Cocoa Supply Chain

- A sequence of buyer and seller arrangements are necessary to connect the primary supply with the final demand.

- The cocoa supply chain performs a series of technological transformations:
  - Production of cocoa beans
  - Grindings
  - Further Processing

and economic activities:
  - Change ownership of cocoa/products
  - Transportation
  - Storage
The **exchange of ownership** of cocoa beans is the major economy activity performed by the cocoa supply chain.

This activity is, however, subject to two classes of risks:

a) **Operational Risks** are related to the operations of shipping cocoa from producing countries; and

b) **Market Risks** are related to the occurrence of either supply shocks or demand shocks or both.

---

**Risks affecting the Economic Activities of the Cocoa Supply Chain**

**OPERATIONAL RISKS**

<table>
<thead>
<tr>
<th>Risk Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUALITY RISK</td>
<td>the buyer receives cocoa not conforming with the requested qualitative parameters;</td>
</tr>
<tr>
<td>TRANSPORTATION RISK</td>
<td>shipping costs changes during the execution of a physical trade; uncertainty surrounding the delivery time;</td>
</tr>
<tr>
<td>CREDIT RISK</td>
<td>one of the two counterparties may default from his/her contractual obligations;</td>
</tr>
</tbody>
</table>

**MARKET RISKS**

<table>
<thead>
<tr>
<th>Risk Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRICE/VOLUME RISK</td>
<td>generated by shocks in either the demand or the supply or both</td>
</tr>
</tbody>
</table>
Forward Contract as mechanism to share the market risk

The two parties involved in a physical trade have competing economic objectives. In particular, the profits of one counterpart come at the cost of the other, and vice versa.

That is, every time the cocoa changes ownership, the buyer wishes to buy at the lowest price given quality of cocoa beans; on the other hand, the seller wishes to sell the cocoa at the highest price.

But as both parties face unavoidable risks, at the conclusion of each physical transaction, one counterparty may be better off than envisaged at the inception of the contract at the expense of the other party, and vice versa.

Greater economic efficiency would achieved, if counter-parties were willing to share their market risk, in addition to their operational risks. And this is the principle behind forward contract.

Forward contracts have a long history dating back to the First Babylonian Dynasty (1894 BC to 1595 BC).

Today, forward contracts are contractual arrangements between where two parties agree for the exchange of a physical asset, at a certain time in the future, for a certain price fixed at the inception of contract.
Being SHORT, being LONG

Being SHORT

↑ Price = lose money

Going SHORT

SELL something

Going SHORT, Going LONG

Being LONG

↑ Price = make money

Going LONG

BUY something
The introduction of Forward Contracts has increased the economic efficiency of physical trade by reducing both operational and market risks.

More in general, forward contracts enable traders to agree on the terms that would best fit their needs by introducing negotiable trading clauses.

Nevertheless, it is worth noticing that once counterparties have initiated a forward agreement, neither party could unilaterally terminate the agreement before its expiration unless costly termination clauses have been previously negotiated.

A futures contract is a financial instrument featuring characteristics of forward contract as regards the terms of the contract.

They differ from forward contracts in three major aspects:

a) futures contract can be terminated any time after inception through reverse trading

b) the validity of a futures contract is independent of the identity of the buyer and seller. Thus, futures contracts with same delivery date are perfect substitute of each other

c) by trading futures contracts, futures markets' participants exchange exclusively contractual obligations
Futures Contracts

Futures Contract

A futures contract on a specific asset is an agreement to buy or to sell
- the underlying asset
- at a particular price (the futures price)
- on a stipulated future date (delivery month).

The contract can be sold or bought back before the settlement date

For example, cocoa futures contract are contractual agreement to buy or to sell
- cocoa beans of a standardized quality as specified by the exchange
- at a particular price (the futures price)
- on a stipulated future date (delivery month).

Cocoa Futures Contracts on the InterContinental Exchange (former NYBOT)

<table>
<thead>
<tr>
<th>Item</th>
<th>Contract Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit of Trading</td>
<td>10 metric tonnes</td>
</tr>
<tr>
<td>Delivery Months</td>
<td>March, May, July, September and December</td>
</tr>
<tr>
<td>Delivery Units</td>
<td>Standard Delivery Unit - bagged cocoa with a nominal net weight of ten tonnes</td>
</tr>
<tr>
<td></td>
<td>Large Delivery Unit – bagged cocoa with a nominal net weight of 100 tonnes</td>
</tr>
<tr>
<td></td>
<td>Bulk Delivery Unit – loose cocoa with a nominal net weight of 1,000 tonnes</td>
</tr>
<tr>
<td>Delivery points</td>
<td>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</td>
</tr>
<tr>
<td>Deliverable growths</td>
<td>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). &quot;Commencing with the May 2007 delivery, Sanchez moved to Group B.&quot;</td>
</tr>
<tr>
<td>Price basis</td>
<td>US dollar per metric tonne</td>
</tr>
<tr>
<td>Minimum price movement</td>
<td>$1.00 per metric tonne</td>
</tr>
<tr>
<td>Daily price movement limits</td>
<td>No limits</td>
</tr>
<tr>
<td>Position limits</td>
<td>No more than 750 contracts per delivery month</td>
</tr>
<tr>
<td>Trading hours</td>
<td>From 8:00 a.m. to 11:50 a.m. eastern standard time (EST)</td>
</tr>
</tbody>
</table>
Cocoa Futures Contracts on the London International Financial Futures Exchange (LIFFE)

<table>
<thead>
<tr>
<th>Item</th>
<th>Contract Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit of trading</td>
<td>10 metric tonnes</td>
</tr>
<tr>
<td>Delivery Months</td>
<td>March, May, July, September and December</td>
</tr>
<tr>
<td>Delivery Units</td>
<td>Standard Delivery Unit - bagged cocoa with a nominal net weight of ten tonnes</td>
</tr>
<tr>
<td></td>
<td>Large Delivery Unit – bagged cocoa with a nominal net weight of 100 tonnes</td>
</tr>
<tr>
<td></td>
<td>Bulk Delivery Unit – loose cocoa with a nominal net weight of 1,000 tonnes</td>
</tr>
<tr>
<td>Delivery points</td>
<td>At licensed warehouses in Amsterdam, Antwerp, Bremen, Felixstowe, Hamburg, Humberside, Le Havre, Liverpool, London, Rotterdam, or Teesside</td>
</tr>
<tr>
<td></td>
<td>Cocos 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 &amp; Tobago, and Jamaica); Group 2, deliverable at a discount of £25/tonne (São Tomé and Principe, and Sri Lanka); Group 3 deliverable at a discount of £50/tonne: Brazil Bahia Superior, Brazil Vitoria Superior, Ecuador and Papua New Guinea); Group 4 deliverable at a discount of £75/tonne (Malaysia); Group 5 deliverable at a discount of £100/tonne (any other origin)</td>
</tr>
<tr>
<td>Price basis</td>
<td>Pounds sterling per tonne</td>
</tr>
<tr>
<td>Minimum price movement</td>
<td>£ 1.00 per tonne</td>
</tr>
<tr>
<td>Daily price movement limits</td>
<td>None</td>
</tr>
<tr>
<td>Position limits</td>
<td>None</td>
</tr>
<tr>
<td>Trading hours</td>
<td>From 9:30 a.m. to 4:50 p.m. Greenwich Mean Time (GMT)</td>
</tr>
</tbody>
</table>

The organized exchange: the Role of a Clearing house

To enable a smooth trade of futures and options contracts, the trade of futures contracts is implemented through the interposition of the so-called CLEARING HOUSE.

1) It acts as principal to each party’s contract. In other words, it acts as the buyer to every seller of futures contracts and as to the seller to every buyer.

⇒ Every trader in the futures market would have a contractual obligation only to the Clearing House

```
Obligation with a clearinghouse

Buyer → CLEARING HOUSE ← Seller

Obligation without a clearinghouse

Buyer ← Seller
```

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The organized exchange: the Role of a Clearing house

Thus, the exchange of one cocoa futures contract (i.e. with delivery DEC 2011 at £2,500 per tonne) implies the following:

⇒ **PARTY A** is selling a DEC 2011 cocoa futures at £2,500 per tonne (i.e. A promise to deliver 10 tonnes of cocoa on December 2011 against the payment of £2,500 per tonne)

⇒ **PARTY B** is buying a DEC 2011 cocoa futures at £2,500 per tonne (i.e. B will pay £2,500 per tonne to receive the delivery of 10 tonnes of cocoa in December 2011)

2) It does not hold any acting position in futures markets.

⇒ Since the Clearing House is interposed to all transactions and does not have any outstanding positions in futures market, it follows that

\[
N. \text{ contracts sold} = N. \text{ contracts bought}
\]

3) It takes responsibility for the commitment made between the two parties in the market.

⇒ Margin requirements
Margin requirements

Initial Margin, Maintenance Margin

⇒ INITIAL MARGIN is the initial amount that traders must deposit on his futures account to trade futures contracts (i.e. NY $2,240 per lot (1 lot = 10 tonnes)).

⇒ MAINTENANCE MARGIN is the minimum level at which the futures account must be maintained (i.e. NY $1,600 per lot (1 lot = 10 tonnes)).

Margin requirements on the New York Futures Markets

10 lots of SEP 2009 cocoa futures on ICE

<table>
<thead>
<tr>
<th>Date</th>
<th>Closing Price ($/tonne)</th>
<th>Profit/Loss on 10 lots of 10 tonnes each</th>
<th>Account balance</th>
<th>Margin Call</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thursday, 11-Jun-2009</td>
<td>2,813</td>
<td></td>
<td>22,400</td>
<td></td>
</tr>
<tr>
<td>Friday, 12-Jun-2009</td>
<td>2,761</td>
<td>-5,200</td>
<td>17,200</td>
<td></td>
</tr>
<tr>
<td>Monday, 15-Jun-2009</td>
<td>2,645</td>
<td>-11,600</td>
<td>22,400</td>
<td>+16,800</td>
</tr>
<tr>
<td>Tuesday, 16-Jun-2009</td>
<td>2,656</td>
<td>1,100</td>
<td>23,500</td>
<td></td>
</tr>
<tr>
<td>Wednesday, 17-Jun-2009</td>
<td>2,539</td>
<td>-11,700</td>
<td>22,400</td>
<td>+10,600</td>
</tr>
<tr>
<td>Thursday, 18-Jun-2009</td>
<td>2,556</td>
<td>1,700</td>
<td>24,100</td>
<td></td>
</tr>
<tr>
<td>Friday, 19-Jun-2009</td>
<td>2,520</td>
<td>-3,600</td>
<td>20,500</td>
<td></td>
</tr>
<tr>
<td>Monday, 22-Jun-2009</td>
<td>2,480</td>
<td>-4,000</td>
<td>16,500</td>
<td></td>
</tr>
</tbody>
</table>
Margin requirements on the New York Futures Markets

10 lots of SEP 2010 cocoa futures on ICE

<table>
<thead>
<tr>
<th>Date</th>
<th>Closing Price ($/tonne)</th>
<th>Profit/Loss on 10 lots of 10 tonnes each</th>
<th>Account balance</th>
<th>Margin Call</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thursday, 11-Jun-2010</td>
<td>2,937</td>
<td></td>
<td>22,400</td>
<td></td>
</tr>
<tr>
<td>Friday, 14-Jun-2010</td>
<td>2,973</td>
<td>3,600</td>
<td>26,000</td>
<td></td>
</tr>
<tr>
<td>Monday, 15-Jun-2010</td>
<td>2,991</td>
<td>1,800</td>
<td>27,800</td>
<td></td>
</tr>
<tr>
<td>Tuesday, 16-Jun-2010</td>
<td>2,977</td>
<td>-1,400</td>
<td>26,400</td>
<td></td>
</tr>
<tr>
<td>Wednesday, 17-Jun-2010</td>
<td>2,977</td>
<td>0</td>
<td>26,400</td>
<td></td>
</tr>
<tr>
<td>Thursday, 18-Jun-2010</td>
<td>2,981</td>
<td>400</td>
<td>26,800</td>
<td></td>
</tr>
<tr>
<td>Friday, 21-Jun-2010</td>
<td>3,004</td>
<td>2,300</td>
<td>29,100</td>
<td></td>
</tr>
<tr>
<td>Monday, 22-Jun-2010</td>
<td>3,071</td>
<td>6,700</td>
<td>35,800</td>
<td></td>
</tr>
</tbody>
</table>

Volume and Open Interest

**VOLUME** units of volume represent the number of traded contracts

**OPEN INTEREST** represents the number of outstanding position, that is, that have not been offset through reverse trading

<table>
<thead>
<tr>
<th>Trading activity</th>
<th>Volume</th>
<th>Open Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Trader A buys 15 contracts</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Trader A sells 10 contracts</td>
<td>30</td>
<td>5</td>
</tr>
<tr>
<td>Trader B buys 5</td>
<td>35</td>
<td>10</td>
</tr>
</tbody>
</table>
Options on Futures Contracts

In addition to futures contracts, there exists another type of contractual obligation which can be traded on a Centralized Exchange: Options

A **Cocoa Options Contract** is a financial contract enabling the holder the right, *but not the obligation*, to buy from (i.e. **call options**), or to sell to (i.e. **put options**), the grantor of the option, within a given time period, cocoa futures contracts at an agreed price.

The cost of the option is called **premium**

**CALL Options (on futures contract)** are employed to set a **maximum purchasing price**

**PUT Options (on futures contract)** are employed to set a **minimum selling price**

---

Options contract

**PUT Options on a Futures Contract**

A **put option** on a futures contract gives the holder the right, *but not the obligation*

- to sell the underlying futures contract
- at a specified price (the **strike price**),
- by a predetermined date (the **expiry or maturity**) to a given party.

- **American style** put option can be sold any time before its expiry (cocoa options contracts)
- **European style** put option can be sold only on its expiry

A **put option** ↔ **insurance contract** that sets the **minimum selling price** for a futures contract
Available Instruments

CALL Options on a Futures Contract

A call option on a cocoa futures contract gives the holder the right, but not the obligation

- to buy the underlying futures contract
- at a specified price (the strike price),
- by a predetermined date (the expiry or maturity) from a given party.

- American style call option can be bought any time before its expiry (cocoa options contracts)
- European style call option can be bought only on its expiry

A call option ↔ insurance contract that sets the maximum buying price for a futures contract

Market Participants

Hedgers have a risk exposure before entering in futures markets

Speculators acquires a risk exposure by entering in futures markets

Arbitrageurs maintains a null risk exposure when entering in futures markets
Concept Arbitrage

Suppose Microsoft shares are listed on the Paris Stock Exchange at € 8 per share and on the Frankfurt Stock Exchange at € 10 per share.

Now imagine a trader simultaneously buying one share of Microsoft from the Paris Exchange and selling it on the Frankfurt Exchange generating a profit of € 2.

This trading strategy would qualify as an academic arbitrage, as no investment is required (i.e. the shares would have been simultaneously bought and sold, so no cash would be required) and because it generates a riskless profit of € 2.
Cost-Of-Carry Model

idea

Suppose a grinder needs 100 tonnes of cocoa in December 2011

He could buy cocoa on spot market today,
store and insure it until until December,
delivery it to his processing facilities in December 2011.

Alternatively, he could buy the December 2011 cocoa futures contracts and accept
the delivery of cocoa at its expiration

Now, the cost of the the above strategies must to be same.

WHY?

Cash-and-Carry Cocoa Arbitrage

Assumption:  
Spot price of cocoa per tonne $3,500  
Price JUL 12 Cocoa Futures Contract per tonne $3,500  
Interest 10%  
Requirements: 10 tonnes of cocoa

<table>
<thead>
<tr>
<th>Date</th>
<th>Transactions</th>
<th>Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2011</td>
<td>Borrow $35,000 for 12 months at 10%</td>
<td>-$35,000</td>
</tr>
<tr>
<td></td>
<td>Buy 10 tonnes of cocoa on the spot market at $3,500/tonne</td>
<td>-$35,000</td>
</tr>
<tr>
<td></td>
<td>Sell one JUL 12 cocoa futures contract at $3,900/tonne</td>
<td>$ 0</td>
</tr>
<tr>
<td></td>
<td>Total cash flow</td>
<td>$ 0</td>
</tr>
<tr>
<td>July 2012</td>
<td>Remove cocoa from the warehouse</td>
<td>$ 0</td>
</tr>
<tr>
<td></td>
<td>Delivery of 10 tonnes of cocoa against the futures contract</td>
<td>+$39,000</td>
</tr>
<tr>
<td></td>
<td>Repayment of the loan, including interest</td>
<td>-$38,500</td>
</tr>
<tr>
<td></td>
<td>Total cash flow</td>
<td>+$ 500</td>
</tr>
</tbody>
</table>

\[ F_{0,t} \leq S_{0}(1+C) \quad F_{0,t} = £ \, 3,850 \text{ per tonne} \]
Reverse Cash-and-Carry Cocoa Arbitrage

Assumption:
- Spot price of cocoa per tonne: $3,600
- Price JUL 12 Cocoa Futures Contract per tonne: $3,900
- Interest: 10%
- Requirements: 10 tonnes of cocoa

<table>
<thead>
<tr>
<th>Date</th>
<th>Transactions</th>
<th>Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2011</td>
<td>Sell short 10 tonnes of cocoa on the spot market at $3,600 per tonne</td>
<td>+$36,000</td>
</tr>
<tr>
<td></td>
<td>Land $36,000 for 1 year at 10%</td>
<td>-$36,000</td>
</tr>
<tr>
<td></td>
<td>Buy one JUL 12 cocoa futures contract at $3,900/tonne</td>
<td>$0</td>
</tr>
<tr>
<td></td>
<td>Total cash flow</td>
<td>$0</td>
</tr>
<tr>
<td>July 2012</td>
<td>Collect proceeds from the loan ($36,000 x 1.1)</td>
<td>+$39,600</td>
</tr>
<tr>
<td></td>
<td>Accept the delivery of 10 tonnes of cocoa against the futures contract</td>
<td>-$39,000</td>
</tr>
<tr>
<td></td>
<td>Use the cocoa from the futures delivery to repay the short sale</td>
<td>$0</td>
</tr>
<tr>
<td></td>
<td>Total cash flow</td>
<td>+$ 600</td>
</tr>
</tbody>
</table>

\[ F_{0,t} \geq S_0(1+C) \]

\[ F_{0,t} = \£ 3,960 \text{ per tonne} \]

Implications

\[ F_{0,t} \leq S_0(1+C) \quad \text{From the Cash-and-Carry arbitrage transaction} \]

\[ F_{0,t} \geq S_0(1+C) \quad \text{From the reverse Cash-and-Carry arbitrage transaction} \]

\[ F_{0,t} = S_0(1+C) \]

Assumption:
- No transaction costs
- Equality of lending and borrowing rates
- No restrictions on short sale
- Storable commodity
Presence of transaction costs

We know that \( F_{0,t} \leq S_0(1+C) \)

Also we know that \( F_{0,t} \geq S_0(1+C) \)

Therefore: \( S_0(1+C) \leq F_{0,t} \leq S_0(1+C) \) 

Adding transaction costs: \( S_0(1+C)(1-T) \leq F_{0,t} \leq S_0(1+C)(1+T) \)

Suppose \( S_0 = $3,500 \) per tonne, \( C=10\% \) or 0.1 and \( T=2\% \) or 0.02

\[
3,500 \times (1 + 0.1) \times (1 - 0.02) \leq F_{0,t} \leq 3,500 \times (1 + 0.1) \times (1 + 0.02)
\]

\[
3,773 \leq F_{0,t} \leq 3,927
\]

No-arbitrage bounds

Presence of transaction costs, different lending and borrowing rates

Adding transaction costs with different LENDING and BORROWING rates:
\( S_0(1+C_L)(1-T) \leq F_{0,t} \leq S_0(1+C_B)(1+T) \)

Suppose \( S_0 = $3,500 \) per tonne, \( C_L=8\% \) or 0.08, \( C_B=12\% \) or 0.12, and \( T=2\% \) or 0.02

\[
3,500 \times (1 + 0.08) \times (1 - 0.02) \leq F_{0,t} \leq 3,500 \times (1 + 0.12) \times (1 + 0.02)
\]

\[
3,704.40 \leq F_{0,t} \leq 3,998.40
\]

No-arbitrage bounds
Price Expectation Model

The Cost-of-Carry model in a perfect market provides a full explanation of the futures price formation at least for storable commodities.

However, as soon as the assumptions on perfect markets are relaxed, the Cost-of-Carry model fails to pinpoint exactly the price level of a futures contract.

No storable commodity?

Market Expectations would provide additional piece of information required to fill this gap of knowledge.

If those expectations were wrong, then profitable arbitrage opportunities would arise.

Hedge Example
What is a hedge strategy?  It is a tool implemented to reduce ex-ante the risk exposure arising from market uncertainty.

Which type of risk can be mitigated?  Nearly everything (i.e. exchange rate risk, credit risk, interest rate risk, price risk, weather risk).

If a futures contract for a particular asset is not traded, investment banks are more than willing to be your counterpart (i.e. there are over-the-counter (OTC) options contracts on life expectancy).

1. Define the risk exposure in term of
   - side (is your concern a ↑Price or ↓Price?)
   - size (by how much ($) are you exposed?)
   - timing of your risk (when does it start? when does it end)

2. Identify the instruments available to deal with the above risk exposure

3. Assess the costs & benefits of the available instruments considering three different scenarios (↑Price, ↓Price and =Price)
HEDGE SIDE

Rule of Thumb

<table>
<thead>
<tr>
<th>Cash Risk</th>
<th>Futures position</th>
</tr>
</thead>
<tbody>
<tr>
<td>long in cash market,</td>
<td>short in the futures market</td>
</tr>
<tr>
<td>if we make a PROFIT,</td>
<td>Sell Cocoa Futures Contracts</td>
</tr>
<tr>
<td>when prices increase</td>
<td></td>
</tr>
<tr>
<td>short in cash market</td>
<td>long in the futures market</td>
</tr>
<tr>
<td>if we make a PROFIT,</td>
<td>Buy Cocoa Futures Contracts</td>
</tr>
<tr>
<td>when prices decrease</td>
<td></td>
</tr>
</tbody>
</table>

HEDGE SIZE

A cocoa futures contract calls for 10 tonnes of cocoa

\[
hedge\ size = \frac{(\text{Volume of cocoa})\ \text{tonnes}}{10\ \text{tonnes}\ \text{contract}} = \#(\text{contracts})
\]

* REMARKS it is not always the case that 10 tonnes of cocoa calls for 1 cocoa futures contract
After having established the side and size of the hedge strategy, we need to decide the delivery month.

It is standard practice to select the delivery month that expires soonest after the end of the cash risk.
Today, it is the 21\textsuperscript{st} February 2014. A cocoa producer is planning to sell part of her/his crop (10 tonnes) at the end of March 2014.

However, s/he is worried that the price will go down by the time her/his crop goes into the market.

The cocoa futures contract with delivery on May 2014 is currently trading at £1,862 per tonne.

Which price risk management strategies are available to her/him?

To start we need to define:
- Side
- Size
- Timing

of her/his risk exposure.

\textbf{HEDGE EXAMPLE: a cocoa farmer}

- **Side**: The cocoa producer has a long position (\textit{PROFIT when \uparrow Price}) \textit{in the spot market}.

- **Size**: The size of his risk exposure (i.e. how much s/he can lose) is \(10 \text{ tonnes} \times (\text{Price}_{\text{MAR}} - \text{Price}_{\text{TODAY}})\).
  
  Since the farmer is long in spot market, \((\text{Price}_{\text{MAR}} - \text{Price}_{\text{TODAY}}) > 0\) generates a profit.

- **Timing**: The risk exposure starts \textit{today} and terminates \textit{at end of March} (when s/he plans to sell her/his crop).
### HEDGE EXAMPLE: a cocoa farmer

<table>
<thead>
<tr>
<th>Risk Exposure</th>
<th>Hedging Opportunities</th>
<th>Do nothing</th>
<th>Hedge with Futures</th>
<th>Hedge with Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side</td>
<td></td>
<td>Long</td>
<td>Short Cocoa Futures Contracts</td>
<td>Buy Cocoa Put Options (right but not the obligation to go short on Cocoa Futures Contract at the strike price)</td>
</tr>
<tr>
<td>Size</td>
<td></td>
<td>10 tonnes</td>
<td>1 Cocoa futures contract (i.e. 10 tonnes of cocoa)</td>
<td>1 Put Option (right but not the obligation to go short 1 Futures contract at the strike price)</td>
</tr>
<tr>
<td>Timing</td>
<td></td>
<td>End of March</td>
<td>MAY14 Cocoa Futures contracts</td>
<td>Put Option on the MAY14 Cocoa Futures contract</td>
</tr>
</tbody>
</table>

*1 refer to slide 40

### NYSE/LIFFE Options Market for Cocoa Futures MAY14
Relevant information

1. The London Cocoa Futures Contract with delivery MAY 2014 is trading at £1,862 per tonne on February 21, 2014 (Today).

2. If the farmer decides to go ahead with a hedge strategy setting a minimum selling price, s/he could buy a put option MAY14 with a strike price of £1,850 per tonne paying a lump-sum of £67 per tonne, as an example.

   This means that anytime before its expiration (last business day of March) if the MAY14 Cocoa Futures trades below £1,850 per tonne, by exercising the PUT OPTION the farmer will sell one cocoa futures at 1,850 (strike price) and buy it back (to cancel her/his obligation with the Exchange) at a lower price and, therefore, make a profit!
HEDGE EXAMPLE: a cocoa farmer

MECHANICS FUTURES HEDGE

From the slide 43 we know that the farmer needs to go short 1 cocoa futures contract with delivery MAY 2014, today (23/2/14). We also know that s/he has planned to sale its crop at the end of March.

<table>
<thead>
<tr>
<th>FEB 2014</th>
<th>MAR 2014</th>
<th>APR 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start of the Risk Exposure</strong></td>
<td><strong>End of Risk Exposure</strong></td>
<td></td>
</tr>
<tr>
<td>Sell 1 MAY14 cocoa futures contract (short)</td>
<td>Buy 1 MAY14 cocoa futures contract</td>
<td></td>
</tr>
</tbody>
</table>

HEDGE EXAMPLE: a cocoa farmer

MECHANICS OPTION HEDGE: Put Option

We decided – as an example – that s/he buys a PUT OPTION with strike price at £1,850 per tonne paying a premium of £67 per tonne.

<table>
<thead>
<tr>
<th>FEB 2014</th>
<th>MAR 2014</th>
<th>APR 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start of the Risk Exposure</strong></td>
<td><strong>END of Risk Exposure</strong></td>
<td></td>
</tr>
<tr>
<td>Buy 1 PUT OPTION on the MAY14 Cocoa Futures contract</td>
<td>Case 1: (Future Price MAY2014) &gt; £1,850 per tonne. The option is out-of-money (worthless)</td>
<td></td>
</tr>
<tr>
<td>Case 2: (Future Price MAY2014) &lt; £1,850 per tonne. The option is in-the-money (it generates a profit). The farmer exercise the PUT OPTION.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S/he has the right to sell one future contracts at £1,850. Then s/he buys back one futures contract at the market price (&lt;£1,850)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FEB 2014</th>
<th>MAR 2014</th>
<th>APR 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start of the Risk Exposure</strong></td>
<td><strong>END of Risk Exposure</strong></td>
<td></td>
</tr>
<tr>
<td>Buy 1 PUT OPTION on the MAY14 Cocoa Futures contract</td>
<td><strong>Case 1:</strong> (Future Price MAY2014) &gt; £1,850 per tonne. The option is out-of-money (worthless)</td>
<td></td>
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<tr>
<td><strong>Case 2:</strong> (Future Price MAY2014) &lt; £1,850 per tonne. The option is in-the-money (it generates a profit). The farmer exercise the PUT OPTION.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S/he has the right to sell one future contracts at £1,850. Then s/he buys back one futures contract at the market price (&lt;£1,850)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Any hedge strategy has costs and benefits. Ultimately, they depend on the market conditions at the time the strategy ends.

To compare the risk and benefits of the proposed strategies:
1. do nothing;
2. hedge with futures contract; and
3. hedge with options contracts,
it is customary to draw a risk profile.

Along the y-axis (vertical axis) we read off what we realize as revenue per tonne as the market conditions (market prices - horizontal line) change.
Today, it is the 21st February 2014. A procurement manager of a grinding company has to buy cocoa beans by the end of March 2014 to meet the plant’s production schedules. In budgeting the production costs, s/he has used as benchmark for the cocoa purchasing price the current price of the London cocoa futures contract with delivery in May 2014 (£1862 per tonne)

However, the procurement manager is worried that the cocoa price will go up. If this happens, all the budgeted production costs will become irrelevant. And he cannot count on his/her manager’s approval for an overspending above his/her contingency plan (i.e. 5%).

What are price risk management strategies available to the procurement manager?

To simplify our analysis we do not consider the fact that the grinder is also exposed to the price risk of its finished cocoa products

As discussed earlier, we need to define:

- **Side**
- **Size**
- **Timing**

of the grinder’s price risk exposure

---

**HEDGE EXAMPLE: a cocoa grinder**

- **Side** The cocoa grinders has a short position (PROFIT when ↓ Price) in the spot market

- **Size** The size of his risk exposure (i.e. how much s/he can lose) is 10 tonnes × \( (\text{Price}_{\text{MAR}} - \text{Price}_{\text{TODAY}}) \)
  
  Since the grinder is short in the spot market, \( (\text{Price}_{\text{MAR}} - \text{Price}_{\text{TODAY}})>0 \) generates a loss

- **Timing** The risk exposure starts today and terminates at end of March (when the grinder plans to actually buy cocoa from the market)
### HEDGE EXAMPLE: a cocoa grinder

<table>
<thead>
<tr>
<th>Risk Exposure</th>
<th>Hedging Opportunities</th>
<th>Hedging with Futures</th>
<th>Hedging with Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short</td>
<td>Do nothing</td>
<td>Hedge with Futures</td>
<td>Hedge with Options</td>
</tr>
<tr>
<td>Side</td>
<td></td>
<td>Long Cocoa Futures Contracts</td>
<td>Buy Cocoa Call Options (right but not the obligation to go long on Cocoa Futures contracts at the strike price)</td>
</tr>
<tr>
<td>Size</td>
<td>10 tonnes</td>
<td>1 Cocoa Futures contract (i.e. 10 tonnes of cocoa)</td>
<td>1 Call Option (right but not the obligation to go long 1 Futures contract)</td>
</tr>
<tr>
<td>Timing</td>
<td>End of March</td>
<td>MAY14 Cocoa Futures contracts</td>
<td>Call Option on the MAY14 Cocoa Futures contract</td>
</tr>
</tbody>
</table>

\(^{1}\) refer to slide 40

### NYSE/LIFFE Options Market for Cocoa Futures MAY14

![NYSE/LIFFE Options Market for Cocoa Futures MAY14](image_url)
Relevant information

1. The London Cocoa Futures Contract with delivery MAY 2014 is trading at £1,862 per tonne on February 21, 2014 (Today).

2. If the procurement manager decides to go ahead with a hedge strategy setting a maximum purchasing price, s/he could buy a call option MAY14 with a strike price of £1,850 per tonne paying a lump-sum of £76 per tonne, as an example.

This means that anytime before its expiration (last business day of March), if the MAY14 Cocoa Futures market is trading above £1,850 per tonne, by exercising the CALL OPTION the procurement manager will buy one cocoa futures at 1,850 (strike price) and sell it back (to cancel her/his obligation with the Exchange) at a higher price and, therefore, make a profit!
MECHANICS FUTURES HEDGE

From the slide 53 we know that the procurement manager has to go long 1 cocoa futures contract with delivery MAY 2014, today (23/2/14). This because her/his manager has approved the current budgeted costs (and 5% of contingencies).

We also know that s/he has planned to buy 10 tonnes of cocoa beans from the market at the end of March.

<table>
<thead>
<tr>
<th>FEB 2014</th>
<th>MAR 2014</th>
<th>APR 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start of the Risk Exposure</strong></td>
<td><strong>Buy 1 MAY14 cocoa futures contract (long)</strong></td>
<td><strong>END of Risk Exposure</strong></td>
</tr>
</tbody>
</table>

MECHANICS OPTION HEDGE: Call Option

We decided – as an example – that s/he buys a CALL OPTION with strike price at £1,850 per tonne paying a premium of £76 per tonne.

<table>
<thead>
<tr>
<th>FEB 2014</th>
<th>MAR 2014</th>
<th>APR 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start of the Risk Exposure</strong></td>
<td><strong>Buy 1 CALL OPTION on the MAY14 Cocoa Futures contract</strong></td>
<td><strong>END of Risk Exposure</strong></td>
</tr>
<tr>
<td><strong>Case 1:</strong> (Future Price MAY2014) &lt; £1,850 per tonne. The option is out-of-money (worthless)</td>
<td><strong>Case 2:</strong> (Future Price MAY2014) &gt; £1,850 per tonne. The option is in-the-money (it generates a profit). The procurement manager exercises the CALL OPTION.</td>
<td></td>
</tr>
<tr>
<td><strong>Case 1:</strong> (Future Price MAY2014) &gt; £1,850 per tonne. Then s/he exercises the CALL OPTION.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>S/he has the right to buy one future contracts at £1,850. Then s/he buys it back at the market price (&gt;£1,850)</strong></td>
<td><strong>S/he has the right to buy one future contracts at £1,850. Then s/he buys it back at the market price (&gt;£1,850)</strong></td>
<td></td>
</tr>
</tbody>
</table>

HEDGE EXAMPLE: a cocoa grinder

HEDGE EXAMPLE: a cocoa grinder

HEDGE EXAMPLE: a cocoa grinder
In this case, we need to compare two possible strategies:

1. hedge with futures contract; and
2. hedge with options contracts

As before along the y-axis (vertical axis) we read off what we realize as cost per tonne as the market conditions (market prices - horizontal line) change.

Costs & Benefits

HEDGE EXAMPLE: a cocoa grinder

Purchasing Costs (£/tonne) vs. Market Conditions

Futures Contracts vis-à-vis Options on Futures Contracts

- P&L without hedge
- P&L with a futures hedge (at £1,862)
- P&L hedge with CALL MAY14 (strike £1,850; premium £76)
MOTIVATIONS

• market liberalization of the Ivorian cocoa sector in the mid 90s
  ⇒ exposed farmers to the volatility of international prices

• ↑ Price Uncertainty ⇒ (-) investment; and
  (-) farm management practice

  ⇒ ↓ Cocoa Farm Income

• These issues were further exacerbated by the absence of
  agricultural policies supporting directly or indirectly the income
  of cocoa farmers
INTERNATIONAL RESPONSE

• The World Bank sets up an International Task Force on Price Risk Management (1998) with the objective of testing the feasibility of futures contracts as a price risk management tool.

• Within this framework, the ICCO prepared a project proposal. Funds were provided by the Common Fund for Commodities (CFC) and the Bourse du Café et Cacao (BCC).

PROJECT’S AIM & OBJECTIVES

AIM

to assess the use of futures and options contracts by cocoa co-operatives in Côte d’Ivoire

OBJECTIVES

a) to deliver a training programme on price risk management
b) to set up a hedge strategies for cocoa producers
c) to test its effectiveness
Two different price risk management strategies were implemented to hedge 1,250 tonnes of cocoa beans.

- put options
- put options + call spread

Both strategies set up a minimum selling price for the cocoa futures contracts. Their difference was on the cash-flows required to pay the premium.

However, the London market was not sufficient liquid to set up the second strategy. So the New York market was used.
HEDGE STRATEGY IMPLEMENTED
BY THE ICCO PROJECTS

After both hedges were put in places, the price moved against the farmers (↓Price).

And just before the expiration, farmers using the put option hedge in NYSE/LIFFE exercised their right to sell the cocoa futures contract at price higher than the trading price (they were in-the-money).

However, those using put option + call spread hedge set a floor price well below the trading prices (they were out-the-money).

ICCO PILOT PROJECT on PRICE RISK MANAGEMENT for COCOA FARMERS in CÔTE D’IVOIRE

OBSTACLES & CONSTRAINTS
• Local banks were unwilling to finance the margin requirements to operate in future market.

• Contacted brokers were unwilling to act as financial intermediaries for cocoa farmers because
  • the small size and the one-off nature of the transaction;
  • exorbitant due diligence costs; and
  • they were unfamiliar with the potential clients;

• Co-operatives stated that they were not in a position to replicate these hedges without external assistance.
The London and New York Cocoa Futures Markets play an important role in the formation of prices for the physical cocoa through the world. Indeed, their prices are used as benchmarks in the physical trade.

Considering their strategic role, futures markets are often scrutinized.

Do cocoa futures prices truly reflect market fundamentals?

Do cocoa farm prices follow developments on cocoa futures markets?

Do speculators distort cocoa prices and volatility?

Is a futures market a “perfect machine” distilling market information into prices all the time?
Do cocoa futures prices truly reflect market fundamentals?

Reference: ICCO Document EX/146/8

At any point on time, the price listed on the cocoa futures market is the price at which two counterparties have agreed to enter into a contractual obligation.

Is this price fair?

Suppose that a trader on the selling side wants artificially increase the cocoa futures price above the “true” price by setting an high asking price.

It is clearly that until the asking price is above the “true” value of cocoa beans, it would be profitable to anyone to enter into the market and setting an asking price slightly lower of previous bid. Considering that in the cocoa futures market a very large number of sellers are competing, the bidding system of the futures market will ensure the convergence of prices to their true and fair value of cocoa.
On the other hand, there are not incentives to bid below the true and fair price. This is because when an order with a price below the true and fair price is fulfilled, the trader making this offer has the commitment to delivery at the price. However, since the true value is above his offer, then it implies that trader has sold cocoa beans at a price below the purchasing prices and, therefore, he has incurred costs. Such a situation is very unlikely to occur.

The unbiasedness of the auction mechanism of futures markets, which underpins the price discovery mechanism of futures markets, is assured by the large number of traders in futures markets. For practical purpose, we may assess the number of traders by the number of contract exchanged. For example, in 2013 the combined total number of futures contracts traded daily on both the London and New York futures markets amounted to nearly 50,000 contracts on average, corresponding to about 500,000 tonnes of cocoa per day.

Figure 1. Stock-to-grinding ratio against real cocoa prices (SDRs per tonne, 2010/2011) from 1960/1961 to 2010/2011, yearly
Do cocoa futures prices truly reflect market fundamentals?

Figure 2. Percentage variation of the stock-to-grinding ratio against the percentage variations of real cocoa prices (SDRs per tonne, 2010/2011) from 1960/1961 to 2010/2011, yearly

Is there a way whether the competitive bidding system of cocoa futures markets is truly representing cocoa market fundamental?

To test statistically this claim, we need to verify that indeed there exists an inverse relation between cocoa prices and a measure of the relative abundance/scarcity of cocoa on the market. To this end, the ICCO prices are used as a proxy of the world cocoa prices, while the stock-to-grindings ratio as a proxy of market fundamentals.

Econometric results indicate that the two variables are indeed related. In particular, about 83% of the price variations observed over half century the period covered is explained by the variations in the stock-to-grindings to ratio. Furthermore, if we quantify by how much cocoa prices change given a change in the stock-to-grindings, we obtain an estimated elasticity of -0.91. In other words, 10 per cent increase in stock-to-grindings ratio leads to a 9.1% decline in cocoa prices, in real term.
Do cocoa farm prices follow the developments of cocoa futures markets?

Reference: ICCO Document EC/1/5

From a strict theoretical point of view, for a single, homogenous commodity, arbitrage forces should lower the price differences between markets, expressed in a common currency, to the levels of transactions costs (i.e. transportation, information and contractual costs).

In particular, the sustained efforts of market participants to exploit any profitable arbitrage opportunity should result in the maintenance of an equilibrium relationship among prices in distant markets. When such a situation occurs, market prices are said to be integrated in the long-run.

Is this the case?
Do cocoa farm prices follow the developments of cocoa futures markets?

Figure 1. Farm-gate prices in Cameroon (CAM), Côte d’Ivoire (CDI) and Nigeria (NIG) in relation to the 2nd position of the London futures prices (left scale) and the dry Baltic index (right scale)

Do cocoa farm prices follow the developments of cocoa futures markets?

Figure 2. Farm-gate prices in Brazil (BRA) and Indonesia (IND) relation to the 2nd position of the New York (left scale) and the dry Baltic index (right scale)
Do cocoa farm prices follow the developments of cocoa futures markets?

Figure 3. Simulated speed of price adjustment at the farm-gate in Cameroon, Côte d’Ivoire and Nigeria

Figure 4. Simulated speed of price adjustment at the farm-gate in Brazil and Indonesia
Do cocoa farm prices follow the developments of cocoa futures markets?

Table 1. Speed of price adjustment at farm-gate given an overnight, permanent price shocks in the cocoa futures markets

<table>
<thead>
<tr>
<th>Country</th>
<th>Long-run Price Equilibrium Price at farm-gate after a price shock of 100 (£ or $) per tonne</th>
<th>Time required by the farm-gate price to register X% of the price shock on the futures market (i.e. 100% indicates that the long-run equilibrium has been restored)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>25%</td>
</tr>
<tr>
<td>Cameroon</td>
<td>£ 98.5</td>
<td>5 days</td>
</tr>
<tr>
<td>Côte d'Ivoire</td>
<td>£ 44.4</td>
<td>41 days</td>
</tr>
<tr>
<td>Nigeria</td>
<td>£ 81.4</td>
<td>8 days</td>
</tr>
<tr>
<td>Brazil</td>
<td>$ 84.1</td>
<td>&lt; 0 days</td>
</tr>
<tr>
<td>Indonesia</td>
<td>$ 98.6</td>
<td>4 days</td>
</tr>
</tbody>
</table>

Results highlight the prevalence of economic inefficiencies in pricing cocoa beans at the farm gate.

The lack of competition among cocoa buyers in the domestic market.

The share of the future price changes transferred to farmers depends on the structure of marketing channel at origins.
Do speculators distort cocoa prices and price volatility?

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.

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 future 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.

Is this the case?
Do speculators distort cocoa prices and price volatility?

![Graph showing No. Contracts vs. Time with data points indicating volume and open interest in LIFFE and NYBOT]

- Daily average of Total Volume in LIFFE
- Daily average of Total Volume in NYBOT
- Daily average volume in both NYBOT and LIFFE

![Graph showing No. Contracts vs. Time with data points indicating daily average total open interest in LIFFE and NYBOT]

- Daily Average Total Open Interest in LIFFE
- Daily Average Total Open Interest in NYBOT
- Daily average open interest in both NYBOT and LIFFE

Do speculators distort cocoa prices and price volatility?
Do speculators distort cocoa prices and price volatility?

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.

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.
Do speculators distort cocoa prices and price volatility?

Commercial and Non-Commercial net positions in the NYBOT cocoa futures markets from January 1986 to December 2005.

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.
Do speculators distort cocoa prices and price volatility?

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.

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, than 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.
Do speculators distort cocoa prices and price volatility?

Revisions in the forecast of closing prices, volatility and trading activities in the LIFFE cocoa futures market after the release of new market information.

Revisions in the forecast of closing prices, volatility and trading activities in the NYBOT cocoa futures market after the release of new market information.
Do speculators distort cocoa prices and price volatility?

Revisions in the forecasts of LIFFE and NYBOT cocoa closing prices after new information on the exchange rate market are released.

Revisions in the forecasts of volatility of LIFFE and NYBOT cocoa prices after new information on the exchange rate market are released.
Is a futures market a “perfect machine” distilling market information into futures prices all the time?

Reference: EX/142/8

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

Usually, the contractual obligations arising from a futures positions are settled either by reversing trading or by making/taking a cocoa delivery to the futures markets.
Is a futures market a “perfect machine” distilling market information into futures prices all the time?

In July 2010 the financial press reported of an alleged squeeze on the July cocoa futures contracts.

A definition of a squeeze on the futures market reads as follows:  
*In a market squeeze, a trader, holding large long positions, achieves effective control over the price of a futures contract due to disruption in the supply of cash commodity. The manipulative part of a squeeze arises when a trader uses this circumstance to create artificially high prices. The disruption that creates the squeeze need not to be due to actions of the controlling trader, but might originate from other natural sources, such as the weather.*


1) there was a shortage of certified cocoa during the 2009/2010 mid-crop, which was more than originally expected.

2) a trader had acquired a very large volume of the July 2010 cocoa futures contracts before the middle of May 2010.

As the delivery time of the July 2010 cocoa futures contract (i.e. 15 July) was approaching, traders who previously sold this contract could fulfil their contractual obligations either by delivering certified cocoa to the London futures market or by buying cocoa contracts with delivery in July 2010. Unfortunately, there was insufficient cocoa on the spot market available for delivery on the future market.

3) many shorts were forced to settle their contracts in cash with the longs. However, as one sole trader controlled a large share of the July 2010 long positions, he extracted profit from the shorts by bidding up the settlement price. This is the reason why this market manipulation is called “squeeze”.

Is a futures market a “perfect machine” distilling market information into futures prices all the time?

Figure 9

$ per tonne

London/New York Jul-10 London/New York Sep-10 London/New York Dec-10