in the futures market. This is consistent with the literature on such taxes.

What we would like to additionally analyse is:

Q1 Did volatility go down after the imposition of the CTT? Did market efficiency and market liquidity also get affected?

Q2 If there was a change in the market quality, did these changes persist, or was it a short-term phenomenon?

Q3 Is it possible to identify a benchmark for what the traded volumes could have been without the CTT?

3 Methodology

In this section we describe the approach used to answer the three questions raised previously.

Q1 We study the impact of CTT on a broader set of market quality measures by measuring the value of the measure in given time period before the CTT was imposed, the value of the measure in the same time period after the CTT was imposed, and using standard statistical tests for significance of the change.

The typical market quality measures are categorised into liquidity, volatility and price efficiency. Within each of these categories, there are specific measures. In this paper, we use the following measures that are described in detail after.

1. Measures of volatility: Range, absolute returns and standard deviation of returns.
2. Measures of efficiency: Basis and basis risk.
3. Measures of liquidity: Traded value, open interest and Amihud's illiquidity ratio.

Q2 We examine the persistence of the effect of the CTT by carrying out the analysis described above using two different time periods:

- a short-term analysis carried out for the period of a *month* before the CTT implementation and one month after, and
- a long-term analysis carried out for a period of a *year* before and after the CTT implementation.

  If there is no long-term effect, we expect that any short-term pattern (in the one month comparison) will not repeat as a long-term pattern (in the one year comparison).

Q3 In order to compare the extent of the change in the traded volumes, we attempt to estimate what would traded volumes have been if there was no CTT. In order to do this, we identify the traded volumes in markets for similar commodity derivatives that have a strong correlation with the Indian markets as an instrument that captures traded volumes in these securities and that will not be affected by the CTT.

The details of the approach that we use for this estimation is presented in Section 3.2.

3.1 Measures of market quality

Volatility is derived from prices, and cannot be directly observed.[4] However, there are other traditional measures and in this paper we use the following:

- Range: Difference between the high and low price of the day, expressed as a percentage of the closing price of the day. It provides volatility of the daily price path without using high frequency data, and has been established as a more efficient measure of volatility than the standard deviation of returns (Brandt and Diebold 2003).
- Absolute returns: The absolute value of daily returns. This measure captures days on which the magnitude of the return is large as a day with high volatility, irrespective of whether the returns was negative or positive.
- Standard deviation of returns (σ): It is computed using daily returns from prices for a week and calculating the standard deviation.

Efficiency is measured by a lack of arbitrage opportunities in the market. If such opportunities exist, then the market is considered to be inefficient. In futures markets, a standard measure of the presence of arbitrage is the *basis*, and the volatility of that basis, which is called *basis risk*. These are calculated as:

[4]One direct measure of volatility is the estimated volatility from options prices. But there are no options traded on commodities in India.

- Basis: Difference between the observed futures price and the theoretical futures price, expressed as a percentage of theoretical futures price.
- Basis risk: Monthly standard deviation of the basis that is calculated above.

Liquidity is measured in the paper in the narrow sense of traded information from daily data to calculate the following measures:

- Traded volumes: Rupee value of the contracts traded calculated as

  $$\text{Traded volume}_t \times \text{Closing price}_t \times \text{Lot size}_t \times \text{Price quote factor}_t$$

  where traded volumes indicates the number of contracts traded, closing price is quoted in price per unit, and price quote factor is the rupee value per unit of contract.
- Open interest: Number of outstanding positions (in terms of number of lots as well as rupee value)
- Amihud's illiquidity ratio (Amihud 2002): This is calculated as the ratio of absolute returns to traded value over a given period of time, and captures the price impact of a transaction. The higher the illiquidity ratio, lower is the liquidity.

3.2 Benchmark for traded volumes

While we can readily observe the traded volume in the market with CTT what is difficult to obtain is what would have been the traded volume in the same period without CTT. In order to calculate this, we need to identify an instrument that captures the behaviour of traded volumes in commodity futures at the MCX, but which is not affected by the CTT.

Since most of the commodities used in the analysis are internationally traded and their prices are internationally determined, there is likely to be a strong correlation between the traded volumes of commodity futures at the MCX as well as at their global counterparts, such as the Chicago Mercantile Exchange (CME) or the London Metal Exchange (LME). For example, the Chicago Mercantile Exchange (CME) trades futures on the four commodities that we have chosen for the analysis. The CME does not have transactions tax, and the traded volumes on CME reflect the trading volumes of a market without the effect of a transactions tax. Thus, a possible instrument for this could be traded volumes of the futures of similar underlying commodities at global commodities exchanges. We can estimate the long-run relationship between

the traded volumes at the CME and at the MCX for each set of common commodities using the following equation:

$$log\left(\frac{\widehat{TV_{MCX,i,t}}}{TV_{MCX,i,t-1}}\right) = \alpha_i + \beta_i \times log\left(\frac{TV_{CME,t,t}}{TV_{CME,i,t-1}}\right) + \epsilon_i$$

Where, for a given commodity i, $\log \frac{TV_{MCX,i,t}}{TV_{MCX,i,t-1}}$ and $\log \frac{TV_{CME,i,t}}{TV_{CME,i,t-1}}$ measure the contemporaneous change in the traded volumes at MCX and CME respectively, and β_i captures the relationship between traded volumes at CME and MCX for that commodity.

Using this equation, we estimate the traded volumes at MCX as a function of the observed volumes at the CME for the pre-CTT and the post-CTT periods. These estimated traded volumes are then used as the counterfactual against which the observed traded volume can be compared in the pre-CTT and the post-CTT analysis.

4 Data

The analysis use daily price and volumes data for the period from June 18, 2012 to July 2, 2014 from the MCX, India's largest non-agricultural commodity futures exchange. We focus on four commodities which generate the largest fraction of the futures traded volumes on the exchange. These include two bullion commodities which are gold, and silver, one base metal commodity which is copper and one energy commodity which is crude oil. The price and traded volumes are collected for the near-month contracts and are rolled over to the next-month contracts. The rollover is done either two or five trading days before expiration, depending on the commodity.

We carry out an event study analysis using the date of implementation of the CTT as the event (Table 2). We exclude the period between the date of notification and the date of the implementation (June 19, 2013 to 1 July, 2013) as the transition period between announcement and implementation. We then analyse the market for a one *year window* around the implementation date as the pre-CTT period and the post-CTT window. These are from 18 June, 2012 to 18 June, 2013 and from 2 July, 2013 to 2 July, 2014 respectively. Since such long periods may also contain other events that may have driven market movement, we also carry out the analysis for a shorter, *one month period*, where the pre-CTT window is from 18 May 2013 through 18

June, 2013 and the post-CTT window from 2 July, 2013 through 2 August, 2013. The exchange used to trade on Saturdays, but these had thin volumes and high volatility. So Saturday trading days are removed from the entire analysis.

In order to estimate the magnitude of the loss in traded volumes, we use CME volumes of the corresponding commodities to estimate traded volumes for the commodities at the MCX without the CTT. Daily price and volumes data for near month contracts trading at CME are obtained using the Bloomberg terminal.

Table 4 Contract specifications and details of commodities analysed

The table below summarises the contract specifications of the commodity futures used in the analysis.

	MCX			**CME**	
	Trading unit	Price quote	Rollover	Trading unit	Price quote
GOLD	1000 gm	Rs./10gm	5	100 troy ounce	USD/troy ounce
SILVER	30 kg	Rs./kg	2	1000 troy ounce	USD/troy ounce
COPPER	1000 kg	Rs./kg	2	25000 pounds	USD/pound
CRUDE OIL	100 barrels	Rs./barrel	2	1000 barrels	USD/barrel
Notes: 1 troy ounce = 0.03 kg, 1 pound = 0.45 kg					

Table 4 lists the specifications of contracts used in the analysis, sourced from the respective exchange websites. We assume these specifications hold for the full period of our analysis.

5 Results

The analysis is carried out using the methodology described above. We present the results for the change in each of market liquidity, efficiency and volatility in Tables 5, 6 and 7 below. In each table, we compare the average values of market quality in the pre-CTT and post-CTT time periods. We test for the significance of the difference between the pre-CTT and post-CTT values using a t-test. In all cases, there is a short-term and long-term assessment. For the short-term analysis, market quality is measured for a one-month period before and after the CTT is imposed, while for the long-term analysis, market quality is measured for a one-year period before the CTT and after.

In the Tables, all the post-CTT values which have been marked in **bold** are significantly different relative to the the values in the pre-CTT period.

Table 5 Impact on liquidity

The table records values of three liquidity measures in a fixed period before and after the implementation of CTT.
The short term analysis uses a one month period before and after 1 July 2013, and the longer term analysis uses a one year period around the same date.
The measures analysed are Traded Volumes, Open Interest and Amhihud's illiquidity ratio. In all cases for the longer period (1 year before and after the CTT was imposed), the market liquidity has been significantly impaired over the longer period, with more than a decrease of 50 percent in most cases. In the immediate period of one month before and after the CTT came in, traded volumes dropped significantly. The results were ambiguous for the open interest and the Amihud's illiquidity measure.

	One month				**One year**			
	$\mu_{(\mathbf{Pre})}$	$\mu_{(\mathbf{Post})}$	t-stat	p-val	$\mu_{(\mathbf{Pre})}$	$\mu_{(\mathbf{Post})}$	t-stat	p-val
Traded Volumes (Rs. billion)								
GOLD	119.99	**72.08**	6.36	< 0.00	112.37	**50.75**	23.18	< 0.00
SILVER	72.09	**33.19**	6.85	< 0.00	96.84	**29.32**	25.61	< 0.00
COPPER	41.19	**25.65**	7.21	< 0.00	40.66	**15.04**	29.02	< 0.00
CRUDE OIL	105.02	**73.99**	4.34	0.00	102.14	**41.65**	27.05	< 0.00
Open interest (Rs. billion)								
GOLD	34.89	31.12	1.58	0.12	44.09	**26.09**	22.83	< 0.00
SILVER	17.14	**13.56**	4.31	< 0.00	29.32	**12.57**	26.49	< 0.00
COPPER	9.12	**10.67**	-3.98	0.00	13.17	**7.03**	23.48	< 0.00
CRUDE OIL	23.44	**31.93**	-5.26	0.00	15.76	**9.71**	9.51	< 0.00
Amihud's illiquidity ratio ($* 10^{-13}$)								
GOLD	0.06	**0.12**	-2.44	0.02	0.53	**1.64**	-9.94	< 0.00
SILVER	1.53	20.3	-1.18	0.24	1.8	**10.07**	-2.57	0.01
COPPER	1.67	**4.01**	-4.07	< 0.00	3.35	**5.59**	-11.25	< 0.00
CRUDE OIL	1.17	1.88	-1.69	0.09	1.06	**2.76**	-7.91	< 0.00

Table 6 Impact on volatility

The table records values of three liquidity measures in a fixed period before and after the implementation of CTT.
The short term analysis uses a one month period before and after 1 July 2013, and the longer term analysis uses a one year period around the same date.
The measures analysed are range, absolute returns and weekly standard deviation of returns.
In some cases for the longer period (1 year before and after the CTT was imposed), market volatility has increased while for the remaining, there has been significant change. In the immediate period of one month before and after the CTT came in, there is no evidence for a decrease in market volatility across all the three measures.

	One month				**One year**			
	$\mu_{(\mathbf{Pre})}$	$\mu_{(\mathbf{Post})}$	t-stat	p-val	$\mu_{(\mathbf{Pre})}$	$\mu_{(\mathbf{Post})}$	t-stat	p-val
Range (in percent)								
GOLD	1.79	1.73	0.24	0.80	1.02	**1.48**	-6.15	< 0.00
SILVER	2.58	2.35	0.59	0.55	1.79	**2.15**	-3.31	< 0.00
COPPER	1.79	1.64	0.79	0.43	1.33	**1.46**	-2.13	0.03
CRUDE OIL	1.77	2.08	-1.57	0.12	1.73	1.70	0.25	0.79
Absolute return ($\lvert r_t \rvert$) in percent								
GOLD	0.82	0.96	-0.59	0.55	0.61	**0.87**	-3.39	< 0.00
SILVER	1.08	1.19	-0.39	0.70	0.97	1.15	-1.77	0.07
COPPER	0.72	1.05	-1.62	0.11	0.75	0.81	-0.97	0.33
CRUDE OIL	1.04	1.32	-1.12	0.26	0.96	1.02	-0.69	0.49
Weekly volatility (σ) in percent								
GOLD	0.01	0.01	-0.63	0.54	0.01	0.01	-2.30	0.02
SILVER	0.01	0.02	-0.51	0.62	0.01	0.01	-1.66	0.10
COPPER	0.01	0.01	-1.26	0.24	0.01	0.01	-0.92	0.35
CRUDE OIL	0.01	0.01	-1.07	0.32	0.01	0.01	-0.59	0.55

Table 7 Impact on market efficiency

The table records values of two market efficiency measures in a fixed period before and after the implementation of CTT. The short term analyses uses a one month period before and after 1 July 2013, and the longer term analysis uses a one year period around the same date.
The efficiency measures are based on the value of the basis between the futures and spot price. In an efficient market, this should be close to zero. The volatility of the basis, or basis risk, must also be very close to zero.

	One month				**One year**			
	$\mu_{(\mathbf{Pre})}$	$\mu_{(\mathbf{Post})}$	t-stat	p-val	$\mu_{(\mathbf{Pre})}$	$\mu_{(\mathbf{Post})}$	t-stat	p-val
Basis (in percent)								
GOLD	-0.44	-0.85	1.55	0.12	-0.42	**-2.39**	15.25	< 0.00
SILVER	-0.50	-0.17	-0.89	0.37	0.08	-0.12	1.82	0.07
COPPER	0.03	-0.07	0.24	0.81	-0.3	-0.08	-1.97	0.05
CRUDE OIL	0.40	0.29	0.24	0.81	-0.07	-0.12	0.41	0.67
Basis risk (in percent)								
GOLD	-	-	-	-	0.65	**1.44**	-25.49	< 0.00
SILVER	-	-	-	-	1.07	**1.14**	-2.49	0.01
COPPER	-	-	-	-	1.16	**1.23**	-2.11	0.03
CRUDE OIL	-	-	-	-	1.33	1.34	-0.19	0.84

In the following, we use the empirical results in order to attempt answers to the questions raised in Section 2.2.

5.1 How has market quality changed?

For each of the market quality variables, the short term impact of the CTT is based on the behaviour of the market quality variable measured over a one month period before and after CTT. The one month period shows the short-term changes in market quality.

Changes in market liquidity

Table 5 presents the change in market liquidity around the date on which CTT was implemented. The immediate impact is measured by a one month period before and after the tax came into effect. Here, we observe significant drop in traded volumes (TV) of all commodities.

However, in the case of open interest and the illiquidity ratio, there is no evidence of drop in either in the values observed after the CTT,

compared to the values before the CTT was imposed.

Changes in market volatility

Table 6 presents the change in market volatility in the immediate, one month period before and after the CTT was implemented. It also shows how market volatility has changed over the longer term. The volatility measures include the range, absolute return which is agnostic to whether the change in the price was a negative or positive and is focused only on the magnitude of the change, and the traditional measure of volatility which is the standard deviation over a week.

The results show that there was no significant change in volatility in the shorter time horizon. This holds for all the market volatility measures and for each of the commodities. These results are consistent with the rest of the literature which reports that there is no change in volatility after a transaction tax is put into place.

Changes in market efficiency

Table 7 shows the changes in the basis. In our calculation of the basis as the difference between the observed and fair price of the futures, we expect that the basis should be zero on average. We find that the basis itself is different from zero in the short-term, in both the pre-CTT and the post-CTT periods. This deviation between the two prices has not changed significantly after the CTT.

This leads us to infer that the CTT has not led to a change in the short-term market efficiency. There were inefficiencies before the CTT was imposed, and these remained at the same magnitudes even after.

In summary, there is a significant deterioration in market liquidity in the short-term after the CTT is imposed. The liquidity measured by traded volume in the market significantly decreased for all the commodities studied in the post-CTT period relative to before CTT. This is unlike the case for market volatility or market efficiency. There is no evidence of a significant change (either increase or decrease) in volatility in the post-CTT period. Similarly for the market efficiency. There were market inefficiencies measured by non-zero basis on average in the pre-CTT period which has continued in the post-CTT period as well, with no significant changes between the two.

5.2 Longer term outcomes

In the tables above, the one year period analysis indicates whether the change was persistent or whether it was temporary. In Tables 5, 6 and 7, several of the market quality variables show significant changes in value for the one year period post-CTT relative to before.

Changes in market liquidity

The longer period analysis shows that all measures of market quality has decreased over a one year period. For all commodities, the traded volumes have dropped, the open interest has dropped and Amihud's illiquidity ratio has worsened for all the commodities. These results are consistent with our hypothesis and most of the literature about the decrease in market liquidity after a transaction tax is imposed.

Changes in market volatility

Over the one year after CTT, there is mixed evidence of changes in the level of market volatility. In two of the three volatility measures (range and absolute return), there is an increase in volatility for GOLD. There is some evidence that the one-year, post-CTT volatility has also increased for SILVER and COPPER. Such evidence supports Kupiec 1996 about decreased trading by informed traders leading to higher volatility in prices. In the case of crude oil, there continues to be no significant increase in the volatility in the post-CTT period.

Changes in market efficiency

If we focus on the average basis risk of the bullion commodities (GOLD, SILVER, COPPER), there is a decrease in market efficiency in the one-year post-CTT period. The basis risk has seen a significant increase away from zero compared with the one-year pre-CTT period.

In summary, there is clear evidence of decreased market liquidity for all the commodities across all the measures in the post-CTT period. The GOLD contract also shows signs of significant lower market efficiency and higher market volatility. The evidence of lower market efficiency is visible for all the bullion commodities. Only the CRUDE OIL contract appears to have seen no impact of the CTT.

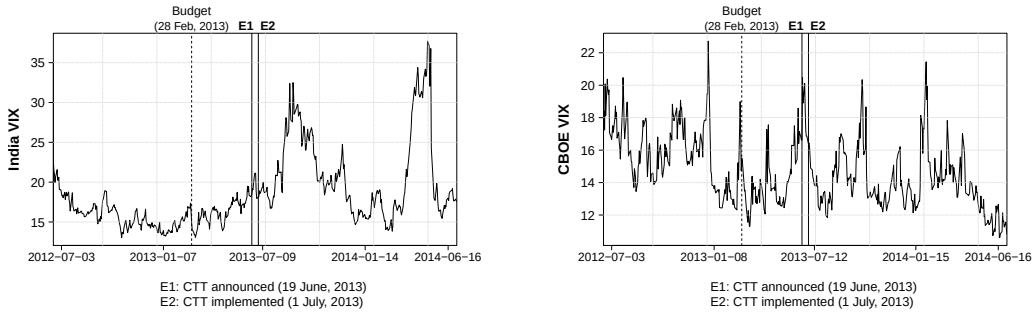
One of the problems with an event analysis carried out over the longer term is that the results could be vulnerable to other events and not just the event of interest. There are two ways in which we can argue that the observed

results are likely to have been because of CTT itself and not other factors: if the long term behaviour is consistently observed for all commodities, and if there are no other macro-economic changes that can explain the event.

We test whether there were changes in the global market conditions, as measured by the volatility indexes in the domestic and the global markets. For this, we examine the changes in the implied volatility index (VIX) calculated from the options markets prices in India and the U.S. around the same period when the CTT was imposed. We use the NSE VIX to measure the Indian volatility and the CBOE ViX to measure the U.S.volatility. The analysis is presented in Figure 2.

Figure 2 Daily market volatility: India VIX and CBOE VIX

The graphs show the daily time series of the Indian and the U.S. volatility index, the NSE India VIX and CBOE VIX, for the period from July 2012 to July 2014, a span covering one year before, and one year after, CTT was imposed in India.
The graphs show that in the period before CTT, India was a less volatile market with the NSE VIX being at and below 20% annualised, while the CBOE VIX reached slightly higher levels at 22%. However, in the period after the CTT, the Indian market had higher volatility while the CBOE VIX had a smaller range of volatility values.
This suggests that some changes in market quality of the commodity derivatives contracts are likely to have been driven by domestic macro-economic changes rather than global macro-economic changes or purely by the CTT.



We observe market volatility in the domestic market (India VIX) to be higher in the post-CTT period. This suggests that some of the changes in market quality are likely to have arisen out of macro-economic factors other than only CTT. Higher levels of domestic macro-economic volatility can help explain the higher post-CTT range and basis risk of the GOLD contract. In part, this can be because the impact of the CTT was the most severe for the liquidity of the GOLD contract, and liquidity and volatility tend to be positively correlated.

5.3 Benchmarking traded volumes without the CTT

The last question that we ask is what the estimated traded volumes on the exchange could have been without the CTT, as described in Section 3.2. We restrict our estimations to trading activity in the four commodities studied so far.

As described in Section 3.2, the first step in the procedure is to estimate the relationship between traded volumes on the MCX and CME. For this, we estimate a model for the ratio between traded volumes on the two exchanges from 2004 till CTT was introduced in 2013, using the equation presented in Section 3.2. Further, we use this pre-CTT relationship between CME and MCX to estimate the volumes at MCX for the post-CTT period. Since there is no change in the tax regime at CME. the relationship will be one indicator of what the MCX traded volumes could have been without CTT.

Table 8 Choice of estimation periods across commodities

The table below summarises the estimation periods selected for each commodity along with the regression coefficient (β) between the change in traded volume at MCX and the change in traded volume at CME, and the R^2 of the regression.

Commodity	Estimation period	β	R^2
GOLD	26 Aug 2009 – 18 June 2013	0.5638	0.4783
SILVER	4 Oct 2010 – 18 June 2013	0.5736	0.1083
COPPER	25 Nov 2009 – 18 June 2013	0.3250	0.1429
CRUDE OIL	17 May 2012 – 18 June 2013	0.0286	0.0033

A visual examination of the time series of traded volumes for these commodities on both the CME and the MCX can be done using the graphs in Figures 3 and 4. These graphs show that there are different regimes of the traded volume relationship between the CME and the MCX. Each regime is a different period with different levels of the relationship in the trading activity between these two exchanges. We identify these regimes using a structural breaks estimation approach.[5] We modify the equation in Section 3.2 to include the breakpoints in the estimation as follows:

$$log\left(\frac{\widehat{TV_{MCX,i,t}}}{TV_{MCX,i,t-1}}\right) = \alpha_i + \beta_i \times log\left(\frac{TV_{CME,t,t}}{TV_{CME,i,t-1}}\right) + D_{i,n} + \epsilon_i$$

[5]Identification of break-points in the CME TV time-series is done using Zeileis et al. 2003 to avoid forecasting errors.

where $D_{i,n}$ is a dummy capturing the n^{th} period break-point for the i^{th} commodity.

Figures 3 and 4 show that there are common dates on which there is a change in the trading volume relationship between the MCX and CME across the four commodities studied. Owing to shifts in regime in the traded volume series at both MCX and CME, we choose that regime or segment as the estimation period for each commodity which has the most optimal β and R^2 values. The dates of the estimation window along with the estimated β and the R^2 values for the different commodities are reported in 8. These capture broad trends in the commodity markets globally. The value of β obtained is used to estimate the daily traded value at MCX in the post-CTT period using the following equation:

$$\widehat{TV_{MCX,t}} = exp\left(\beta \times log\left(\frac{TV_{CME,t}}{TV_{CME,t-1}}\right)\right) \times TV_{MCX,t-1}$$

Figure 3 Regimes in the relationship between traded volumes at MCX and CME for GOLD and SILVER

The graphs below show the traded volumes of commodities at Multi Commodity Exchange (MCX) against traded volumes of corresponding contracts on Chicago Mercantile Exchange (CME). We use near month contracts of commodity futures for all our analysis. The dashed gray lines show the traded volumes at CME and the solid black lines represent traded volumes at MCX of the corresponding commodity futures contract. The vertical lines mark the break-points in the CME TV time-series. The dates of structural breaks are reported to the left of each line.

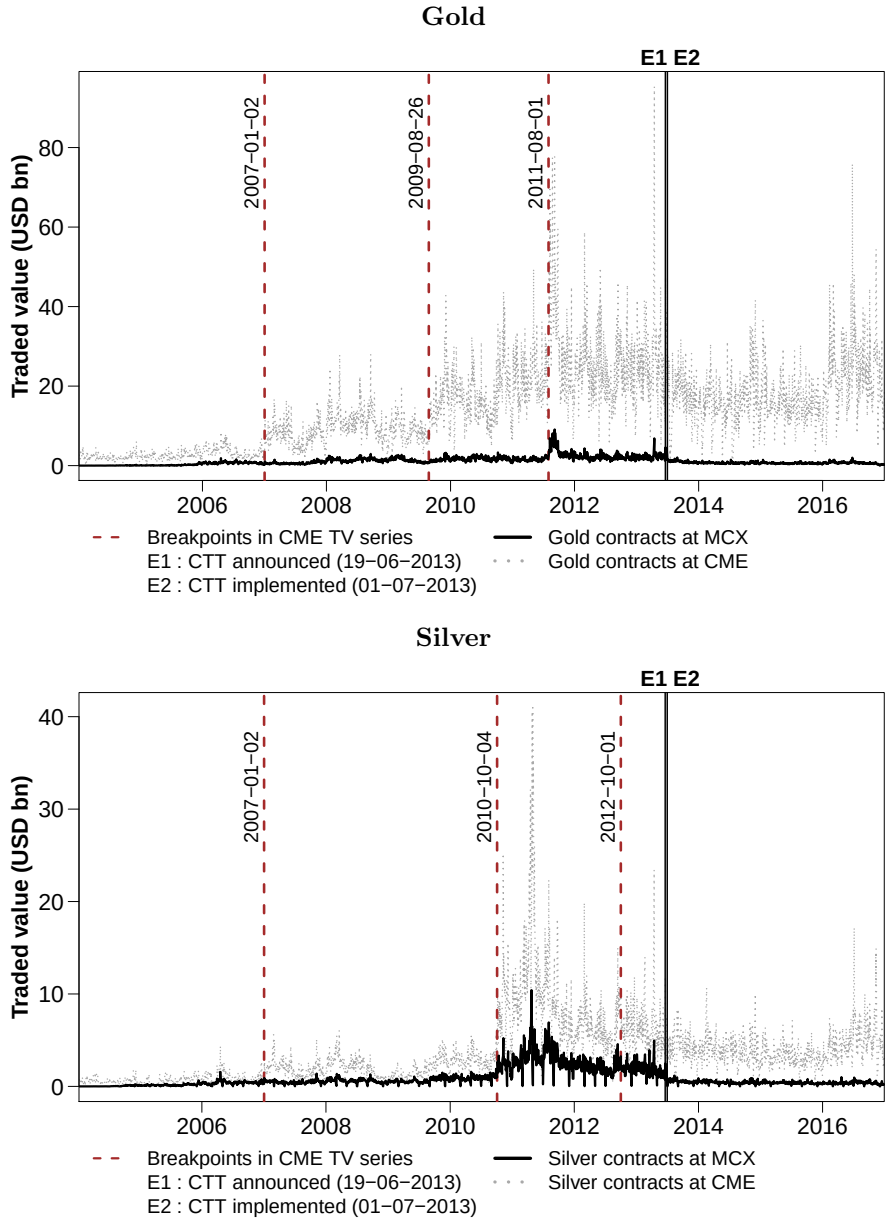
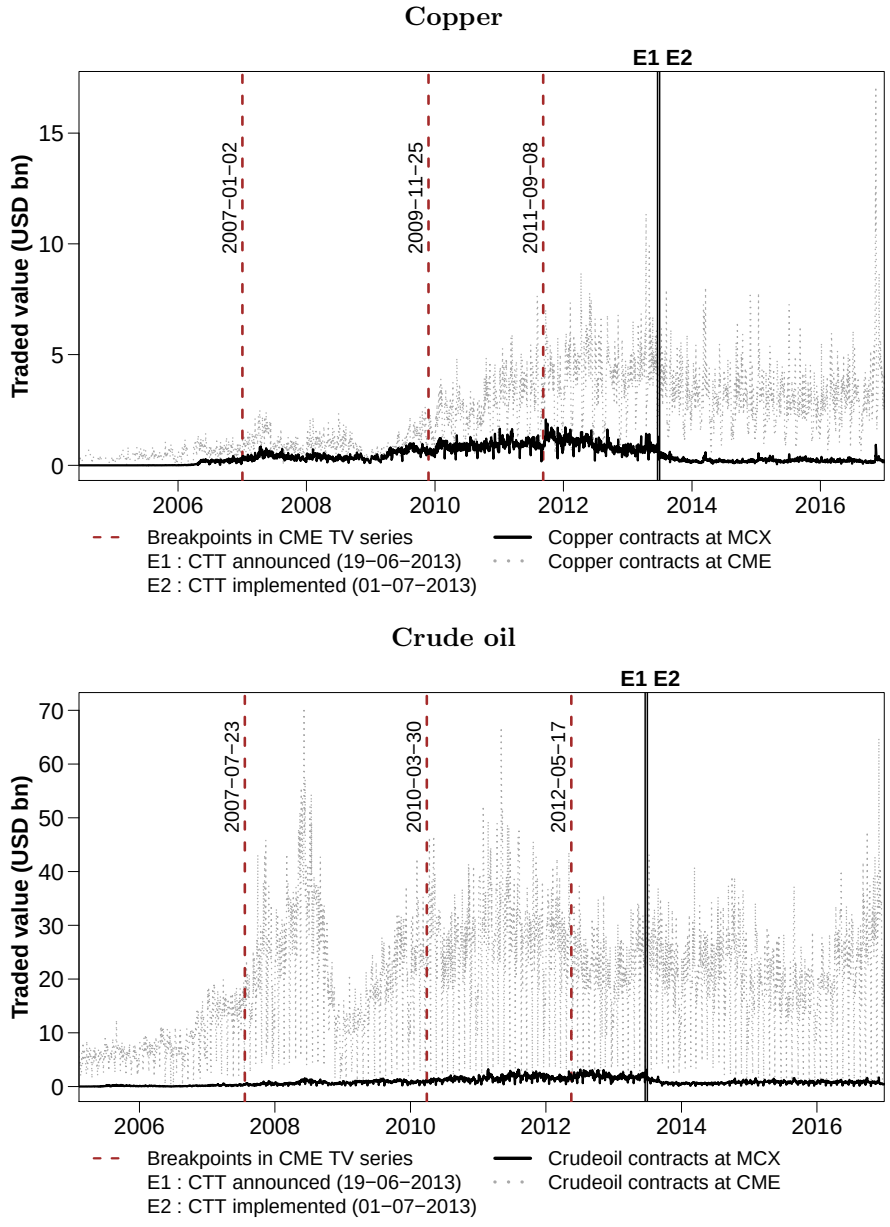


Figure 4 Regimes in the relationship between traded volumes at MCX and CME for COPPER and CRUDE OIL

The graphs below show the traded volumes of commodities at Multi Commodity Exchange (MCX) against traded volumes of corresponding contracts on Chicago Mercantile Exchange (CME). We use near month contracts of commodity futures for all our analysis. The dashed gray lines show the traded volumes at CME and the solid black lines represent traded volumes at MCX of the corresponding commodity futures contract. The vertical lines mark the break-points in the CME TV time-series. The dates of structural breaks are reported to the left of each line.



We use these estimated $\hat{\beta}$ values to obtain estimated traded values for each commodity at MCX after imposition of CTT, in relation to the traded volumes at CME. Estimated MCX traded values in the post-CTT period are obtained using the pre-CTT relationship between MCX and CME volumes, this is calculated as the product of the estimated $\hat{\beta}$ from Table 8 and the observed CME traded volumes.

Table 9 shows the difference between observed traded volume at MCX and the estimated traded volume in relation to the traded volumes at CME. The estimated values represent the no CTT hypothetical scenario. In table 9, we find that the observed volumes of each commodity analysed was at least 2× less compared to its estimated levels (our model). The point to stress is, these are the most liquid contracts trading on MCX which were hit so badly due to imposition of additional transactions costs. The exercise reinforces our hypothesis that volumes in the Indian commodities markets greatly shrunk as a result of CTT. From Figures 3 and 4, we know that there was already a large gap between CME and MCX volumes even in the pre-CTT period. In the post-CTT period, the difference between the traded volumes between the CME and the MCX worsened.

Table 9 Observed and estimated traded volumes at MCX, July 2013-Dec 2016

The table below shows the observed and estimated volumes (using our model) of commodities trading at MCX, expressed in Rs. trillion. The values reported are the cumulated traded volumes after the introduction of CTT, from 1 July 2013 through 31 Dec 2016.

	(Values in Rs. trillion)	
	Traded volumes	
	Actual	Estimated
GOLD	36.96	143.70
SILVER	21.39	66.26
COPPER	11.54	34.33
CRUDE OIL	40.67	112.28
Total	110.57	356.56

5.4 Summarising the results

We use the results in the above sections to present the following answers to the questions in Section 2.2:

Q1 Was volatility reduced after the imposition of the CTT? Did market efficiency and market liquidity also get adversely affected?

We find that there was no significant reduction in market volatility in the one-month period after CTT was imposed. There is a significant and systematic negative impact on the liquidity of the commodity futures markets, with a drop in both traded volumes as well as open interest in the one month period post-CTT.

The damage in terms of lower market quality is the highest in the case of the GOLD futures, which has lower liquidity, lower market efficiency and higher market volatility over the longer term of one-year after the CTT was imposed. Other than in traded volumes and open interest, there is no evidence that the CTT had any effect on the market quality of the CRUDE OIL futures at the MCX.

Q2 Did these changes persist, or was it a short-term phenomenon?

The changes do appear to persist beyond the immediate period when the CTT was applied. Some of the changes in market quality (loss in traded volumes, increase in basis risk) are significant in the one year, post-CTT period, but mostly for the bullion commodities (COPPER, GOLD and SILVER). As with the short-term (one month) results, there is no impact of the CTT on the one-year post CTT market quality of CRUDE OIL futures. In some part, the higher volatility may be explained by higher macro-economic volatility in India as measured by the VIX.

Q3 Is it possible to identify a benchmark for what the traded volumes could have been without the CTT?

We use the volumes on the CME as an instrument to estimate what the traded volumes could have been without CTT. The estimated values in Table 9 suggest that there is a 3× gap between the estimated values and the traded volumes observed in the post-CTT period.

In summary, the evidence is clear that traded volumes were effected when the CTT was put in place. These volumes saw a drop of at least 50 percent compared to the traded volumes in the period before the CTT. However, when we compare it to the estimated traded volumes based on the CME traded volumes in the similar period, we find that without CTT, the volumes can have been thrice the observed volumes.

In comparison, evidence of a change in the market volatility, either in the period immediately after the CTT was imposed or in the one year period after, is much weaker. The increase in volatility can be explained by a higher macro-economic volatility in the post-CTT period in India. This is similar to much of the empirical literature described in Section 2. Several studies describe a drop in liquidity and market size, and other describe no change in volatility.

6 Conclusion

In this paper, we attempt to empirically estimate the economic results of a transaction tax imposed on the commodity future trading, CTT, at the MCX. In keeping with the remainder of the literature on empirical studies of the impact of transaction taxes, we analyse what was the change in market volatility after the CTT was imposed. We augment the analysis with an empirical analysis of the change in other measures of market quality, specifically market liquidity and market efficiency. We restrict our analysis to four of the large non-agricultural commodity derivative products at the MCX, which includes gold, silver, copper and crude oil. These products made up for a significant fraction of the trading at the exchange.

Our results show that the economic effect of the CTT is negative, or zero in some cases. There is clear evidence that the liquidity of this market significantly decreased. This is visible for all the commodities and across all the measures that we use. The largest change is in the liquidity of the GOLD futures contract.

For the other measures of market quality similarly, the biggest changes are visible in the GOLD futures contract, and over the longer term horizon. There is no impact on the short-term market volatility for any of the commodities, using any of the measures. There is some evidence of higher volatility for the bullion commodities. CRUDE OIL has no evidence of significant changes in volatility either in the short or long term analysis, using any of the measures. This pattern is similar for market efficiency as well. There is evidence of deterioration of basis risk in the three bullion commodities futures in the post-CTT period but no impact in CRUDE OIL futures.

A transaction tax is often imposed as an instrument to reduce non-productive, excessive trading. One of the observations from studies of a transactions tax applied in other financial markets globally is the shift in traded volumes from a market with a transactions tax to a market without. This can include markets within the country, or to global markets.

When the CTT was imposed on commodities futures, there is likely to have been a shift in trading interest to a relatively less expensive market. Given the presence of the high STT incidence and costs on the equity spot and derivatives in India, it is more likely that traders shifted their trading either to international trading venues, or to domestic informal "dabba" markets.

Such a shift may not be clearly visible for commodities trading in India because the size of our commodities markets prior to CTT were already

significantly smaller compared to international exchanges like CME, as can be seen in Figures 3 and 4. But there is evidence that barriers to trading such as higher margin requirements or higher charges of trading in domestic markets lead to a shift in traded volumes to international competitors. This can be seen from the example of other Indian securities markets numbers like equity and currency, Table 10 presents a story of domestic markets losing market share in recent years to international competitor exchanges.

Table 10 International competitiveness of Indian derivatives

The table below presents traded volumes and open interest of Indian derivatives contracts on equity (futures and options on the NSE-50 index), commodities and currency (USD-INR futures). The international competitors to underlying in India include:

- Agri commodities: wheat (Chicago Merchantile Exchange, CME/Zhengzhou Commodities Exchange, ZCE), sugar (InterContinental Exchange, ICE/ZCE), cotton (ICE/ZCE), soyabean (CME/Dalian Commodities Exchange, (DCE)), soya oil (CME/DCE).
- Non-agri commodities: gold (CME/Shanghai Futures Exchange, SHFE), silver (CME/SHFE), crude oil (ICE), natural gas (CME).
- Currency derivatives: USD-INR futures. The international competitor is Dubai Gold and Commodities Exchange, DGCX.
- Equity derivatives: Index (NIFTY and SENSEX) futures and options. The international competitor is the Singapore Exchange, SGX.

The table shows aggregates at two different points in time – January to March 2016 and 2017. This shows whether Indian exchanges are gaining or losing market share on Indian underlyings in 2017 compared with 2016.

(All values are in USD billion)

	Q1-2016				**Q1-2017**			
	Traded Volumes		Open Interest		Traded Volumes		Open Interest	
	India	Intl.	India	Intl.	India	Intl.	India	Intl.
Commodity futures								
Agri commodities	0.067	10.020	0.097	24.290	0.150	30.741	0.335	55.570
Non-agri commodities	1.718	5.175	0.564	39.897	4.434	19.906	1.601	152.461
Currency derivatives								
Currency futures	3.230	1.900	5.650	3.520	6.720	4.290	12.870	20.610
Equity derivatives								
Index futures	1.970	0.200	3.800	4.500	4.380	0.530	11.300	16.520
Index options	30.450	0.001	22.760	0.220	63.650	0.000	65.540	0.880

Table 10 shows that traded volumes of Indian currency and equity markets, where India should fully dominate, have seen very small or no growth in the years 2016-2017. Whereas the traded volume on the same underlyings in the US and the newer Chinese exchanges have seen much higher growth. The report on the *Report of the Standing Council on international competitiveness of the Indian financial sector, Volume 1* 2013 examines a broader set of commodity derivatives traded in India as well as international exchanges.

The findings of the report substantiate the fact that that the traded volume of commodity contracts in India are much smaller than that in international exchanges. One reason stated often, in conversation with securities markets participants, for the worsening market share of India relative to global competitors for Indian securities, is that transactions taxes have worsened the competitive edge that India can offer to international investors on these products.

It is obvious that the loss of market share implies there is a loss of business revenue of transactions domestically and provide opportunities to exchanges abroad. What is also important for the policy maker to recognise and acknowledge is that price discovery takes place in the most liquid and the largest markets. As international exchanges become the preferred venue for trading Indian products, they will supplant domestic exchanges as the location of price discovery. It is thus important for policy to take into account such detrimental effects of the transactions tax in financial markets, and remove such anti-competitive barriers to price discovery and market liquidity.

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