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STUDY ON THE IMPACT OF THE TERMINAL MARKETS ON COCOA BEAN PRICES

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INTRODUCTION

1. In recent years, a number of market participants have called into question the economic efficiency of futures markets by arguing that speculative access was creating economic inefficiencies in commodity futures markets. Specifically, it was believed that speculative positions might influence the direction of cocoa futures markets prices, regardless of market fundamentals.

2. An additional source of concern was represented by the spill-over effects that speculative activities in foreign exchange markets might have on the London and New York cocoa terminal markets. Foreign exchange investors shift from the US Dollar to Pound Sterling and *vice versa*, in large part because of the expected difference in returns to holding assets. As a result, speculation in exchange rate markets could have spill-over effects on both New York Board of Trade (NYBOT) and London International Financial Futures Exchange (LIFFE) cocoa futures prices and volatility.

3. The general objective of this document is to evaluate the impact of exchange futures trading on cocoa prices and volatility. The specific objectives are the following:

- to illustrate the major characteristics of commodity futures markets;
- to compare specifications of both NYBOT and LIFFE cocoa futures contracts;
- to assess the economic efficiency of both LIFFE and NYBOT cocoa futures markets;
- to evaluate whether shocks in the exchange rate markets affect price and volatility in both NYBOT and LIFFE cocoa futures contracts; and
- to assess the impact of commercial and non-commercial trading activities on price and volatility in the NYBOT cocoa futures contracts. This last assessment could not be carried out in the LIFFE cocoa markets because information on the open interest broken down by typology of traders is not publicly available.

4. This document consists of six parts and two appendices. The first part describes the salient aspects of commodity futures exchanges. In this, emphasis is placed on the mechanisms that assure their functioning. In the second part, the attention moves on to the two major financial centres trading cocoa futures contracts: LIFFE and NYBOT. Differences and similarities between cocoa futures contracts from these two markets are discussed in detail. The third part provides an assessment of the effect of trading activities on price levels and volatility of both LIFFE and NYBOT cocoa futures market. The fourth part appraises the existence of eventual spill-over effects of the US Dollar/ Pound Sterling market on LIFFE and NYBOT. The fifth part describes some empirical evidence concerning Commercial and Non-Commercial Traders in the NYBOT cocoa futures markets. The sixth part evaluates the impact of Commercial and Non-Commercial traders in the NYBOT cocoa futures market. Finally, two appendices conclude the document. **Appendix 1** outlines data used in the empirical analysis, while methodological aspects are discussed in **Appendix 2**.

5. Thanks are due to the following experts and practitioners who commented on the earlier draft of this document: Christopher Gilbert, Tom Harrison and Robin Dand, as well as to Gavin Hill who kindly provided information about the legal aspects concerning LIFFE.

COMMODITY FUTURES MARKETS

6. The origin of futures markets can be traced back to the nineteenth century. At that time, merchandising relationships in the international market were revolutionized by the invention of the telegraph and by the introduction of steamships and railroads. As a result of these innovations, it was no longer required for traders and brokers to be physically present wherever a commodity was unloaded or stored. Instead, they found it more convenient to congregate and organize the exchange of futures contracts in so called futures markets.

7. A major difference exists between spot and futures markets. The difference is not based on the timing of the transaction, but rather on how prices are determined. In a cash market, prices are set at delivery time, while in a futures market, prices are set at the time of contract initiation.

8. A futures contract is a commitment to make or to take delivery of a specific quantity and quality of a given commodity at a predetermined place and time in the future. All contract terms are standardized and set in advance. The party committed to take delivery of the commodity is the “long”, while the party committed to make such delivery is the “short”.

9. Futures contracts for a particular commodity on a particular exchange are interchangeable, except for delivery time. Traders speak of the “May contract”, “the July contract”, etc. and synonymously, of the “May expiration”. The delivery month, which is about to end is called the “expiring” contract, the next contract the “nearby” contract, and those more than one year ahead are referred to as the “deferred” contracts. A comparable usage is to indicate the contracts as the “first position”, the “second position”, and so on.

10. A spread or basis exists among prices of cocoa futures contracts with different delivery months. The spread is said to be “contango” or “positive carrying charge”, when prices are progressively higher in the succeeding delivery months than in the nearest delivery month. On the other hand, the spread is said to be “backwardation” or “inverse carrying charge”, when prices of more distant delivery months are below the nearer’s price. The size and sign of the spread provide economic incentives to traders to store commodities. A “contango” spread will provide the economic incentives to buy and store the commodity because prices are expected to increase. For the opposite reason, a backwardation spread provides the economic incentive to sell the commodity.

11. A spread also exists between two contracts on different exchanges: LIFFE and NYBOT. In general if both LIFFE and NYBOT react in a similar manner to the release of new information, their spread should be equal to the transportation costs after accounting for the exchange rate and different quality specifications of deliverable growths in these centralized exchanges.

12. Finally, a spread also exists between futures and spot prices. In this case, traders speak of “basis”. The basis arises because of spatial, temporal and quality differences between the cash commodity and the futures contract specifications: $\text{Basis} = \text{Spatial Basis} + \text{Temporal Basis} + \text{Quality Basis}$.

13. Of these, the spatial and the temporal basis are the most important since these variables can be difficult to predict, while quality discounts/premiums are specified in futures contracts with respect to deliverable growths.

14. Futures contracts are traded in organized futures exchanges, such as the London International Financial Futures Exchange, the New York Board of Trade and the Tokyo Commodity Exchange. Organized exchanges are essential in the price discovery mechanism. In fact, they provide the facility and the trading platform that brings the buyers and sellers together. Moreover, they establish and enforce rules to ensure that trading takes place in an open and competitive environment. For this reason, all bids and offers must be made through the exchange's "clearinghouse", either through the exchange's electronic order-entry trading system, as in LIFFE, or in a designated trading pit by open outcry, as in NYBOT. As a result, the exchange's clearinghouse is acting as the buyer to all sellers and the seller to all buyers.

15. To enter into a transaction with the exchange's clearinghouse, a broker must deposit a specified amount of money to guarantee his or her commitment to the terms of the contract. This money is called "initial margin", and is a small proportion (i.e. 2 to 10%) of the total value of the contract. Once a contract is open, the position is "marked to the market" daily. If the futures position loses value (i.e., if the market moves against it – e.g., the trader is long and the market goes down), the amount of money in the margin account will decline accordingly. For example, if the price of cocoa declines one dollar per tonne or 10\$ per contract (i.e. a cocoa futures contract calls for delivery of a lot size of 10 tonnes of cocoa beans), this amount is subtracted from the accounts of all buyers and added to the accounts of all sellers. If the amount of money in the margin account falls below the specified maintenance margin (which is set at a level less than or equal to the initial margin), the futures trader will be required to post additional variation margin to bring the account up the initial margin level. On the other hand, if the futures position is profitable, the profits will be added to the margin account. It is worth noting that while the initial margin is small, a trader with a large and consistently losing position may have to tie up significant volumes of cash to maintain the margin.

16. Volume and open interest are the two most frequently cited statistics in reference to the trading activity of a futures contract. Each unit of volume represents a contract traded. When a trader buys a contract and another trader sells that same contract, the transaction is recorded as one contract being traded. On the other hand, open interest refers to the number of futures positions that have not been closed out either through offset or delivery. To illustrate this, we assume that a trader buys fifteen contracts and then sells ten of them back to the market before the end of the trading day. His trading activity adds twenty-five contracts to the day's total volume. Since five of the contracts were not offset, open interest would change by five contracts as a result of his activity.

17. Futures market participants fall into two general categories: hedgers and speculators. Hedgers are market participants who try to avoid or reduce a possible loss in the cash market by making counterbalancing investments in the futures market. On the other hand, speculators do not produce or use a commodity, but risk their own capital by trading futures in that commodity in the hope of making a profit on price changes.

18. Three different types of speculators can be distinguished: position traders, day traders and scalpers. Position traders are those speculators who have an opinion about general price trends and will

hold a position for several days or weeks. Day traders close out their positions by the end of the trading day (and avoid overnight margin calls). Finally, scalpers are exchange members who only hold positions for a few minutes or even seconds endeavouring to profit from the difference between the bid-ask spread.

COCOA FUTURES CONTRACTS

19. The London Financial Futures Exchange (LIFFE) and the New York Board of Trade (NYBOT) are by far the most important commodity exchanges for cocoa. The US Dollar/ Pound Sterling exchange rate assures the economic link between these two centralized exchanges. On a daily basis, LIFFE and the NYBOT are exchanging the equivalent of 0.2 million tonnes of cocoa, while the daily average number of futures contracts outstanding is equivalent to 2.5 million tonnes of cocoa. **Figure 1** and **Figure 2** graphically present the daily average volume and the daily open interest of cocoa futures contracts traded in LIFFE and NYBOT, respectively.

20. Trade in these centralized exchanges is believed to increase market transparency. In fact, all the actual and potential traders have equal access to the exchange prices. Moreover, by facilitating speculative access, the increased transparency should result in increased market efficiency.

21. LIFFE and NYBOT cocoa futures contracts are highly standardized, by specifying delivery months, trading units, daily price movement limits, quality of deliverable and delivery specifications. **Table 1** and **Table 2** summarize salient aspects of the cocoa futures contracts exchanged at LIFFE and NYBOT, respectively.

22. LIFFE trades cocoa futures contracts calling for delivery of a lot size of 10 tonnes of cocoa beans in the months of March, May, July, September and December. Cocoa futures contracts are exchanged through an electronic trading system from 9:30 a.m. to 4:50 p.m. Greenwich mean time (GMT). Futures contracts are priced in British pounds (£) with a minimum price movement of one Pound per tonne and no limit on daily price movements. LIFFE accepts delivery at licensed warehouses located in Amsterdam, Antwerp, Bremen, Felixstowe, Hamburg, Humberside, Le Havre, Liverpool, London, Rotterdam and Teesside. According to rule 4.08 of LIFFE Cocoa Futures Contract (i.e. Exchange Contract No.401), a price discount is applied to deliverable growths if cocoa beans do not meet exchanges' quality standards.

23. LIFFE is one of the seven Recognized Investment Exchanges (RIEs) in UK. Under the Financial Services and Markets Act 2000 (FSMA) part XVIII, the RIEs are exempt persons from the Financial Services Authority (FSA) handbook, and have regulatory obligations in effect deeming them to be front-line regulators of their own markets. Under this designation they have responsibility for, amongst other things, real-time and post-trade monitoring of those markets. RIEs are required to have market monitoring controls and procedures in place to monitor and detect, for example, abusive or manipulative behaviour as detailed in the Market Abuse Handbook.

24. In general, LIFFE monitors positions on a daily basis in the weeks leading into an expiry, paying particular attention to physically delivered contracts where there is greater potential for abusive squeezes, and will share with the FSA, under the FSMA gateways, any large or unusual positions in the course of the usual regulatory dialogue.

25. The NYBOT features cocoa futures contracts calling for delivery of a lot size of 10 tonnes of cocoa beans in the months of March, May, July, September and December. These contracts are exchanged in the NYBOT pit floor by open outcry from 8:00 a.m. to 11:50 a.m. eastern standard time (EST) every business day. Spot delivery is accepted at licensed warehouses in the Ports of the New York District, the Delaware River Port District, the Port of Hampton Roads as well as at the ports of Albany and Baltimore. Cocoa lots are then sampled and graded by exchange-licensed graders and they may be subject to price adjustments according to the quality standards set by the exchange.

26. The NYBOT cocoa futures contracts are priced in US dollars with a minimum price movement of one dollar per tonne and no limits on daily price movements. It is standard practice to pay a premium over the nearby futures contract prices for cocoa beans of high quality.

27. A third party, the US Commodity Futures Trading Commission (CFTC), monitors market activity in NYBOT. The CFTC identifies potential concentrations of market power within the cocoa futures market through its market surveillance programme: the Large-Trader Reporting System (LTRS). For example, in the case of the cocoa futures market the LTRS obliges traders holding more than 100 cocoa futures contracts to file a daily electronic confidential report with the CFTC about their market activity. The total amount of all the traders' positions reported to the CFTC represents approximately 70%-90% of the total open interest. The remaining part is constituted by smaller traders who do not pass the CFTC reporting threshold.

28. The CFTC uses the adjective "commercial" and "non-commercial" to classify commodity futures traders. A reportable trader gets classified as "commercial" if he/she is engaged in business activities hedged by the use of the futures and options markets. The adjective "non-commercial" is used to identify speculators.

29. Non-reportable position (NRP) participants are those traders whose commercial and non-commercial classifications are not known, because they hold a number of contracts below the reportable position threshold. For the cocoa futures market, this limit is set at 100 contracts per delivery month.

30. The CFTC is also responsible for the enforcement of speculative position limits, which are set to no more than 750 cocoa futures contracts for each delivery month.

PRICE LEVELS, PRICE VOLATILITY AND FUTURES TRADING IN LIFFE AND NYBOT

31. From a market microstructure perspective, price movements are caused by the release of new information which is then incorporated by trading processes into prices. If futures markets are efficient, then we expect that their prices react instantaneously to release of new market information. A natural way to evaluate the hypothesis of market efficiency is to examine the revisions in the forecasts of prices, volatility and trading activity after new information is released. If those revisions are equal to zero then the efficient market hypothesis (EMH) holds.

32. Price levels, price volatility and trading activity (i.e. volume de-trended by the open interest) are modelled through a linear simultaneous system of equations, in which each variable is explained by its own lagged values and by current and past values of the remaining variables. This linear system of

equations is also called vector of autoregression (VAR). One of the interesting aspects of a VAR is its ability to capture the dynamic interrelationships among the variables through the impulse response function. The latter can be thought of as a conceptual experiment during which the revisions in forecasts of all variables that would occur if some of the initial conditions were suddenly changed (i.e. a positive shock in one of the variables) are evaluated. Often the response is portrayed graphically, with time on the horizontal axis and the response on the vertical axis. The intuitive derivation of the impulse response function is depicted in **Figure 12** in **Appendix 2**.

33. Data and methods are outlined in **Appendix 1** and **2**, respectively. **Figure 3** illustrates the revisions in forecasts of prices, volatility, and trading activity in the LIFEE cocoa futures markets after new market information is released. Unequivocally, empirical results suggest that LIFEE cocoa market adheres to the EMH. In the econometric exercise, the release of a new market information, e.g. a one-day delay in major shipment ports, has been simulated by a price shock of +1.8% at time $t=0$. Then, we have calculated the revisions in the forecast of prices, volatility and trading activity in the subsequent days, e.g. from time $t=1$ to $t=15$. Results suggest that those revisions are substantially equal to zero. This result implies that LIFEE has incorporated instantaneously the new market information as shown in **Figure 3**. As a result, nobody can forecast LIFEE cocoa prices using all public available information.

34. **Figure 4** illustrates the revisions in forecasts of prices, volatility, and trading activity in the NYBOT cocoa futures markets after new market information is released. Results suggest that also the NYBOT has reacted instantaneously to the release of new market information. In fact, after the revision in the forecast of prices, volatility and trading activities are substantially equal to zero. As a result, also in the NYBOT cocoa market traders cannot forecast NYBOT cocoa prices using all the available public information.

35. Results suggest that both LIFEE and NYBOT react instantaneously to the release of new market information. As a result, traders cannot profit from any trading mechanism attempting to forecast prices. The major implication of this result is that the price discovery mechanism in these centralized exchanges is efficient and that futures prices are unbiased forecasts of spot market prices.

THE US DOLLAR/POUND STERLING EXCHANGE RATE AND ITS IMPACT ON PRICE, VOLATILITY IN LIFEE AND NYBOT

36. Foreign exchange investors shift from the US Dollar to the Pound Sterling and vice versa in large part because of the expected difference in returns to holding assets. As a result, herd behaviour in this financial market might exacerbate changes in prices and volatility in both LIFEE and NYBOT cocoa markets.

37. This issue has been investigated assessing whether shocks in the Dollar/Pound Sterling exchange rate have an impact on price level and price volatility of LIFEE and NYBOT cocoa futures contracts. Using the VAR approach, as previously outlined, and accounting for the statistical property of the exchange rate and the LIFEE and NYBOT prices (i.e. co-integration), revisions in forecasted prices and volatility have been computed after new information was released (i.e. shocks in the exchange rate) in such exchange rate markets. Results suggest that both LIFEE and NYBOT cocoa prices are not affected by shocks in the exchange rate (see **Figure 5**). On the other hand, revisions in forecasted

volatility of LIFFE and NYBOT cocoa prices are registered with some delays after the shock in the exchange rate (see **Figure 6**). However, the magnitude of this revision is quite small, i.e. +0.04%, and can be considered negligible.

38. These results suggest: first, LIFFE and NYBOT cocoa markets converge toward the same price equilibrium after accounting for the different sets of premium/discount applied to deliverable growths; and second, the hypothesis of spill-over effects between exchange rate markets and LIFFE and NYBOT cocoa market is ruled out. As a result, speculation activity in the currency markets does not have any impact on cocoa futures price levels and volatility.

COMMERCIAL AND NON-COMMERCIAL TRADERS IN NYBOT COCOA FUTURES MARKETS

39. The US CFTC, through its market surveillance programme (i.e. LTRS), reports on the trade activities of commercial and non-commercial traders in the NYBOT cocoa futures markets. From these data it is possible to assess the trading activity of both commercial (i.e. hedgers) and non-commercial traders (i.e. speculators – position traders). **Table 3** reports on statistical averages (“means”) of daily open interest, trading volume, and the turnover ratio by type of traders in the NYBOT cocoa futures markets from January 1986 to December 2005. The turnover ratio is defined as the ratio of the average volume to average open interest. It quantifies the share of the open interest that is settled at the end of the daily trading session. In addition to hedgers and speculators, **Table 3** reports statistics for another category of futures market participants: “other traders”. They are market participants with a non-reportable position, e.g. less than 100 cocoa futures contracts.

40. On average, hedgers have a higher open interest than speculators and “other traders”. They account for 69% of all “open” cocoa futures contracts in the NYBOT. However, their relative trading activity is rather low. In fact, on average, they are expected to settle only eight per cent of their open positions at the end of the trading session.

41. Speculators are more active traders than hedgers. On a daily basis, they settle 24% of their open positions. However, speculators’ open interest accounts for only 16% of all “open” cocoa futures contracts in the NYBOT.

42. **Figure 7** illustrates the average daily open interest for all traded contracts broken down by type of traders from January 1986 to December 2005. A high correlation exists between hedgers’ open interest and the total open interest. Not surprisingly, hedgers account for more than two out of three of all open positions in the cocoa futures markets. Finally, speculators and “other traders” contribute to the remaining part with an equal share.

43. **Figure 8** compares the trade activity of hedgers and speculators over time, by plotting the average daily volume for all traded contracts broken down by type of traders from January 1986 to December 2005. Interestingly, speculators’ and hedgers’ average daily volume follow similar patterns and have approximately similar sizes. As a result, there are no differences in absolute terms between hedgers’ and speculators’ trade activity.

44. **Figure 9** depicts the average daily net positions of hedgers and speculators in the NYBOT cocoa futures markets from January 1986 to December 2005. On the vertical axis, a positive value indicates

a net “long” position (i.e. traders are net buyers of cocoa futures contracts), whereas a negative value corresponds to a net “short” position. Interestingly, the average net positions of hedgers and speculators always have opposite signs. This evidence suggests that speculators facilitate risk transfer in the NYBOT cocoa futures markets.

PRICE LEVELS, PRICE VOLATILITY AND TRADING ACTIVITY OF DIFFERENT TYPES OF TRADERS IN THE NYBOT COCOA FUTURES MARKETS

45. In recent years, a number of market participants raised issues on the economic efficiency of cocoa terminal markets. Specifically, they believe that speculative access may influence the direction of cocoa futures markets prices, regardless of market fundamentals. To address this issue, the impact of trading activities of different types of traders in the NYBOT cocoa markets has been evaluated. Data used in the analysis are illustrated in **Appendix 1**. The same analysis could not be carried in LIFFE because of a lack of data on open interest broken down by typology of traders.

46. A VAR has been estimated to capture the dynamics interrelationships among price level, price volatility and trading activities of different types of traders. Exogenous shocks in trading activities have been simulated to assess how price levels and volatility would react if either commercial or non-commercial or other types of traders increased their trading volume. The impact of these exogenous shocks has been evaluated in term of forecast revisions with respect to a baseline scenario (i.e. no shock). Finally, for completeness we have traced out also the effect of price shocks on volatility and vice versa.

47. Concerning the impact of speculation activity on price volatility, two competitive hypotheses can be formulated. On the one hand, speculation activity increases price volatility by exacerbating the price movements in one direction or in the other. On the other hand, speculation reduces price volatility, by increasing market liquidity. **Figure 10** illustrates the revisions in forecasted volatility because of shocks in trading activity of commercial, non-commercial and “other” traders and in prices. According to our results, shocks in trading activities of commercial, non-commercial and “other” traders reduce instantaneously price volatility by -0.18, -0.13 and -0.03%, respectively. As a result, speculation does not increase price volatility in the NYBOT cocoa markets. On the contrary, speculation reduces price volatility by increasing market liquidity. Finally, results suggest that volatility is expected to increase by 0.48% in response to a positive price shock. However, this initial impact will gradually decline and disappear after six weeks.

48. Concerning the impact of trading activity on price level, we expect the existence of correlation between the two. However, we cannot set a benchmark, by specifying the direction of such correlation, because of a lack of a satisfactory theoretical framework for price-volume relationship in futures markets. **Figure 11** illustrates the revisions in forecasted price level because of shocks in trading activity of commercial, non-commercial and “other” traders and volatility. Shocks in trading volume of commercial, non-commercial and non-reportable positions will decrease trading prices in the range of 0.2 to 0.4%. Then, they will disappear in four weeks. This result indicates that in our sample the volume of transactions in which the price change is negative is larger than the volume of transactions in which the price change is positive. As a result, on average, “bear” traders have outnumbered “bulls” in the NYBOT cocoa markets. Finally, a positive shock in volatility (i.e. an increase in the spread between the maximum and minimum price) will raise the price initially by 0.77%. Afterwards,

revisions in forecasted prices will converge toward zero in four weeks. This result is confirming the existence of a positive relationship between price and volatility.

49. Results from this analysis suggest that non-commercial traders, specifically long position traders, do not exacerbate the volatility in the New York cocoa terminal market. Indeed, their trade activity has to some extent a stabilizing role because it raises market liquidity. Finally, it is worth noting that because price and volatility are positively related, non-commercial trading slightly reduces cocoa future prices by -0.42%. However, this effect is only temporary.

CONCLUSIONS

50. The New York Board of Trade and the London International Financial Futures Exchange are the two major financial centres trading cocoa futures contracts. A cocoa futures contract is a standardized agreement to purchase or sell cocoa beans for delivery in the future: (1) at a price that is determined at initiation of the contract; (2) that obligates each party to the contract to fulfil the contract at the specified price; (3) that is used to assume or shift price risk; and (4) that may be satisfied by delivery or offset by an opposite transaction on the futures market.

51. Cocoa futures markets offer four major advantages to market participants: price discovery mechanism, leverage, liquidity and transparency. The price discovery mechanism is the process through which price is determined in the marketplace. Leverage is the ability of a trader to control large amounts of a commodity with comparatively small amounts of money. Liquidity is a characteristic of the market to absorb large transactions without a substantial change in the price. Finally, the cocoa futures market is considered transparent because the order flow is open and fair, and everyone has an equal opportunity to trade in the market.

52. However, for many people, trading in the futures markets is seen as a suspicious activity. A major issue in recent years has been the role that large, managed futures funds and pools play in the futures markets. A number of market participants argue that managed trading in the futures markets increases price volatility because of the large size of managed futures trading volume and their herd behaviour.

53. Empirical findings suggest that both LIFFE and NYBOT react instantaneously to the release of new market information. This means that traders cannot profit from any trading mechanism attempting to forecast prices. As a result, the price discovery mechanism in these centralized exchanges is efficient and futures prices are unbiased forecasts of spot prices. Moreover, trading activities in the exchange rate market seem to have a negligible impact on the London and New York cocoa terminals. Results suggest that shocks in US Dollar/Pound Sterling exchange rate increase price volatility of both LIFEE and NYBOT cocoa futures contracts slightly (i.e. +0.03%) and temporarily (i.e. two trading days).

54. Results from the analysis of the impact of non-commercial traders in the NYBOT cocoa futures market indicate that non-commercial traders do not exacerbate the volatility of cocoa futures contract prices. Indeed, their trade activity seems to have a stabilizing effect.

55. However, caution has to be exercised in the interpretation of these last findings. In fact, these tests have been carried out using only the speculators' reportable positions recorded on each Tuesday by the

US Commodity Futures Trade Commission. As a result, this investigation does not account for speculators' activity in other trading sessions of the week. The US Commodity Futures Trading Commission has denied ICCO access to higher frequency data, because open interest broken down by typology of traders on daily basis would, in their view disclose privileged commercial and financial information.

56. An analysis using a larger amount data could provide a different conclusion. Daily data on the open interest broken down by type of traders would allow us to appraise the impact of day traders, e.g. speculators holding their positions overnight, on price level and volatility of cocoa futures contracts. On the other hand, trading data with a frequency of 15 minutes would be necessary if the focus of the investigation is the impact of scalpers, e.g. speculators not holding their positions overnight, on price volatility of cocoa futures markets.

TABLES AND FIGURES

Table 1. Specifications of cocoa futures contracts traded at the London International Financial Futures Exchange (LIFFE)

Item	Contract Specifications
Unit of trading	10 metric tonnes
Delivery Months	March, May, July, September and December
Delivery Units	Standard Delivery Unit - bagged cocoa with a nominal net weight of ten tonnes Large Delivery Unit – bagged cocoa with a nominal net weight of 100 tonnes Bulk Delivery Unit – loose cocoa with a nominal net weight of 1,000 tonnes
Delivery points	At licensed warehouses in Amsterdam, Antwerp, Bremen, Felixstowe, Hamburg, Humberside, Le Havre, Liverpool, London, Rotterdam, or Teesside
Deliverable growths	Cocoas are divided into four classifications: Group 1, deliverable at par (Ghana, Côte d'Ivoire, Nigeria, Sierra Leone, Togo, Cameroon, Equatorial Guinea, Democratic Republic of Congo -formerly known as Zaire-, Western Samoa, Grenada Fine Estates, Trinidad & Tobago, and Jamaica); Group 2, deliverable at a discount of £25/tonne (São Tomé and Príncipe, and Sri Lanka); Group 3 deliverable at discount of £50/tonne: Brazil Bahia Superior, Brazil Vitoria Superior, Ecuador and Papua New Guinea); Group 4 deliverable at discount of £75/tonne (Malaysia); Group 5 deliverable at a discount of £100/tonne (any other origin)
Price basis	Pounds sterling per tonne
Minimum price movement	£ 1.00 per tonne
Daily price movement limits	None
Position limits	None
Trading hours	From 9:30 a.m. to 4:50 p.m. Greenwich Mean Time (GMT)

Table 2. Specifications of cocoa futures contracts traded at the New York Board of Trade (NYBOT).

Item	Contract Specifications
Unit of Trading	10 metric tonnes
Delivery Months	March, May, July, September and December
Delivery Units	Standard Delivery Unit - bagged cocoa with a nominal net weight of ten tonnes Large Delivery Unit – bagged cocoa with a nominal net weight of 100 tonnes Bulk Delivery Unit – loose cocoa with a nominal net weight of 1,000 tonnes
Delivery points	At licensed warehouses at the Port of New York District, Delaware River Port District, or Port of Hampton Roads. Commencing with the May 2006 delivery, the ports of Albany and Baltimore have also become delivery points
Deliverable growths	Cocoas are divided into three classifications: Group A, deliverable at a premium of \$160/tonne (including the main crops of Ghana, Nigeria, Ivory Coast, among others); Group B, deliverable at a premium of \$80.00/tonne (includes Bahia, Arriba, Venezuela, among others); Group C, deliverable at par (includes Sanchez*, Haiti, Malaysia and all others). *Commencing with the May 2007 delivery, Sanchez moved to Group B.
Price basis	US dollar per metric tonne
Minimum price movement	\$1.00 per metric tonne
Daily price movement limits	No limits
Position limits	No more than 750 contracts per delivery month
Trading hours	From 8:00 a.m. to 11:50 a.m. eastern standard time (EST)

Table 3. Statistical averages (“means”) of daily open interest, trading volume, and turnover ratio by type of traders in the NYBOT cocoa futures markets from 4 January 1994 to 30 December 2005.

	Open Interest (no. of contracts)	Volume (no. of contracts)	Turnover ratio
Hedgers	54,518	4,386	8%
Speculators	12,924	3,061	24%
“Other traders”	12,145	1,941	16%

FIGURE 1. DAILY AVERAGE VOLUME IN LIFFE AND NYBOT COCOA FUTURES CONTRACTS FROM JANUARY 2002 TO DECEMBER 2005.

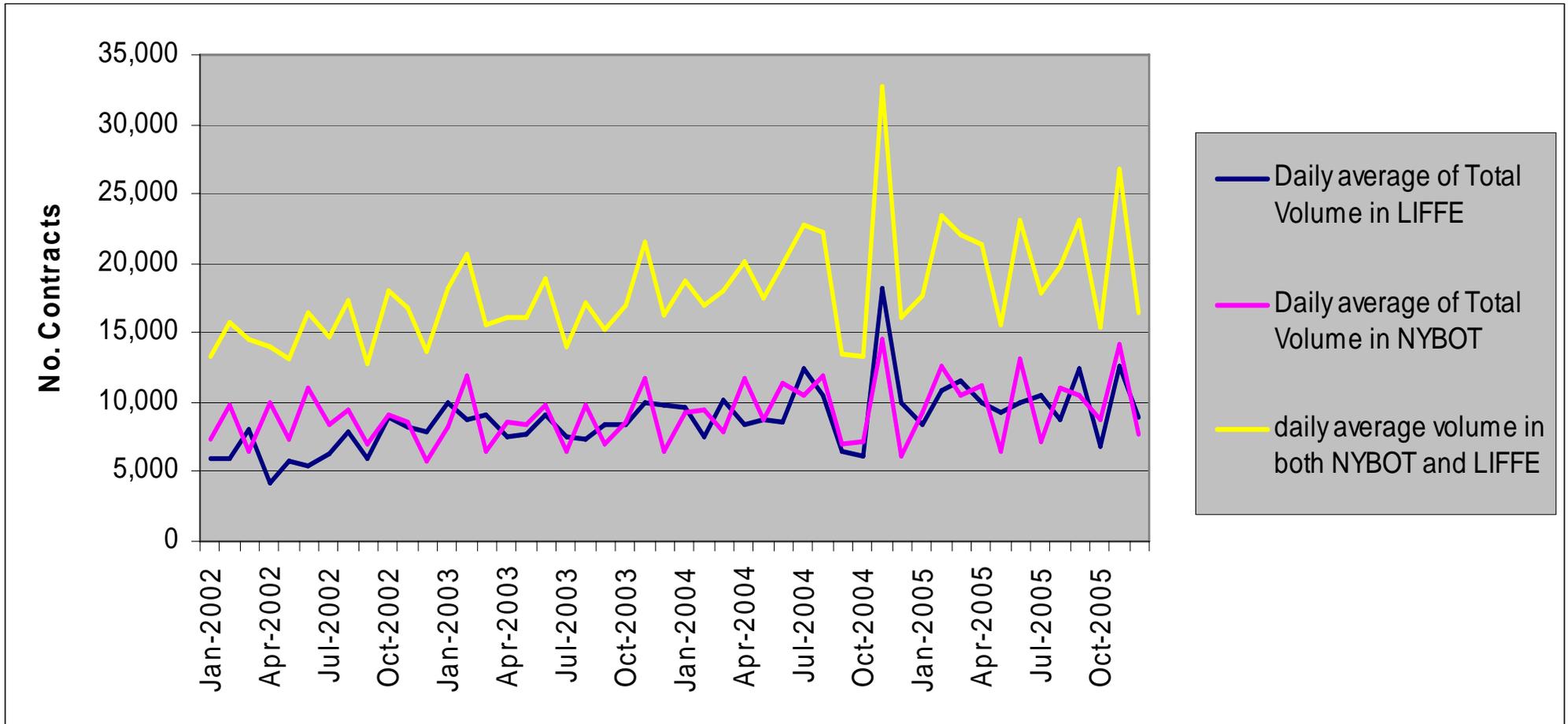


FIGURE 2. DAILY AVERAGE OPEN INTEREST IN LIFFE AND NYBOT COCOA FUTURES CONTRACTS FROM JANUARY 2002 TO DECEMBER 2005.

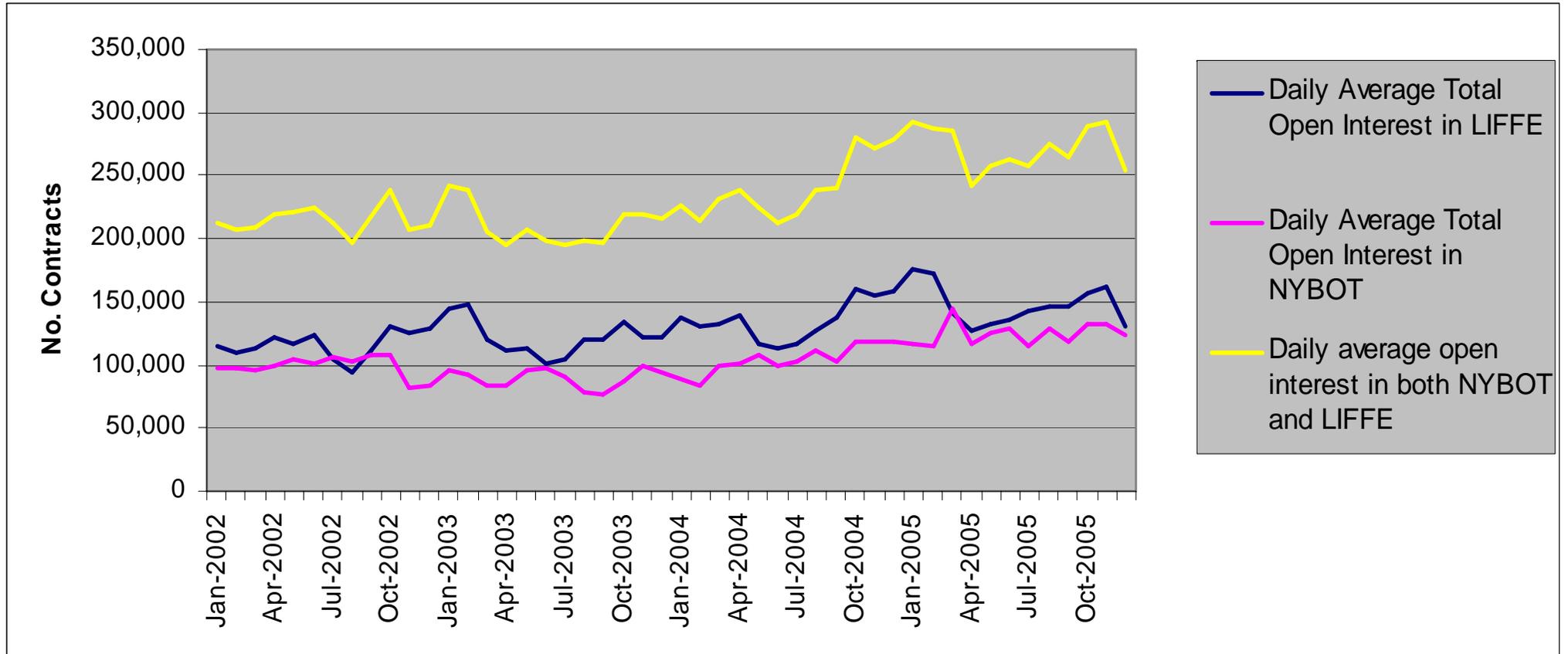


FIGURE 3. REVISIONS IN THE FORECAST OF CLOSING PRICES, VOLATILITY AND TRADING ACTIVITIES IN THE LIFFE COCOA FUTURES MARKET AFTER THE RELEASE OF NEW MARKET INFORMATION.

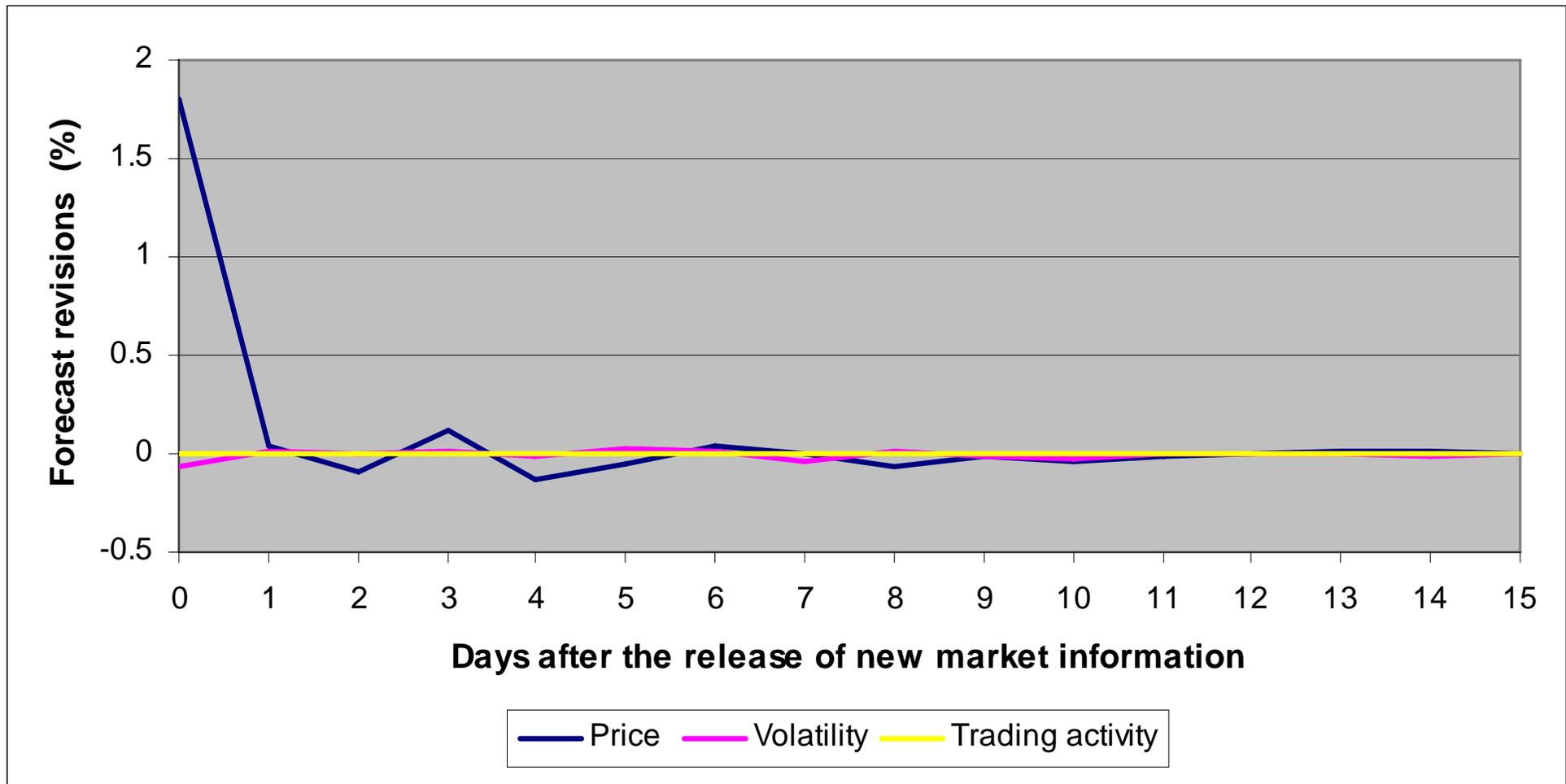


FIGURE 4. REVISIONS IN THE FORECAST OF CLOSING PRICES, VOLATILITY AND TRADING ACTIVITIES IN THE NYBOT COCOA FUTURES MARKET AFTER THE RELEASE OF NEW MARKET INFORMATION.

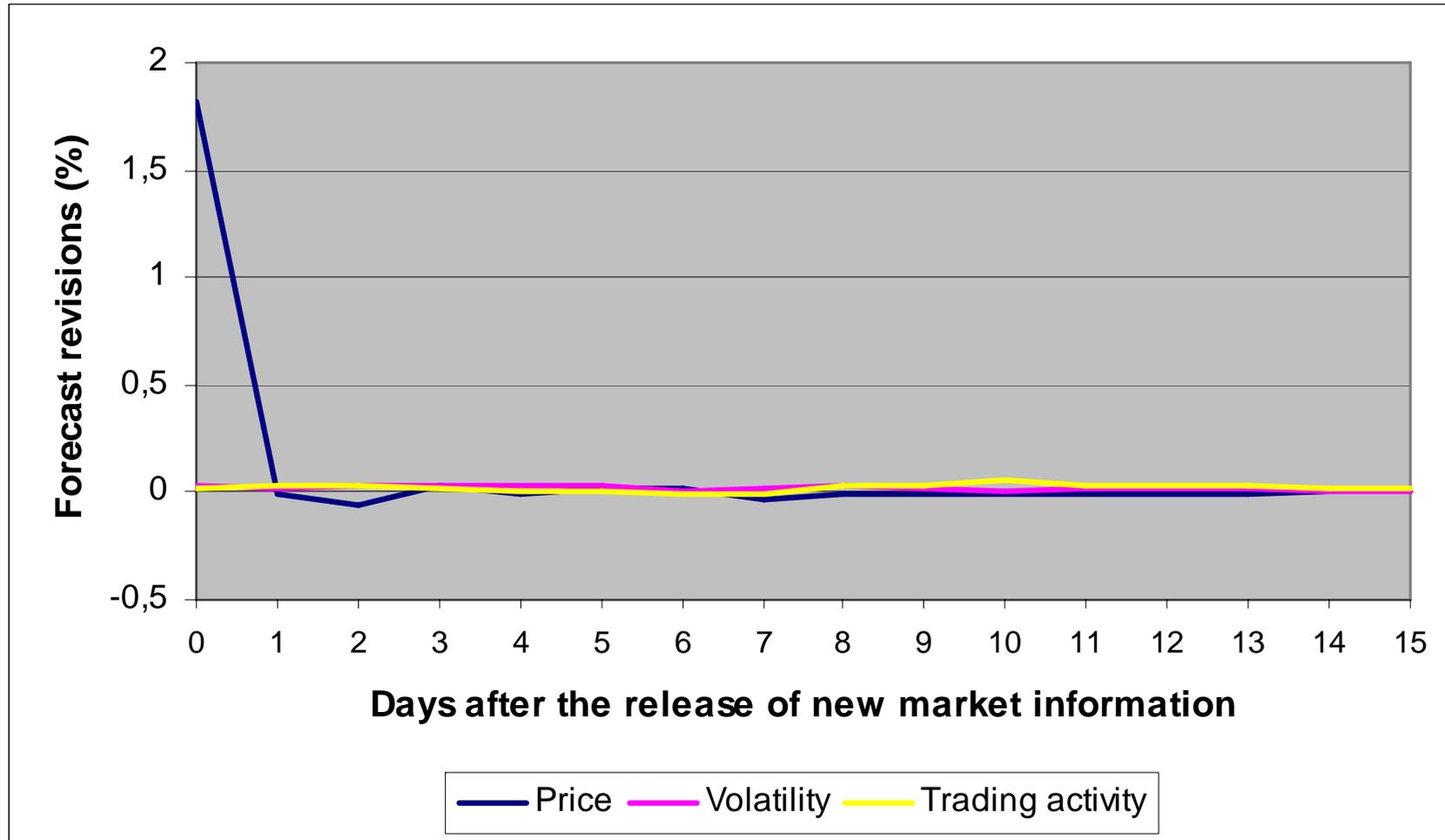


FIGURE 5. REVISIONS IN THE FORECASTS OF LIFFE AND NYBOT COCOA CLOSING PRICES AFTER NEW INFORMATION ON THE EXCHANGE RATE MARKET ARE RELEASED.

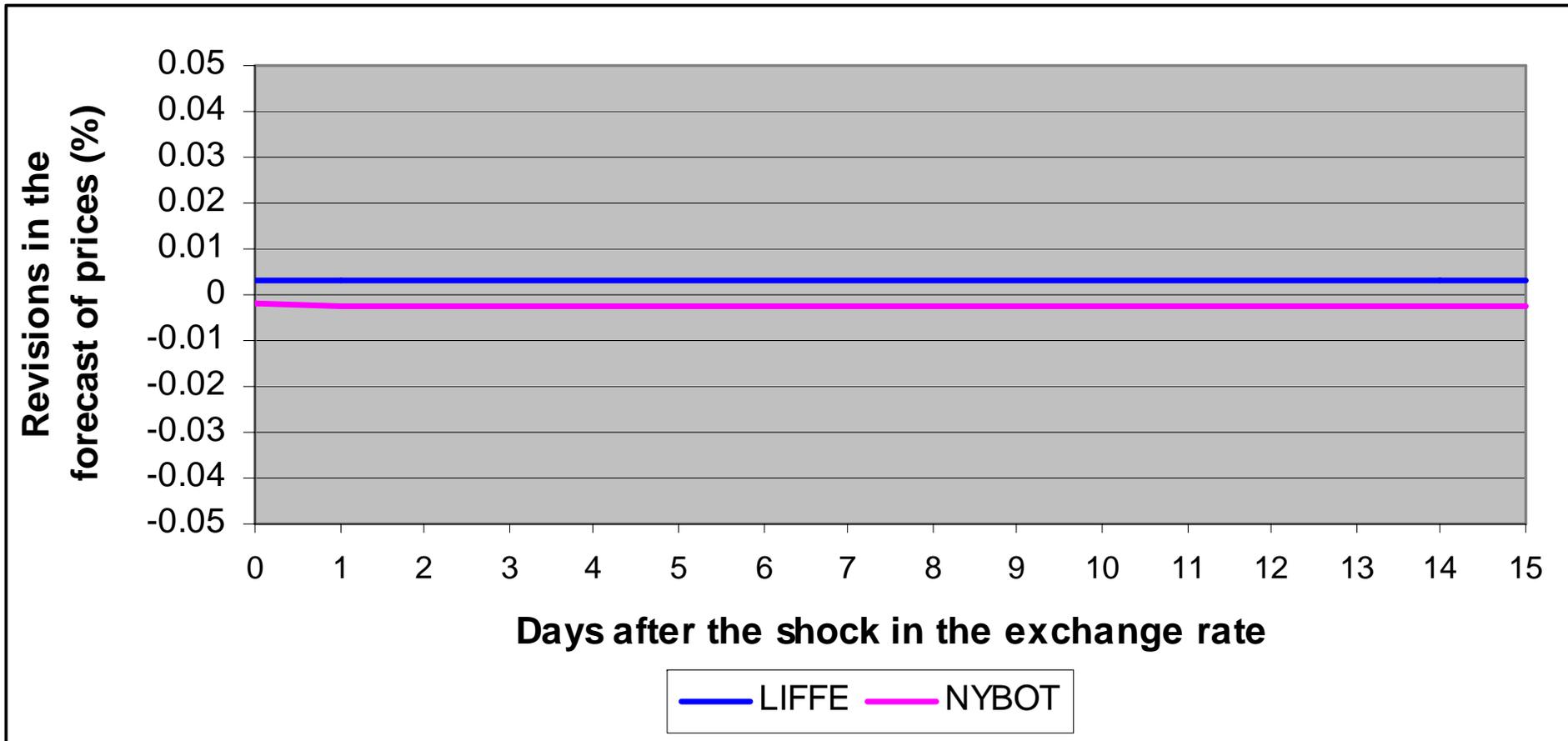


FIGURE 6. REVISIONS IN THE FORECASTS OF VOLATILITY OF LIFFE AND NYBOT COCOA PRICES AFTER NEW INFORMATION ON THE EXCHANGE RATE MARKET ARE RELEASED.

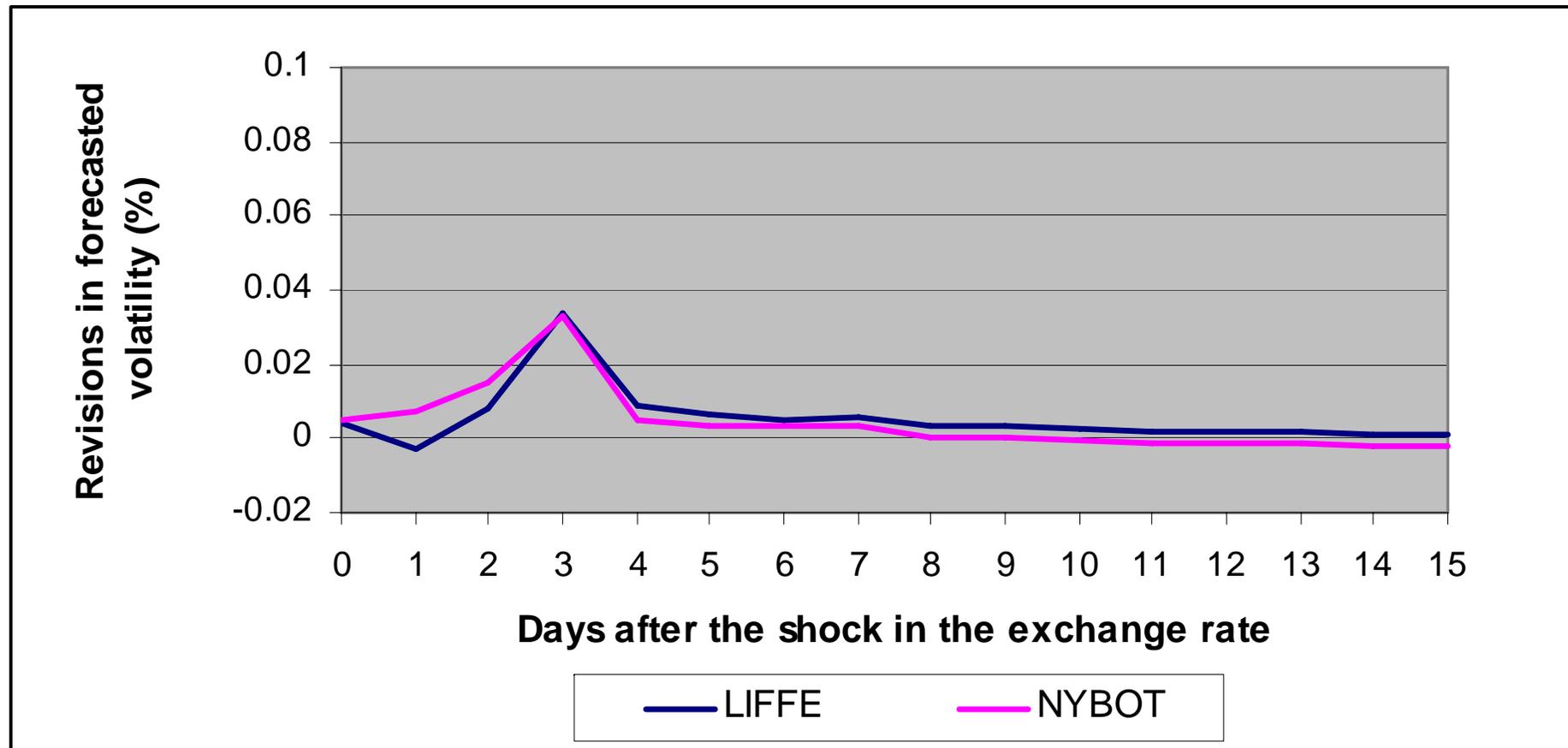


FIGURE 7. OPEN INTEREST BROKEN DOWN IN COMMERCIAL (COMM), NON-COMMERCIAL (NonCOMM) AND NON REPORTABLE (NonREPT) POSITIONS IN THE NYBOT COCOA FUTURES MARKETS FROM JANUARY 1986 TO DECEMBER 2005.

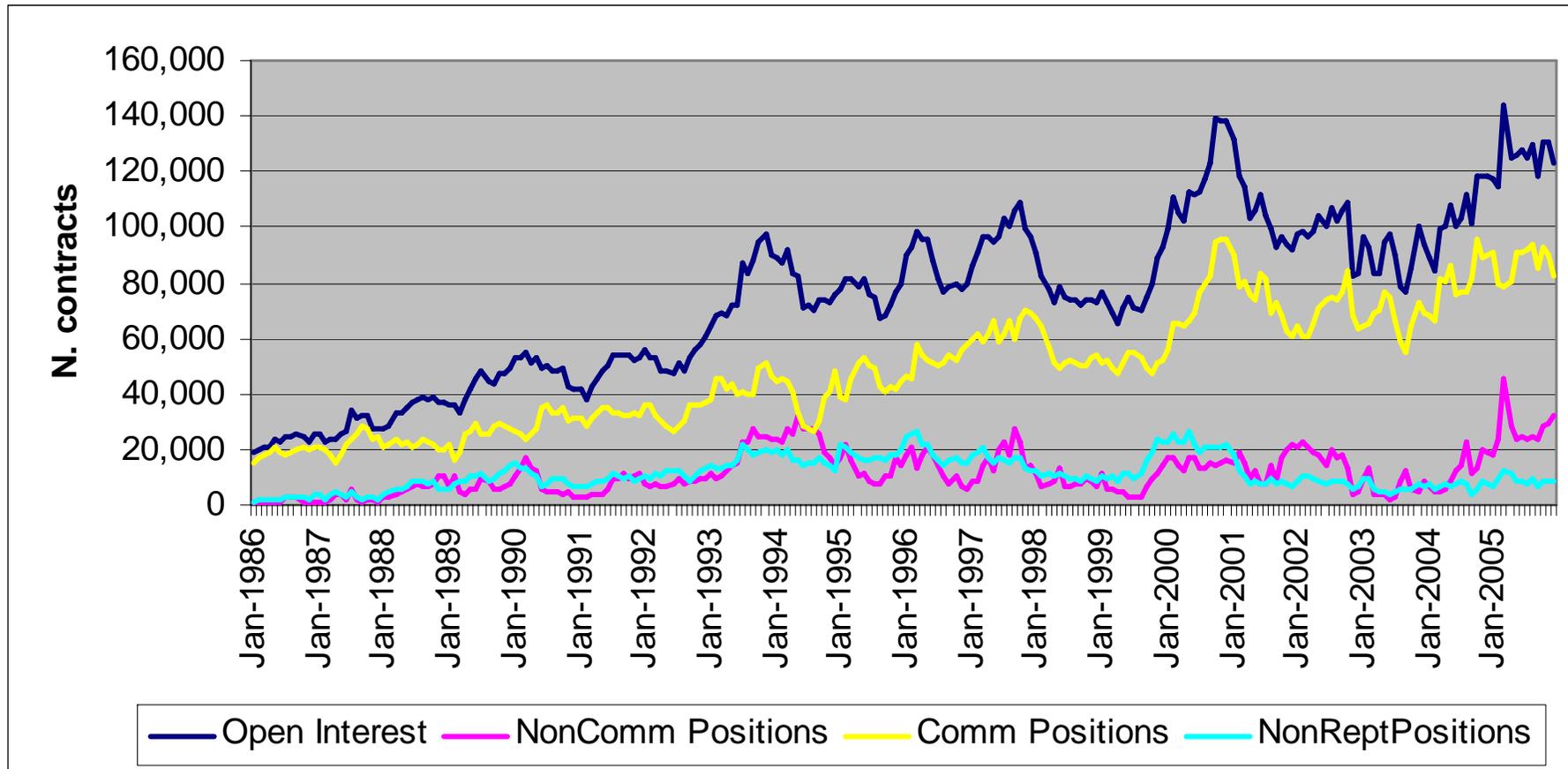


FIGURE 8. VOLUME BROKEN DOWN IN COMMERCIAL (COMM), NON-COMMERCIAL (NONCOMM) AND NON REPORTABLE (NONREPT) POSITIONS IN THE NYBOT COCOA FUTURES MARKETS FROM JANUARY 1986 TO DECEMBER 2005.

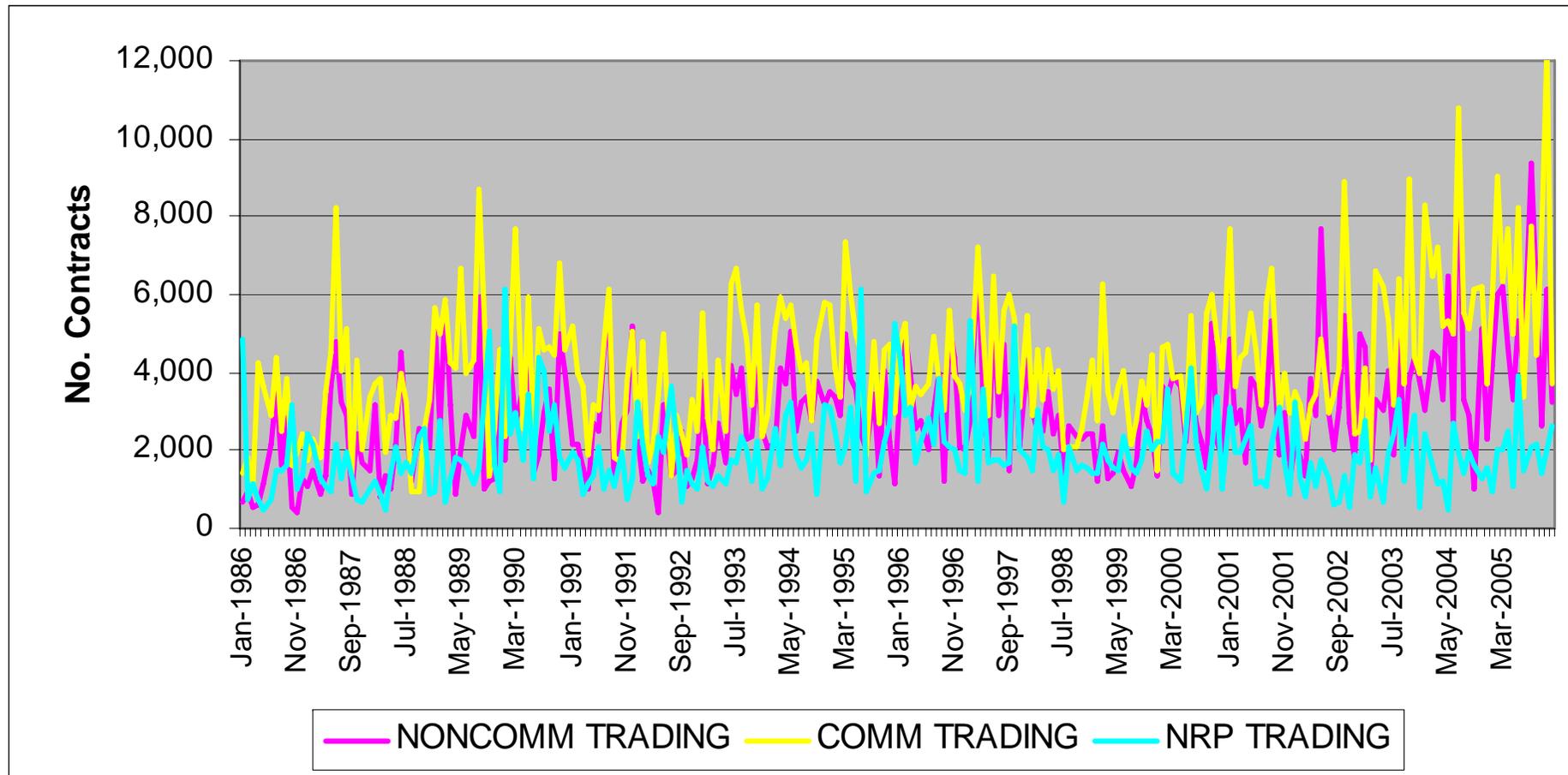


FIGURE 9. COMMERCIAL AND NON-COMMERCIAL NET POSITIONS IN THE NYBOT COCOA FUTURES MARKETS FROM JANUARY 1986 TO DECEMBER 2005.

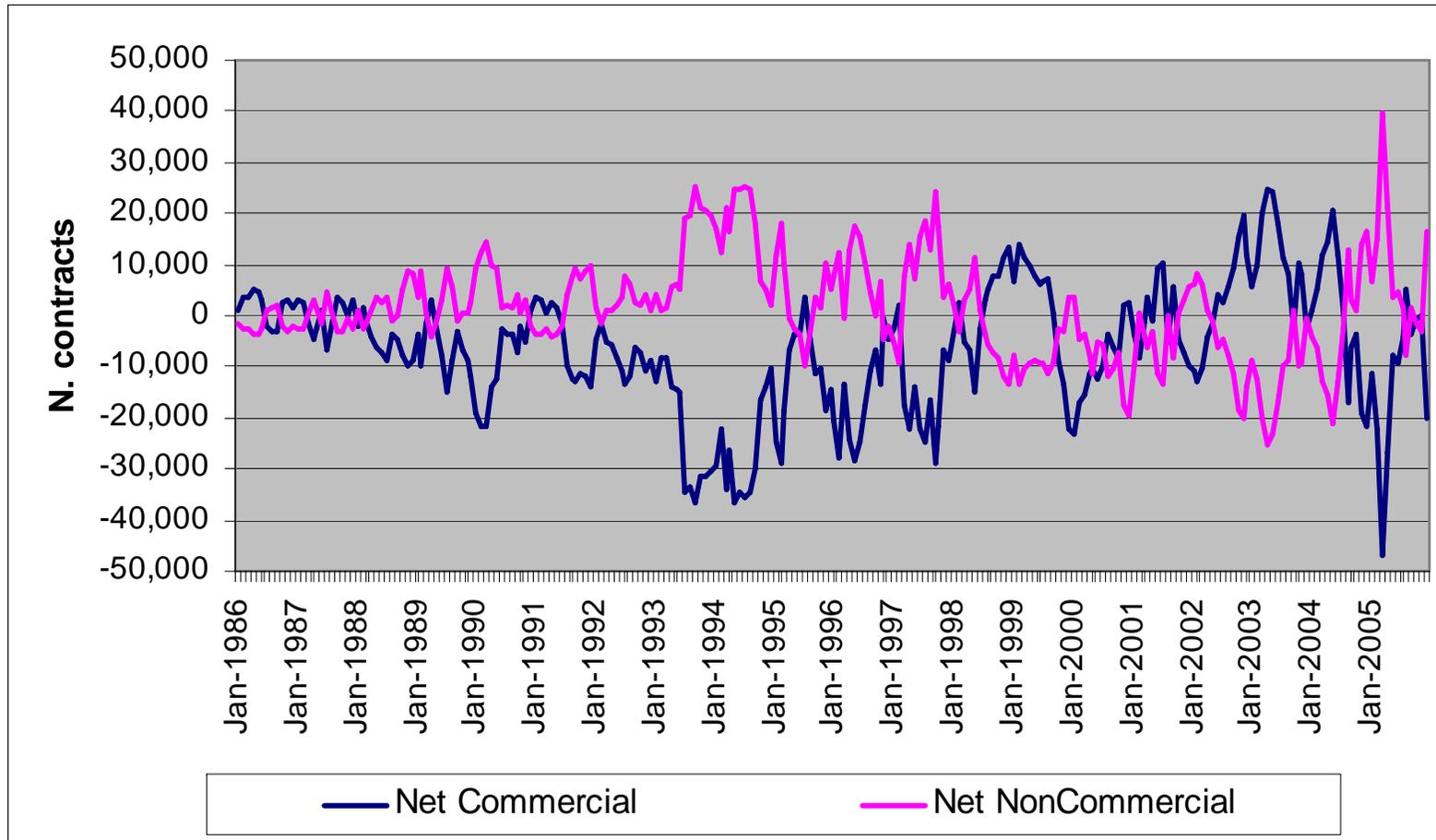


FIGURE 10. REVISIONS IN FORECASTED VOLATILITY AS A RESULT OF SHOCKS IN PRICE LEVELS AND IN THE VOLUME OF COMMERCIAL, NON-COMMERCIAL AND NON-REPORTABLE POSITIONS. DATA RANGES FROM JANUARY 1986 TO DECEMBER 2005, DAILY.

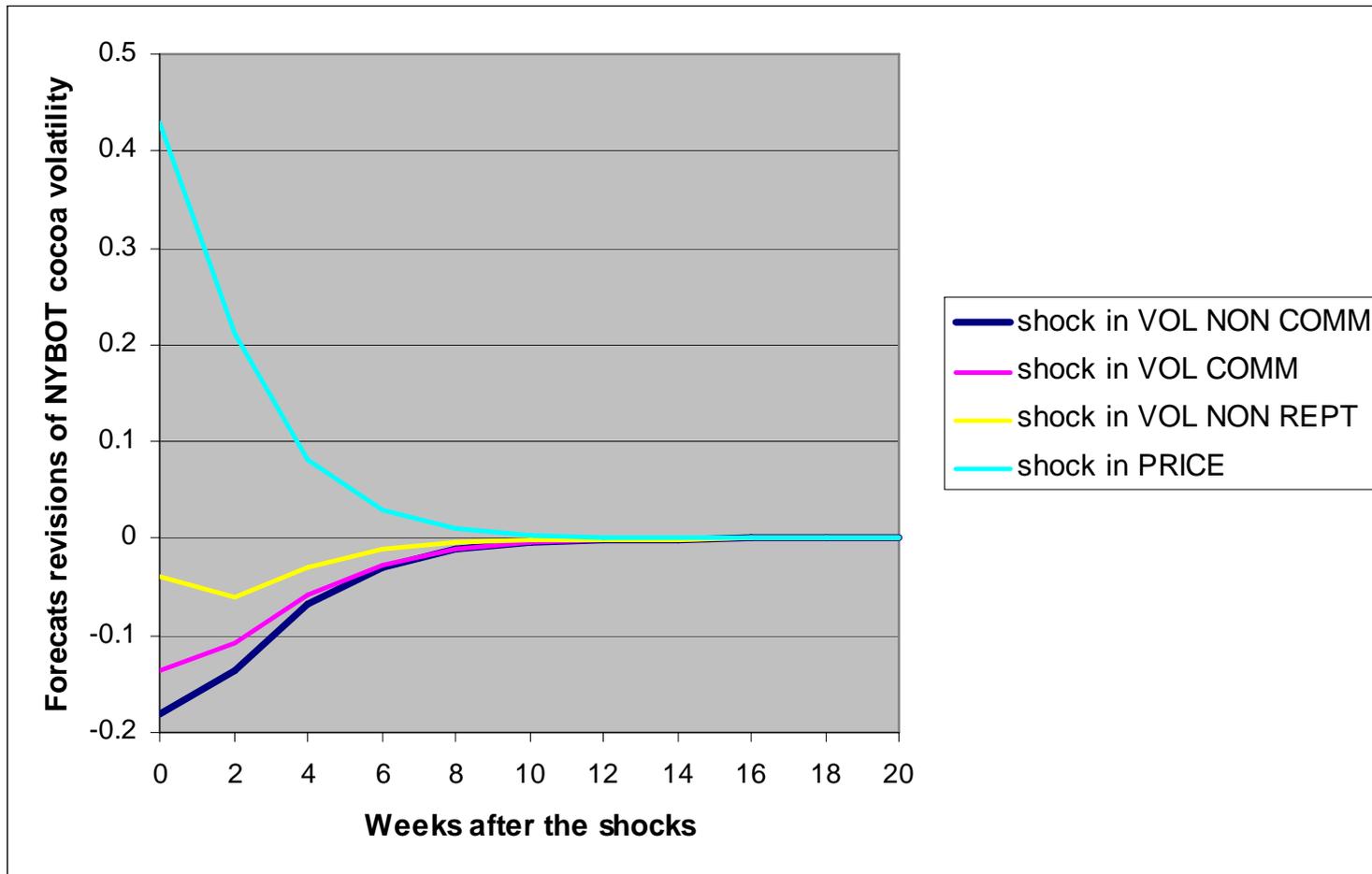
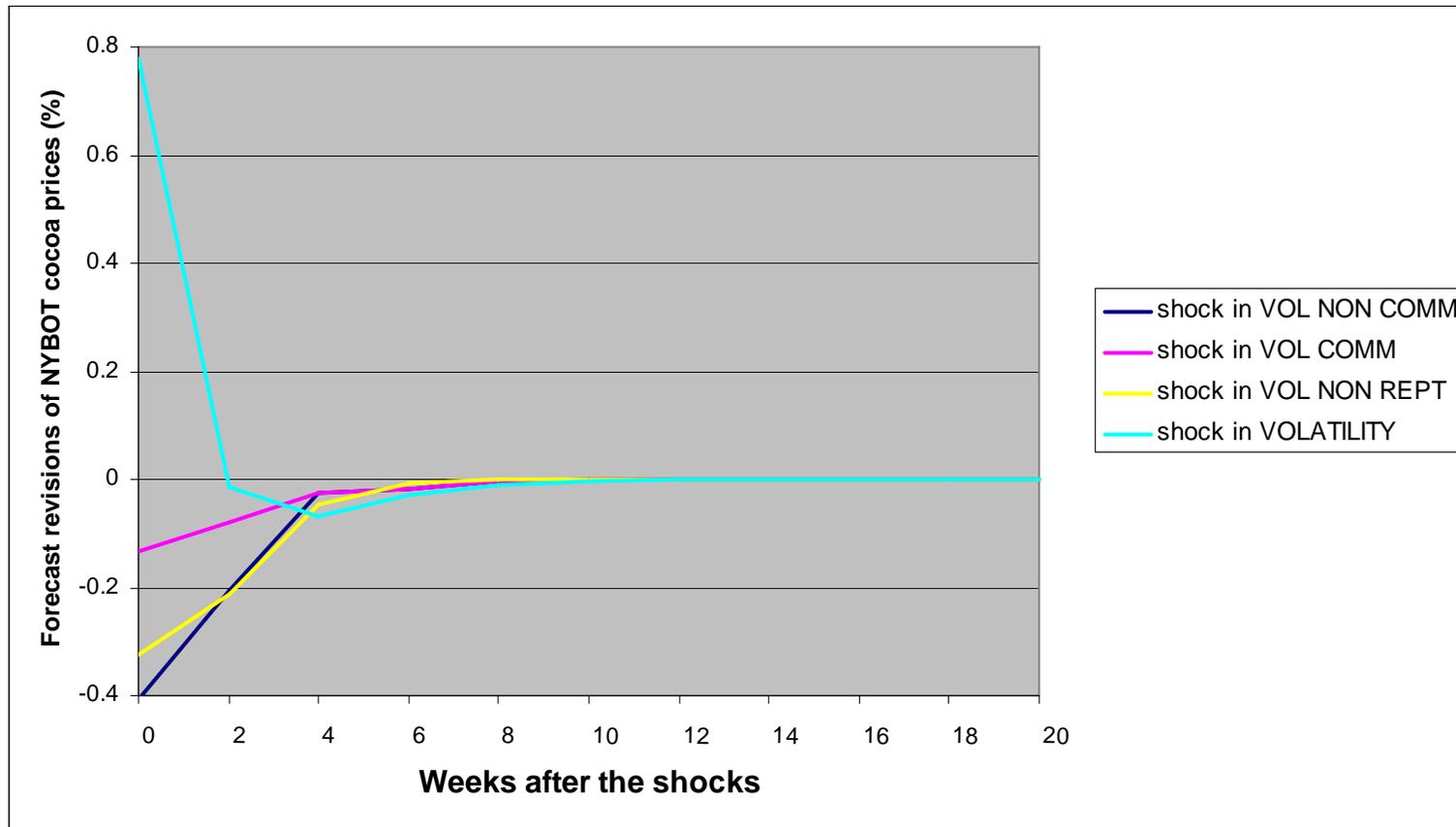


FIGURE 11. REVISIONS IN FORECASTED PRICE CHANGES AS A RESULT OF SHOCKS IN VOLATILITY AND IN THE VOLUME OF COMMERCIAL, NON-COMMERCIAL AND NON-REPORTABLE POSITIONS. DATA RANGES FROM JANUARY 1986 TO DECEMBER 2005, DAILY.



APPENDICES

APPENDIX 1:

DATA: PRICES, EXCHANGE RATE, OPEN INTREST AND VOLUME.

57. The LIFFE and NYBOT are sources of information of prices, open interest and volumes. The LIFFE and NYBOT datasets run from 5 January 1987 to 30 July 2006. However, data on LIFFE open interests and volumes ranges from 2 January 2002 to 31 January 2006.

58. Data on the exchange US dollar/pound sterling refers to daily six-month forward rate of the London exchange at closing time. Dataset ranges runs from 5 January 1987 to 30 July 2006.

NYBOT TRADING POSITIONS

59. Every Friday at 3:30 p.m. Eastern Time, the Commodity Futures Trade Commission (CFTC) releases the Commitment of Traders (COT) report. Concerning the NYBOT cocoa futures markets, the COT reports the Tuesday's open interests for all delivery months broken down by typology of futures market participants: hedgers, speculators and non-reportable traders. Tuesday's short and long reportable positions for hedgers, speculators and NRP traders have been collected from 15 January 1986 to 27 December 2005. For each market participant, the weekly trading volume has been estimated by first calculating the changes in the trader's long and short positions between the Tuesday of week t and the Tuesday of week $t-1$. These changes are represented as follows:

$$\Delta LP_{i,t} = LP_{i,t} - LP_{i,t-1} \quad [1]$$

$$\Delta SP_{i,t} = SP_{i,t} - SP_{i,t-1} \quad [2]$$

where $LP_{i,t}$ is the Tuesday's long position of trader i for all delivery months in the cocoa futures markets on week t , and $SP_{i,t}$ is the corresponding short position. If a trader initially has a long position and decreases the size of the long position over the period $[t-1, t]$, then $\Delta LP_{i,t}$ will be negative and $\Delta SP_{i,t}$ will be zero. For a trader who initially has a long position and changes to a short position over $[t-1, t]$, $\Delta LP_{i,t}$ will be negative (and equal to $-LP_{i,t-1}$) and $\Delta SP_{i,t}$ will be positive (and equal to $SP_{i,t}$). Changes in long and short positions, equations [1] and [2], are then used to calculate the trading volume for trader i over the period $[t-1, t]$:

$$Long\ VOL_{i,t} = + \max[0, \Delta LP_{i,t}] - \min[0, \Delta SP_{i,t}] \quad [3]$$

$$Short\ VOL_{i,t} = - \min[0, \Delta LP_{i,t}] + \max[0, \Delta SP_{i,t}] \quad [4]$$

60. Ordinarily, either $LongVOL_{i,t}$ or $ShortVOL_{i,t}$, but not both, will be non zero. The sum of these terms is the minimum volume during the week to arrive at the change in a trader's reported long and short positions from the previous week.

$$VOL_{i,t} = LongVOL_{i,t} + ShortVOL_{i,t} \quad [5]$$

Trading volumes for each market participant, calculated as outlined in equations [1] to [4], are then averaged over a two weeks period.

61. However, this estimate of trading volume understates the actual trading volume for two reasons. First, trading volume is calculated as if, between each Tuesday, there was no market activity. Second, intraday round-trip transactions are not captured unless the open interest broken down by market participants is registered every 15 minutes during a normal trading session.

VOLATILITY OF COCOA FUTURES CONTRACT PRICES

62. Price volatility is a measure of market uncertainty. Specifically, it assesses the tendency of the price to rise or fall within a set period. In this study we used as measure of volatility the 'corrected' Parkinson scaled range measure.

APPENDIX 2: VECTOR OF AUTOREGRESSION (VAR) AND THE VECTOR ERROR CORRECTION MODEL (VECM).

63. The Vector of Autoregression (VAR) and the Vector of Error Correction Model (VECM) have been used in this document to evaluate the impact the dynamics interrelationships among prices, volatility, trading volume and exchange rate. Different sets of either VECMs or VARs, depending on whether variables of interest were co-integrated or not, were estimated. Results were then used to generate the so called generalized impulse function, which is invariant to the ordering of the variables entering either in the VAR or in the VECM.

64. The impulse response function is a conceptual experiment in which a variable is subject to shock in order to trace the impact on the remaining variables. An example of impulse response function is illustrated in **Figure 12**, where for illustrative purposes prices are shocked at time t_0 to evaluate the impact on market volatility.

Figure 12. Hypothetical impulse response function of market volatility after a price shocks.

