SAFEGUARDING FOOD SECURITY IN VOLATILE GLOBAL MARKETS

EDITED BY

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Edited by Adam Prakash

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Chapter 20

Using risk management tools to manage price volatility in food imports: practice

Morgan Stanley Commodities Group

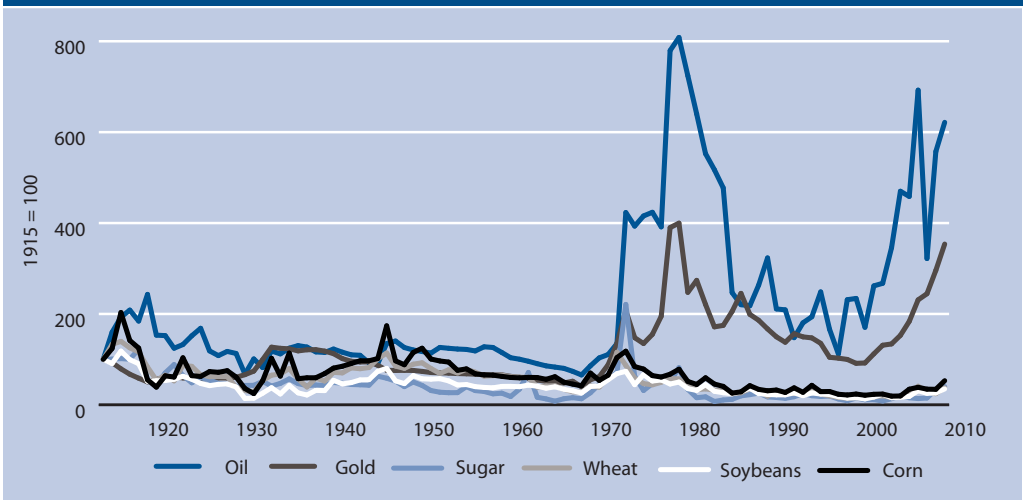
The last half-century has seen a significant rise in the demand for agricultural commodities owing to factors such as global economic development, urbanization and demographic growth. This has served to tighten the market, and as a result, supply issues are becoming more of a determinant of volatility and pricing – thus magnifying the effects of supply shocks. Supply factors that typically come into play include the weather, conflicts, government intervention, land-use competition and infrastructure issues. Indications are that several factors described above and numerous others that characterize the current market environment are likely to persist, and indeed be exacerbated, in the coming decades.

Over the last few years, we have become increasingly aware of the volatility and general upward trends broadly inherent in commodity prices. However, agriculture prices in real terms have remained significantly lower than they were a century ago and, in fact, are basically close to their lows of the century (Figure 20.1). The downward trend in agricultural prices since the mid-1970s, against the backdrop of population growth, would point to marked supply productivity gains through that period, which now appear to be moderating. The price trend in agriculture contrasts sharply with those of gold and oil, which are priced significantly higher in real terms now. Agricultural prices certainly have the scope for sustained increases relative to other commodities.

For consumers or importers of agricultural products, the possibility or prospect of a volatile and rising price environment for commodities deemed essential for food security, presents some serious challenges. Thus, the factors and trends mentioned above make this an appropriate and timely juncture to explore risk management in agricultural markets thoroughly.

This chapter seeks to demystify certain concepts surrounding risk management for governments. The authors delve into the rationale, approaches, experiences and methods of agricultural price risk management for governments. Simulations, case studies and logistical considerations are incorporated for a more practical explanation. The authors' experience of risk management with large clients, agricultural hedgers and governments in particular is drawn on throughout the chapter.

Figure 20.1: Commodity real price evolution: index points (1915=100)



Source: Morgan Stanley Commodities, Bloomberg, Morgan Stanley Research.

Objectives of a risk management programme

It is critical to note that a number of factors affect the price of agricultural products including: supply and demand fundamentals in a given agricultural product, weather in producing regions, demographic growth and economic development in consuming regions, natural disasters, global crises and conflicts and the development of biofuels. Most of these factors are highly unpredictable, and the rapid changes that can occur in the supply and demand balance may translate into short-term spikes or longer-term structural shifts in the market.

In this context, consumers and users of these commodities should consider the opportunity of using forward markets[1] to implement a risk management strategy. Risk management using *derivatives* provides the consumer with the opportunity to lock in or protect against a price rise in a specific market, better plan the cost associated with the purchase of agricultural commodities and enhance budget predictability. This is achieved by externalizing the risk to the market. Similarly, commodity producers have been using commodity *derivatives* to lock in or protect their revenues.

Risk management application

Company risk management

Various industries have been using commodity *derivatives* for many years in order to manage their price risk, especially with regard to energy. The airline industry is probably the most mature industrial user of commodity exchanges for risk management purposes. Airlines utilize the oil and jet fuel forward and options markets to manage their fuel price risk.

[1] Forward markets are markets in which financial instruments (forward contracts) are bought and sold for future delivery at prices mutually agreed upon today. Forward contracts are not standardized and can be of varied characteristics such as volumes, periods and settlements.

As risk management programmes have evolved in the airline industry, some best practices have emerged that can be applied more widely. The more sophisticated airlines' risk management programmes are now consistent and disciplined in both upward and downward trending markets. Conversely, the less sophisticated risk managers may have a tendency not to act when prices rise and act quickly when prices fall. This can result in an under-hedged position at times when risk is greatest.

Therefore, one of the central tenets of a risk management programme is to institute a disciplined approach towards execution and protection-building, with rules and guidelines for every step of the process.

Last, but not least, it is of the utmost importance that a risk management programme is understood thoroughly before proceeding with its execution. In particular, once the choice of instruments is made, it is crucial that "worst-case" scenario simulations are undertaken to understand how the structures could impact the hedger in terms of cash flow, credit exposure, collateral and margin calls.[2] The impact would need to be detailed and explained to the decision-makers and stakeholders in order to ensure that all potential outcomes of the hedging are understood and acceptable. Partner banks should be able to help with the necessary analysis and reporting.

Government risk management

Governments can be exposed to agricultural commodity price risk in two different ways. On the one hand, they could have a producer's exposure because some of their revenues are linked to prices of these products, either directly in the case of large producing countries, or indirectly via taxation of exports of these products. On the other hand, they could face a consumer's exposure, because they must secure large imports of agricultural products for domestic consumption or ensure an acceptable domestic price for these products in order to mitigate the social, economic and political impact of higher commodity prices on the population.

It is this latter scenario – when governments import or consume agricultural products – that is the basic focus of this chapter.

In the past, only a few governments globally have used commodity derivatives to protect against price risk. There are a number of reasons why some governments with large exposures in these markets have not tended to actively manage their risk in an appropriate way, or at all. These include:

1. Incorrect understanding of derivative instruments and markets. In particular, words like "derivatives" and "options" have been associated with risky and speculative behaviour owing to relatively isolated misuse that has caught the media's attention. However, companies across many industries commonly use these instruments on a regular basis in an appropriate way to facilitate effective risk management.
2. Concern with "getting it wrong". Hedging has often been associated with simply "fixing prices" that could result in situations where the government incurs negative cash flows and foregoes benefits if prices subsequently fall, thus exerting pressure on the government and hedging committee. However, there are other instruments with relatively limited and finite cash flow liability, such as call options and call spreads, that could help counter the issue of risk. These alternative instruments will be explained further in this chapter.

[2] A margin call refers to the collateral required to cover negative credit exposure arising from adverse movements in derivative contracts. It is usually calculated and adjusted daily.

3. Bureaucracy. Response time is of key importance when dealing with commodities markets. This can be problematic for governments owing to the typical bureaucracy involved with putting the framework in place, obtaining the authorizations and explaining the concept and strategy to the different parties involved. The government could see the favourable market pricing opportunity disappear by the time the set-up is completed.
4. Political and reputational risk. Where the responsibility for the decision rests with one person or a group, concerns about public perception could mean they abstain from risk management. This may be preferable to undertaking risk management decisions that could result in negative cash flows that can then be attributed to them. This potential problem can be addressed by putting the appropriate authorities and structure in place – another area we focus on in more detail later in this chapter.
5. Credit Constraints. There is an element of credit risk inherent in the use of derivatives in risk management, based on the ability of a counterparty to perform its contract obligations. Therefore, governments with a poor credit rating may encounter difficulties when trying to enter into instruments that are credit-intensive such as swaps or collars, or for longer tenors.[3] Call options are much less credit-intensive and may be a solution for these governments. Poorer countries may also be able to work with supra-national organizations, such as the World Bank, to access the markets on their behalf.

While all of these barriers to hedging are certainly valid, they can be appropriately managed and contained with the right approach to risk management, which involves a good understanding of the markets and instruments as well as the formulation and implementation of a detailed risk management policy.

Instruments utilized in risk management

The term "derivatives" refers to financial instruments, the prices and settlements of which depend on the evolution of value of an underlying asset or commodity. There is a broad spectrum of derivatives, ranging from very simple "plain vanilla" products to the more exotic types. In commodity risk management, and particularly for government use, we discuss here the more standard and simple instruments that are widely available in the market.

Exchange-listed commodities have a futures market in which participants can buy and sell the commodity at a future date directly on the exchange via these instruments. They are standardized in their specification, size, maturity, expiry date and settlement procedure and involve daily margining by the exchange.

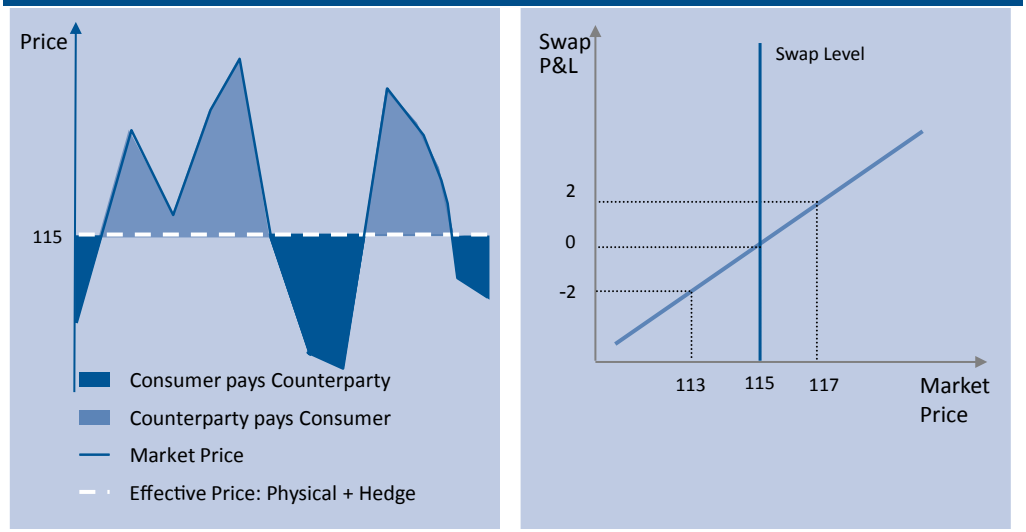
Besides the futures exchanges, over-the-counter (OTC) markets have developed and account for most of the liquidity for instruments related to markets later in time (for instance, hedging a wheat exposure three years ahead). These are markets where participants directly and mutually agree on transactions. Prices are easily obtained and are comparable to the futures markets with the added flexibility of tailor-made products in terms of size, maturity, expiry date and settlement procedure. However, there is a credit risk element associated with OTC products as transactions are executed directly between parties and are not necessarily collateralized. This can be preferable to many corporations and governments who may prefer to utilize open credit lines with the banks rather than dealing with daily margin or collateral payments associated with a futures exchange.

Swaps

The simplest OTC instrument is a swap. This is a forward transaction, which represents an obligation to buy or sell the commodity over a specified time period. The obligation to buy

[3] A "tenor" refers to the maturity of the instrument.

Figure 20.2: Illustration of a swap strategy



Source: Morgan Stanley Commodities.

or sell is a fundamental element of these contracts and represents the key difference to option transactions (Figure 20.2).

Average price swaps are OTC instruments that provide the users with a method of fixing their commodity price at an average level for the duration of the contract. These instruments have proven popular with buyers and sellers who have continuous exposure to commodity prices and who wish to simplify the way they manage their pricing risk. Swaps involve no physical delivery and are cash settled, typically against the average of the price of the underlying commodity over a specific period. This underlying, in most cases, is the more liquid exchange front-month futures contract. They are liquid tools that ease the operational and transactional burden on both producers and consumers of commodities.

Swap price exposure is symmetrical. For a consumer who buys a swap, if the average price rises, the potential cash flow on the swap will be positive. Conversely, if the average price falls, the potential cash flow will be negative. If the swap is being used to hedge physical costs (the purchase price), an increase in outward (negative) cash flows against the physical purchases will be offset by the gain in inward cash flows from the swap contract so, on a net basis, the price for the consumer is fixed at the swap price. This fixed price effect is also the same if prices fall, i.e. improved cash flows on the physical contracts are offset by negative cash flows from the swap contract.

In the above example, the government buys a swap at USD 115[4]. The government is therefore fixing its purchase price at $115.

If the average price over the period is below $115, the government will have to pay the difference between the fixed price ($115) and the market price – for example, paying $2 at a price of $113. In the meantime, it would be buying its physical commodity at the prevailing market rate which is $113, therefore having a net cost of $115 ($113 physical + $2 paid on the hedge).

4 From hereon, all currency ($) quotations refer to United States Dollars.

Conversely, if the average price over the period is higher than $115, the government will receive the difference (example: it will receive $2 at a price of $117). At the same time, the government will be buying its physical at $117. The net price for the government, combining the physical purchase and the hedge, is therefore $115. In this example, by buying the $115 swap, the government has fixed its price exposure to $115.

A swap is the simplest instrument; it is costless to implement and generally easy to understand by the public. However, in the case of a government, the risk could be perceived as high in a falling price environment, where the necessary payouts on the hedge could be seen as a lost opportunity for the government to use that money for other development purposes. If this is a concern for governments, then using options should be considered.

Options

A holder of an option has the right to choose whether to effect a particular transaction by a certain date. This is known as "exercising" the option.

There are two main types of options: *call options* and *put options*. A call option is the right to buy the commodity (whether futures, physical or cash settled) at a specified price by a certain date. Conversely, a put option is the right to sell (whether futures, physical or cash settled) at a specified price by a certain date.

The product specified in an option contract is the underlying commodity. The price at which the option's underlying commodity would be bought or sold, if the option holder chose to exercise the option, is the strike price. The strike price relates to the purchase price referenced in a call option, or the sale price specified in a put option. An option contract will also include the established time by which the owner must elect to either use (exercise) the option or not: the expiration date or maturity date. Most options are referred to as "American" or "European" style. American options can be exercised at any time prior to expiration, but European options can only be exercised on the maturity date. As an example, a company that holds an American call option for May Chicago Board of Trade (CBOT)[5] wheat with a strike price of $5.95 that expires on 8 April has the right, but not the obligation, to buy May CBOT wheat at $5.95 on or before 8 April. A holder of a put option, with otherwise the same specifications, has the right, but not the obligation, to sell May CBOT wheat at $5.95 on or before 8 April.

Asian options are another option category, but the term has nothing to do with any exercise restrictions. Instead, the profit/loss of an Asian option is determined by comparing the option's strike price with an average of the underlying commodity prices over a period (e.g. a monthly average of cotton prices). Asian options are also called average price options, or APOs. This type of option is usually used in the OTC market because the cash settlements are made automatically each settlement period (usually monthly) when the option is "in-the-money".

After the expiration date, the rights of the option holder no longer exist, and an unused option is said to have expired or lapsed. An option holder may also re-sell the option prior to its expiration in the market, just as one can re-sell a futures or forward position before the termination of trading. Thus, the owner of an option has three alternatives with which to dispose of his option: exercise the option, allow the option to expire unused or sell out of the option position before expiry.

[5] The Chicago Board of Trade is a designated market operating a futures, derivatives and options exchange for a variety of products including commodities.

Box 20.1: Average price derivatives – a closer look

An average pricing derivative (or Asian derivative) is a contract with a payout determined by an average of underlying prices over a pre-agreed period. This is different from European derivatives such as those traditionally listed on the exchange (futures, listed options) where the payoff is determined by the underlying price on a single date, at maturity.

Average pricing derivatives (both swaps and options) are the most commonly traded in OTC commodities markets, with averages usually assessed on a monthly basis.

The main reason behind the use of these types of options is that the commodity price exposure for both consumers and producers of commodities is often spread over the month rather than at one point in time. A producer of soybean oil will sell regularly throughout the month rather than on one day at the end of the month. Similarly, a country that imports wheat would be buying wheat regularly to match its domestic consumption rather than on one single day.

Another benefit of average pricing products is that they avoid the risk to the hedger of being impacted by the price movement on a single day. Instead, hedgers are exposed to an average price or trend over a period. This reduces the volatility of the underlying reference and therefore contributes to Asian options being cheaper than European options.

Below is a typical example of how a confirmation for a French MATIF (Marché à Terme International de France) milling wheat monthly pricing instrument would be worded:

Floating Price: With respect to a Calculation Period, the unweighted arithmetic mean of the Relevant Price for each Pricing Date during the Calculation Period.

Relevant Price: A price for a Pricing Date will be that day's settlement price per tonne of deliverable grade milling wheat on EURONEXT LIFFE of the First Nearby Month Futures Contract, stated in Euros and Euro cents, as determined by EURONEXT LIFFE on that Pricing Date.

Calculation Period: Each calendar month from and including the Effective Date, to and including the Termination Date.

The settlement can be either cash settled, by comparing the reference price with the strike price and settling the difference, or "physically" settled with the option holder buying a future or swap at the agreed price (strike) from the option seller.

An option holder can only purchase an option if some other participant is willing to sell that option. Liquidity (availability) of options at competitive prices is usually not a problem when using the most-traded commodity indices. The seller of an option is also referred to as the grantor or writer of an option. The buyer of a call option has obtained the right to buy the underlying commodity (e.g. wheat) from the seller of that option. If the buyer chooses to exercise the call option, then the company that sold the option is obligated to sell wheat to the buyer at the option strike price. If the buyer of a wheat put option exercises the right to sell, then the company that sold that put option is required to buy wheat from the option holder. For both puts and calls, the buyers of options gain rights while the sellers of options incur potential obligations.

As there is no obligation to exercise an option, it will only be used when it is a profitable alternative.

The market advantage – the ability to use the option when it is beneficial or to allow it to lapse when the current price is more favourable – comes at a defined cost: the option premium.

Table 20.1: Factors affecting the premium of an option

	Put option	Call option
↑ Time To Expiry	↑	↑
↑ Volatility	↑	↑
↑ Strike Price	↑	↓
↑ Underlying Price	↓	↑

Commodity options are priced in the same denomination as the underlying commodity. A premium of $0.15 per bushel to buy a corn option for 10 000 bushels of corn represents a total cost of $1 500 for that option. The buyer of the option typically pays the premium to the seller when the option is purchased. However, it may be possible to agree with the option seller to defer the payment of the option premium. It should also be possible to price the option in local currency, if preferred.

The determinants of the option price are the variables that determine the probability of the option expiring "in-the-money" or not.

The five major factors that affect options prices are (1) the time to expiry; (2) price volatility of the underlying commodity; (3) the strike price; (4) the market price of the underlying; and (5) interest rates (Table 20.1).

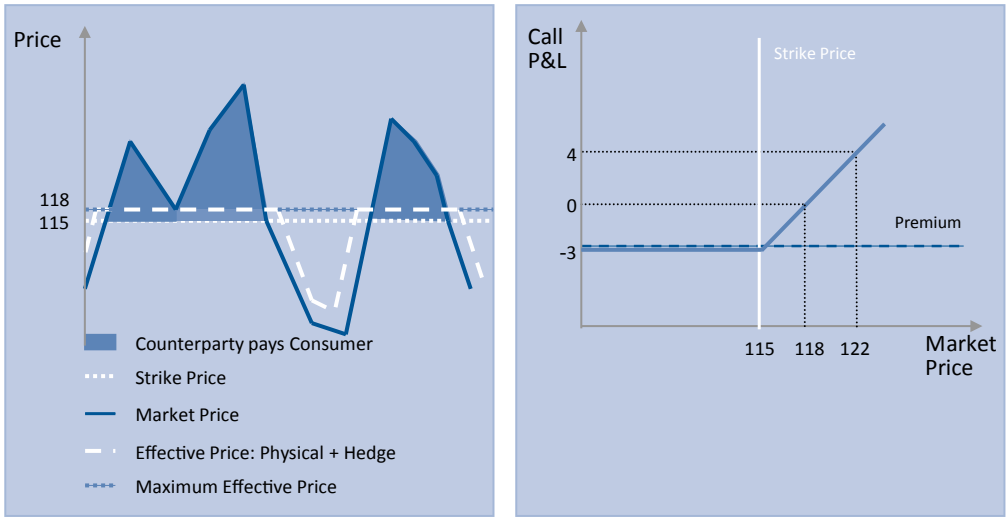
1. The longer the time to expiry, the more expensive the option will be, as there is more time for market conditions to change, which could move the market price significantly through the option strike price.
2. A higher market volatility implies a higher likelihood that the market reaches the strike price, therefore increasing the cost.
3. A higher strike price for a put makes the option more expensive, because the holder of the option has the right to sell the underlying commodity at a higher price (if exercising the option). Conversely, the call less expensive because the option holder has the right to buy the underlying commodity at a higher price (if exercising the option). The closer the strike is to the prevailing market price, the more expensive the cost will be.
4. A higher underlying market price, with other factors constant, would increase the cost of a call option and decrease the cost of a put option.
5. Changes in interest rates are generally the least important factor in determining option pricing, as they will affect the discounting factor applied in the premium calculation.

In the example shown in Figure 20.3, the government pays $3/unit to buy the $115 call option. The total cost is this premium of $3 multiplied by the total volume hedged under this contract. This premium cost is usually paid up front, similar to an insurance premium. The government is therefore protected against a price rise above $115 and will still benefit in a falling price environment.

If the average price over the period is below $115, the option will not be exercised and there is no further exchange of payment. The government's cost associated with the strategy is limited to the premium paid of $3 on its financial hedge. On the physical market, the government will be able to buy its commodity at the prevailing market price (lower than $115).

If the average price over the period is higher than $115, the government will receive the difference (example: it will receive $7 at a price of $122). The net benefit of the hedge

Figure 20.3: Illustration of a call strategy: buying a call (long call)



Source: Morgan Stanley Commodities.

will be the positive cash flow minus the premium ($7 – $3 = $4 in this case). In parallel, the government will be buying its physical at $122. The net price for the government, combining the physical purchase and the hedge, is therefore $118 (which is the strike + premium).

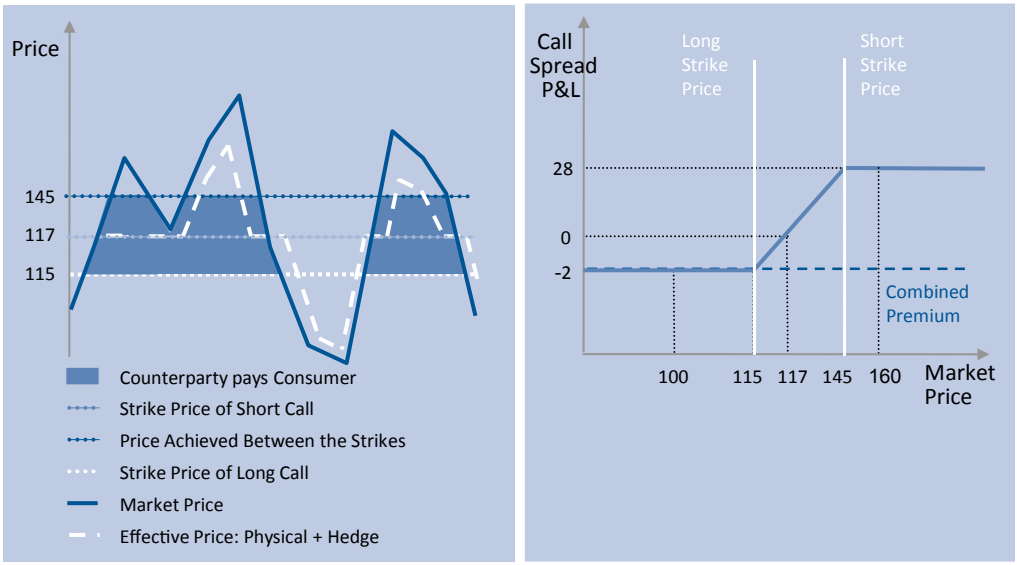
In this example, by buying the $115 call option at $3, the government has ensured that its price exposure is capped at $118.

> ***A Practical Example:***
> *The owner of a call option on July cotton with a strike price of $1.30/lb will exercise the right to buy only if July cotton prices are at least $1.30/lb. If prices were lower (e.g. $1.20/lb), the owner of the $1.30/lb option would be better served by letting the option expire unused and buy July cotton directly in the market at a lower price. Even if the price of July cotton were only slightly lower than the strike price (e.g. $1.28/lb), the option holder would be better off purchasing directly from the market.*

Average price call options are OTC instruments that provide the user with a method of protecting or insuring against higher average commodity prices over a period. These instruments have proven popular with buyers with continuous exposure to commodity prices and who wish to protect against rising prices while retaining the potential benefit of lower prices in a downward market. Similar to swaps, these APO call options involve no physical delivery, and are cash settled against the average price of the underlying over a specific period.

Unlike swaps, call options do not lock the consumer into a fixed purchase price, so the consumer will be protected in a rising market but will benefit from falling prices. The negative cash flow is known at the inception of the trade and is limited to the premium (option cost). In this way, these options are often thought of as similar to classic insurance policies; they have an upfront cost (premium) but potential positive cash flow (the option payout) when the risks exceed a pre-determined level.

Figure 20.4: Illustration of a call spread strategy



Source: Morgan Stanley Commodities.

Alternative strategies

In some instances, the government may look at alternative strategies for its hedging. For example, in a high volatility environment, the cost of a call option could rise substantially and prevent the government from executing its hedging programme. Other instruments may be more appropriate in these instances. They are discussed below.

The call spread strategy is a combination of buying a call (long call) and selling a call (short call) at a higher strike on the same underlying commodity and for the same period, aiming to reduce the cost of the hedge or insurance by giving away some of the protection, resulting in limited protection.

In effect, the customer buys a call to protect against higher prices. Simultaneously, the customer sells a call at a higher strike and collects the premium of that sale, thus reducing the overall cost of the strategy. The sale of the higher call will reduce the total cost of the strategy but will also limit the protection: the maximum cash flow this strategy will generate is the difference between the strike prices of the long and short call options (minus the net premium). The buyer is exposed to the rise in prices above the higher strike. Figure 20.4 illustrates the payoff of the call spread strategy, taking the example of a 115/145 call spread:

In the example shown in Figure 20.4, the government pays $2 to buy the 115/145 call spread. The strategy is a combination of a long call at $115, which costs $3, and the sale of the $145 call, which pays $1, creating a call spread with a net cost of $2.

The government is therefore protected against a price rise above $115 up until prices are above $145, while still benefiting from market prices in a downward price environment.

If the average price over the period is below $115, no option is exercised and there is no exchange of payment. The government's cost associated with the strategy is limited to the premium paid of $2 on its financial hedge. On the physical market, the government will be able to buy its commodity at the prevailing market price (lower than $115).

If the average price over the period is higher than $115 and below $145, the government will receive the difference between the reference market price and the strike of the long call (for example, it will receive $7 at a price of $122). The net benefit of the hedge will be the positive cash flow minus the premium ($7 - $2 = $5 in this case). In parallel, the government will be buying its physical at $122. The net price for the government, combining the physical purchase and the hedge is therefore $117.

If the average price over the period is higher than $145, the government will only receive the difference between the two strikes ($145 - $115 =$30) and will therefore be exposed to further price movements. For example, if the market averages at $160, the government will receive $30 on its hedge (so, a net cash flow of $28 including the premium) but will have to pay the prevailing market price of $160 on its physical purchase. Its net position, when including the physical and hedge, will therefore be the physical cost of $160 minus the hedge benefit of $28, resulting in a net cost of $132.

This strategy guarantees the government a net price of $117 if the market price does not move above the higher strike of $145. Above that, the government will be exposed to further increases ($15 more than $117 at a market price of $160 in our example).

This strategy can be cost effective compared with to the normal call option in a high volatility environment, as it is not as greatly impacted by higher volatility (the sale of a call partly offsets the volatility effect of the call bought). It also works very well in an environment where it is perceived that prices have a limited upside potential. This strategy could well represent 20-40 percent of a total hedging portfolio. It retains the benefit of a call option in that the liability (cost) is limited and finite and so is also less credit intensive.

The collar strategy is a combination of a long call and a short put. The government buys a call that is financed partly or totally by the sale of a put at a lower strike. The government is protected against rising prices above the call strike level by receiving the difference between the market price and the call strike. However, the government will forgo the benefit of lower prices below the put strike by paying the difference between the put strike and the market price to the collar provider, as shown in the following example:

In the example shown in Figure 20.5, the government buys the $125 call and sells the $90 put for zero net premium (commonly referred to as a zero-cost collar, or ZCC). The strategy is a combination of a long call at $125, which costs $2.50, and the sale of the $90 put, which pays $2.50, resulting in a zero-cost strategy.

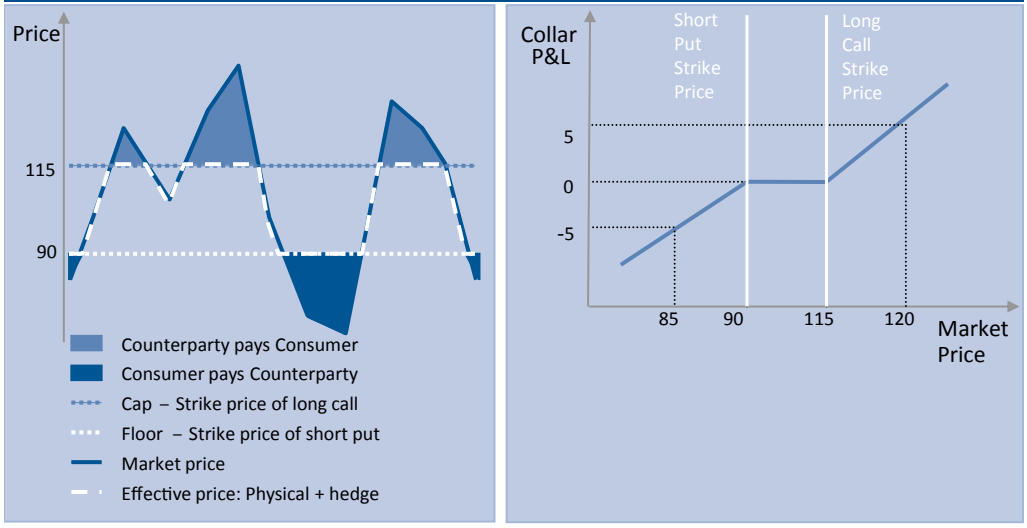
The government is therefore protected against a price rise above $125 by receiving the difference between higher prices and the strike of $125 (it will receive $5 at the price of $130). The net price, when combining the physical purchase at the market price of $130 and the hedge for the government, is therefore set at $125 ($130 physical less the $5 received on the hedge).

There will be no exchange of payments when the market price is between the put strike and the call strike ($90 and $125 in this example), and the government's net exposure will be the actual price it pays for its physical purchases.

If the average price over the period is below $90, the government will need to pay the difference between the put strike and the market price (paying $5 at the price of $85, for example). The government would then effectively set a floor for its net price and any physical purchase cheaper than the put strike (cheaper than $90 in the example) will be offset by the payment that would be made on the hedge contract, therefore setting a price floor at the put strike level ($90 in the example).

This hedging instrument can guarantee the government a ceiling on its purchase price at a zero premium, but there is the potential liability associated with the short put position, i.e. a floor is set on the purchase price.

Figure 20.5: Illustration of a collar strategy



Source: Morgan Stanley Commodities.

Therefore as with swaps, this strategy has a "political" risk: in lower price environments there may be complaints of a missed opportunity owing to the structure of the instrument. This strategy should therefore be used carefully by governments and only applied to a smaller portion of the total hedging portfolio. It should only be used when the put strike can be set at a level that is relatively low and would be broadly accepted, thereby limiting downside risk.

Planning and implementing a risk management programme

Initial considerations

To set up a robust risk management programme, governments should take certain key steps:

1. Designate appropriate hedging instrument(s) that may be used for the purposes of hedging its physical commodity exposure. Governments need to understand and be ready to accept worst-case outcomes that may arise with the use of the chosen instruments.
2. Determine the maximum amount or quantity of agricultural products that should be hedged. This would require input from the departments responsible for the physical procurement. There is a risk of being over hedged if physical purchases eventually turn out to be less than the volumes hedged. It is also important to consider the country's total risk exposure in all agricultural commodities in order to make the final decision on the level of the exposure to be covered by hedging, i.e. considering all direct and indirect exposures.
3. Establish, in advance, the time frame and execution frequency for the hedging strategy. For instance, a strategy may be a quarterly programme for the next two years (initial implementation of hedging two years forward within three months of this policy being in place, and then additional hedges executed on an ongoing basis to meet policy every quarter). A rolling-strategy could state that the government would hedge 60% to 75% of its consumption or production for the first six months, between 60% and 45% for months seven to twelve, between 30% and 45% for months 13 to 18 and 15% to 30% for months 19 to 24 as summarized in Figure 20.9. Every three months, the government should therefore top up its hedging for all months that need an increase in their coverage ratio as

Box 20.2: A study and comparison of different hedging strategies over time

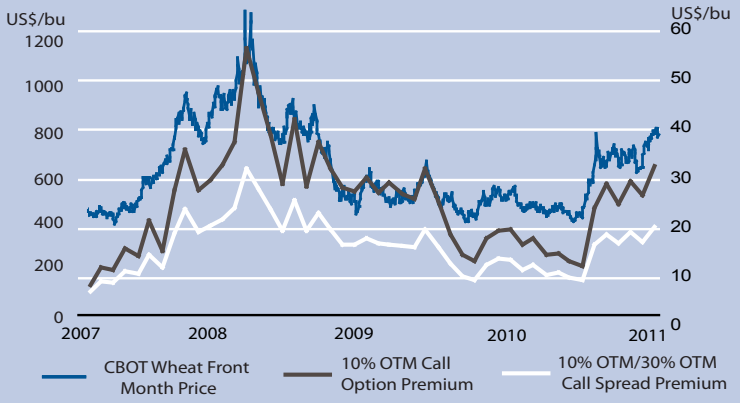
Here, we outline a study that was carried out with the purpose of evaluating the performance of the various hedging strategies we have described so far.
We have focused on the wheat market from 2007 onwards. Since January 2007, the agricultural commodity markets have been characterized by periods of high levels of volatility in both rising and falling price environments. This allows us to consider how the strategies compare in different market environments.
We have calculated the cost of each strategy as of the last business day in each month since January 2007. In each case, we use a strategy providing price protection for the six months following the execution date:

- A structure priced as of 30 January 2009 would price out (provide protection from rising prices) over the six months from February to July 2009.

Figure 20.6 below shows the evolution of the premium (cost) of two of our considered strategies since January 2007:

- 10% OTM (out of the money) wheat call option.
- Wheat call spread (buy 10% OTM call; sell 30% OTM call).

Figure 20.6 CBOT wheat premium and hedging strategy premium



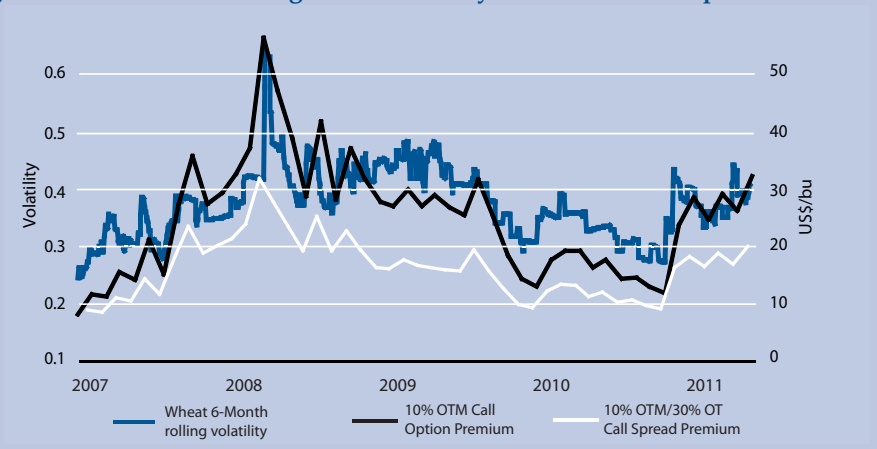
Note: The specific structure considered is an APO Call Strip, with even volumes across each of the six months; 10% OTM (Out-of-The-Money) means the call strike price is 10% higher than the market price of the underlying, for the same pricing period, at the time of the transaction. Source: Morgan Stanley Commodities.
It is immediately clear that the 10% OTM call option strategy is always more expensive than the 10% OTM/30% OTM call spread strategy. As previously explained, this is because the call spread involves "selling away" some of the unlimited protection against rising prices that a call option provides.

The cost or premium of the two strategies, and the difference between these two premia has varied significantly over time, however. This is explained by the level of volatility in wheat prices over time.

We know that increased volatility in the underlying price makes options more expensive, as it increases the likelihood of larger price moves in either direction. Therefore, in periods of high volatility in the wheat market, the premium or cost of the 10% OTM call option increases, while the premium of the 30% OTM call option also increases (see Figure 20.7 below).

- During the agricultural commodity price spike that peaked in early 2008, we see the price of call options and call spreads peaking, while the spread between the two prices also reaches its widest level.
- Wheat swap ("at the money", ATM, no premium required).
- 10% OTM wheat call option.

Figure 20.7 Six-month rolling wheat volatility and CBOT wheat premium



Source: Morgan Stanley Commodities.

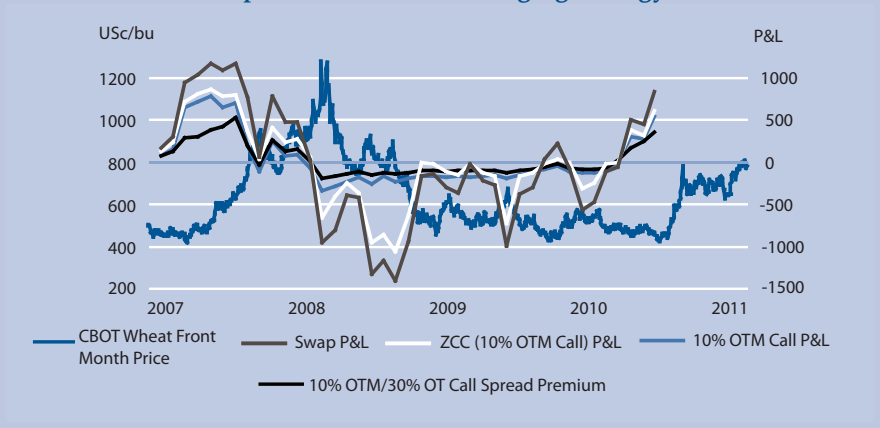
Figure 20.8 shows how some of our considered strategies have performed since January 2007 (assuming that the structures are held to expiry).

- Wheat call spread (buy 10% OTM call option, sell 30% OTM call option).
- Wheat zero-cost collar (buy 10% OTM call option, sell put option for the same premium).

Each data point on a Profit and Loss (P&L) line in the figure shows the realized profit or loss of the instrument priced as of that date, which is active for the following six months. This P&L is inclusive of the premium.

For example, the 30 January 2009 value for the call option represents the P&L generated by a six-month 10% OTM call option purchased on that date, having priced out during February – July 2009.

Figure 20.8 CBOT wheat price evolution and hedging strategy realized P&L



Source: Morgan Stanley Commodities.

Key take-away messages from the analysis in terms of a comparison between the different strategies are that:

- The **swap** provides the best performance during a rising market, but the worst during a falling market, with potential gains unlimited and losses limited only to the swap level (in the unlikely case that the price falls to zero).
- The **zero-cost collar (ZCC)** provides a similar performance to the swap, but it makes smaller gains in a rising market and smaller losses in a falling market.
- The performance of the **call option** in rising markets will always be slightly lower than that of the ZCC. This is because while the call has the same strike-price for upside protection as the ZCC, the P&L will be lower owing to the premium paid for the call. In a falling market, however, the call option's loss is limited to this premium, while the ZCC's losses can increase to the equivalent of the short put strike in the unlikely case that the price falls to zero.
- The P&L of the **call spread** resembles that of a call option to a certain degree. In a falling market, when the loss of both structures is equal to their respective premia, the performance of the call spread benefits from the fact that its premium is lower. In a rising market, so long as the gains do not exceed 30% (the percentage by which the short call leg of this strategy is OTM) of the initial swap level, the call spread will also outperform, again benefiting from its lower premium. However, should the gains in the underlying exceed 30%, the call spread's P&L will be capped, while the call option will continue to benefit from all further price increases. If this is the case, the performance of the call option will exceed that of the call spread – an example being structures bought in the first half of 2007.

Table 20.2 below summarizes the total profit or loss that would have been generated by December 2010 by entering into a rolling six-month hedging programme from January 2007 onwards. These P&Ls are net of premium.

- The first column lists the four instruments that have been used in this simulation, each of which has been described in some detail earlier in this chapter.
- The second column shows the total profit on the hedging programme from January 2007 based on a total volume of one bushel of wheat in each month for the entire rolling hedging programme.
- The third column presents the total profit or loss, over the entire period from January 2007 to December 2010, on a hedging programme which protects against rising prices for a total 100 000 tonnes of wheat in each month.

Table 20.2 Overall profit and loss generated by a rolling six-month hedge: Jan 2007 to Dec 2010

Total Instrument	Total P&L with a monthly underlying of one bushel (USc)	Total P&L with a monthly underlying of 100 000 tonnes (USD)
Swap	-28.32	-1 039 344
10% OTM call	323.24	11 862 908
10% OTM/30% call spread	266.62	9 784 954
Zero-cost collar (10% OTM call)	82.58	3 030 686

Note: 36.7 bushels are equivalent to one tonne of wheat.

For instance, since 2007, a strategy of purchasing 10% OTM call options on CBOT wheat at the end of each month for the following six months would have yielded a total profit of USc 323.24 on the basis of one bushel of wheat per month hedged in the rolling programme. Assuming that the total monthly volume hedged each month since January 2007 was 100 000 tonnes of wheat, then this is equivalent to a total profit of $11 862 908.

Given the volatility in the wheat market since January 2007, the performance of the different instruments has varied somewhat over time. Tables 20.3 to 20.6 summarize the profit or loss made by the hedging programme in the different years it would have been in place.

- Note that the tables reflect the profit or loss of the instruments purchased in that year, so the 2007 table reports the profit and loss (P&L) of instruments entered into in 2007, although some of these would have priced out in 2008.
- Note that the first half of 2010 is reported rather than 2010 as a whole. This is because instruments purchased in the second half of 2010 would partly price out in 2011 following the completion of this study.

Table 20.3 Profit and loss from a rolling six-month hedge: 2007

Instrument	P&L with a monthly underlying of one bushel (USc)	P&L with a monthly underlying of 100 000 tonnes (USD)
Swap	1 407.86	51 668 462
10% OTM call	705.28	25 883 776
10% OTM/30% call spread	476.07	17 471 769
Zero-cost collar (10% OTM call)	938.01	34 424 967

Table 20.4 Profit and loss from a rolling six-month hedge: 2008

Instrument	P&L with a monthly underlying of one bushel (USc)	P&L with a monthly underlying of 100 000 tonnes (USD)
Swap	-1 323 04	-48 555 568
10% OTM call	-407.26	-14 946 422
10% OTM/30% call spread	-239.74	-8 798 458
Zero-cost collar (10% OTM call)	-867.46	-31 835 782

Table 20.5 Profit and loss from a rolling six-month hedge: 2009

Instrument	P&L with a monthly underlying of one bushel (USc)	P&L with a monthly underlying of 100 000 tonnes (USD)
Swap	-562.70	-20 651 090
10% OTM call	-264.16	-9 694 672
10% OTM/30% call spread	-168.51	-6 184 317
Zero-cost collar (10% OTM call)	-334.79	-12 286 793

Table 20.6 Profit and loss from a rolling six-month hedge: first six months of 2010

Instrument	P&L with a monthly underlying of one bushel (USc)	P&L with a monthly underlying of 100 000 tonnes (USD)
Swap	449.56	16 498 852
10% OTM call	289.38	10 620 246
10% OTM/30% call spread	198.80	7 295 960
Zero-cost collar (10% OTM call)	346.82	12 728 294

In Table 20.7, we show a summary of the performance characteristics for each of the strategies.

Table 20.7 Performance characteristics of hedging strategies

	Protection against price increases	Benefit from price decreases	Upfront cost
Swap	√	x	Zero
Call	√	√	Premium paid out
Call spread	√ (Limited)	√	Premium paid out
Collar	√	x (limited)	Zero/premium paid out
√ = yes x = no			

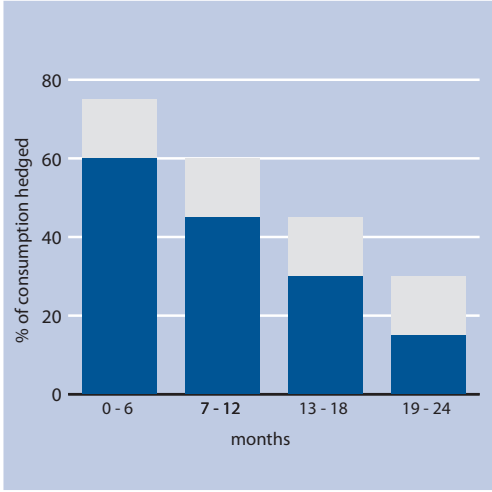
they come closer, i.e. minimum percentage cover is always adhered to, regardless of any personal view on the market. The higher percentage targets can be met if and when the government feels its risk tolerance, or market view, warrants it, i.e. some limited scope for personal view and opinion. The choice of instruments could also be different depending on the maturity, with call options for shorter maturities and call spreads and collars for longer maturities, noting that calls can get more expensive owing to the impact of time value.

4. Retain the flexibility to add or reduce hedges depending on market conditions, subject to the minimum percentage cover being reinstated in a relatively short timeframe.

Depending on market conditions, the government, after consulting with its advisers and market participants, should be able to determine

1. Tenor.

Figure 20.9: A rolling risk management strategy



Source: Morgan Stanley Commodities.

2. Hedge ratios.
3. Volumes to be hedged.
4. Instrument(s).

Internal risk management processes and procedures

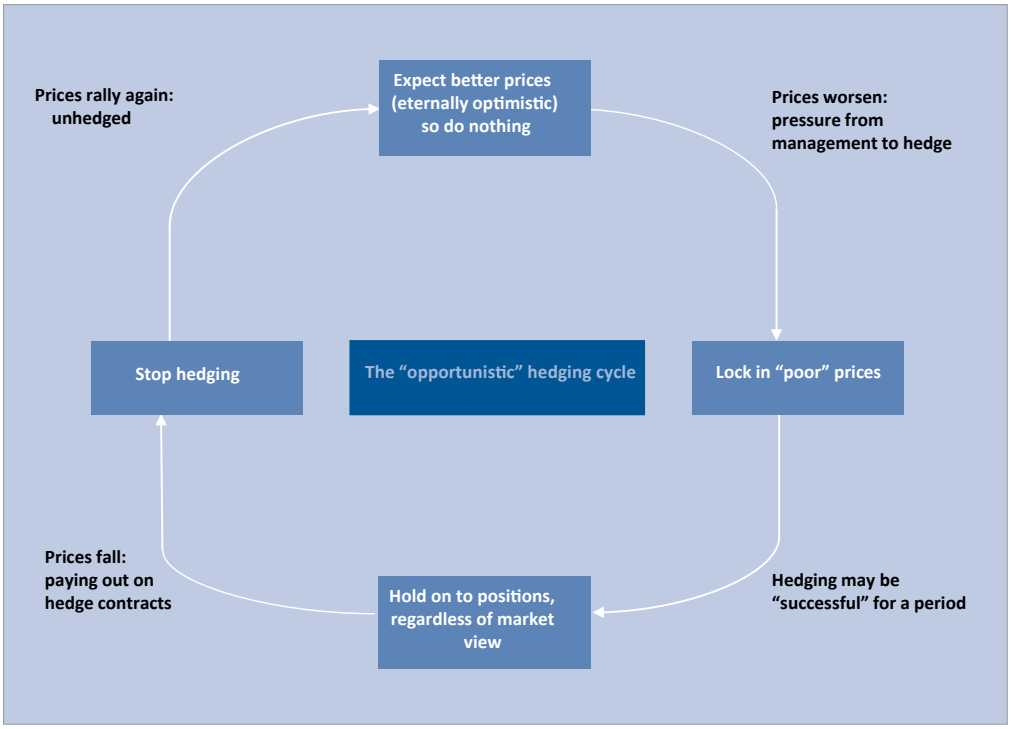
The experiences gained from previous government hedging initiatives and observed trends in corporate hedging behaviour have proven that a successful risk management programme is a strategic, systematic one.

In order to achieve this discipline, risk management should be executed under a clear policy set by the government (usually between the Ministries of Finance and Agriculture), determining the choice of instruments, tenor, volume, underlying commodities and so on. It should be executed by the hedge managers. The hedge managers have a duty to report the progress of the hedging strategy on a regular basis, requiring that they execute and monitor hedges routinely as set out in the strategy, regardless of their personal view or sentiment about the market.

This aspect is critical and stands at the centre of every successful hedging strategy. The purpose should be to externalize the risk and not to try to "beat the market". Personal or individual views on the market should not dictate the hedging process. That way, the government always has an adequate level of hedges for the period and with the instrument that they are comfortable with. This will preclude the "emotional" aspect that is illustrated in the Figure 20.10.

Communication is key in this process and will flow from the different hedging counterparties to the risk managers, providing them with market colour, pricing updates and ideas that should flow back to the Ministry to be considered in the larger hedging policy. The Ministry should also regularly interact with the hedge managers and give its guidance for the future hedges as illustrated in Figure 20.11.

Figure 20.10: A typical non-systematic hedging cycle



Source: Morgan Stanley Commodities.

Usually, these conversations are held on at least a monthly basis and include representatives of the ministry and the execution team to discuss recent hedging and the policy and strategy for future transactions.

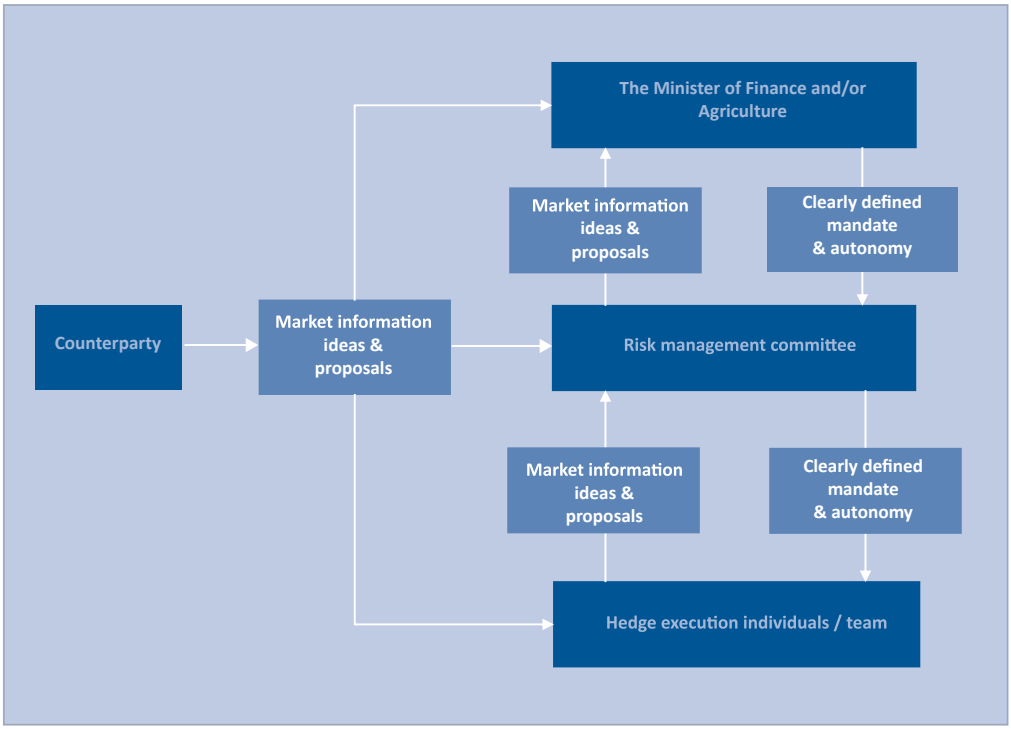
Choice of counterparty

The counterparty in a risk management programme needs to be selected carefully for various reasons. The first aspect is the credit worthiness of the counterparty as there will be an element of credit risk inherent in the use of derivatives, i.e. the ability of the counterparty to perform on its contractual obligations. The second key aspect is the experience and expertise in the given commodity market and the extent of the counterparty's involvement in that market as there will be times when meaningful risks need to be warehoused by the counterparty in order to ensure a smooth and efficient execution. Also important, especially for governments, is the counterparty's experience in dealing with corporations and governments that are new participants in the market and working with them to set up their risk management programme.

The counterparty will be a critical facilitator for the government in getting into the commodities market, with roles ranging from information dissemination to ensuring a transparent and efficient execution. The counterparty also provides assistance in establishing the risk management programme by sharing previous experiences.

In summary, as a non-exhaustive guide, the counterparty selected by the government

Figure 20.11: Organization structure in risk management



Source: Morgan Stanley Commodities.

should:

1. Be a strong credit-worthy institution, preferably rated at least A2 by Moody's or A by Standard and Poor's (S&P). Credit exposure limits can be set at pre-agreed levels with collateral arrangements in place beyond these limits. These credit arrangements are typically documented under a Credit Support Annex (CSA);
2. Have recognized experience in dealing with financial derivatives;
3. Have a broad knowledge and experience of the underlying commodity markets;
4. Have the relevant documentation in place with the government or relevant entity:

    (a) International Swaps and Derivatives Association (ISDA) Master Agreement

    (b) CSA, if relevant; and

5. Have proven experience of government hedging programmes.

The number of counterparties should be sufficient to ensure transparency and competitive pricing but still limited enough to avoid information spreading into the market and creating an "echo effect" that could distort the market and increase the government's cost of hedging. Typically, governments tend to have two to four selected counterparties with the ability to execute.

Conversely, banks would look for proof that the local jurisdictional framework allows for the use of these instruments and that the specific government entity leading the risk management effort is allowed to transact (i.e. has the required capacity and authority).

Execution

Before execution takes place, the government must set up the necessary documentation for trading commodity derivatives with its counterparties. The regulatory authorities insist that a certain level of client due diligence is carried out prior to engaging in business. The government will need to submit some organizational information to satisfy requirements before starting to transact. The counterparty must also perform a credit analysis and legal review of the jurisdiction in order to set the terms for the contractual documents that will govern the transactions. These transactions will normally be covered under an ISDA Master Agreement (which is the industry standard for derivatives) plus additional annexes (such as the CSA) that include any specific credit terms mutually agreed upon between the government and the counterparty.

Once the legal and documentation framework is set, the government can start executing trades with the counterparties that have been selected and set up.

The hedge manager will receive regular updates on market fundamentals, opportunities and pricing for the selected instruments.

Once the decision has been made to trade at a particular level, the hedge manager will request pricing from the different counterparties and select the best offer. The time between receiving indications and executing the trade needs to be extremely limited as the market keeps moving and indications can be void after a minute or less if the market is moving quickly.

The trade is then immediately agreed and the economics of the trade are recapped over the phone. These details include the type of instrument, the underlying commodity and reference price, the period, volume, pricing methodology (Asian or European), strike and premium. These form the contractual agreement of the operation. At this point of agreeing terms by telephone, the deal is complete and both parties are contractually obligated to the trade. Usually, the counterparty would additionally send an email after the transaction with the economics of the trade in writing as detailed above.

The full legal text confirmation is then sent within two days after the trade and needs to be signed and returned.

A dynamic approach

This approach recognizes that from time to time, and depending on market conditions, the government will want to reduce the hedging ratio and re-enter the market at a later stage. The government may also decide to accelerate the execution of its programme when the market presents an opportunity that fits its strategy.

Examples of recent government transactions in agricultural markets

In this section we outline a recent example of government involvement in the agricultural markets – a government of an emerging market country during the wheat price shock of 2007-08. At the time, the government did not have a hedging policy around its agricultural price risk, but felt it must take action to protect its increasing exposure owing to the wheat and bread subsidies in place for its domestic population.

The government therefore enacted an emergency hedging programme with the aim of covering 25–35 percent of its imports of wheat by buying call options referenced to the CBOT wheat market, which is the most liquid and transparent wheat index. The government was satisfied with the correlation of the CBOT wheat market to the market price it was paying on its physical contracts. The size of the programme was in excess of one million tonnes for one year, at a time when the liquidity was relatively poor. Therefore, the hedge was split into multiple smaller tranches (50 000 tonnes to 250 000 tonnes) that were executed gradually from the end of October 2007 to the end of January 2008, as the market price kept rising. The government received updates on prices and market conditions on a daily basis and decided to act regularly at the prevailing market price.

Once the programme was completed at the end of January 2008, the government kept monitoring its long call option positions and receiving regular updates from the counterparty. At the end of February, the market showed signs that the supply and demand tightness in the global wheat markets was easing. Therefore, the government decided to sell its position to monetize the intrinsic value in its hedge contracts (three times the amount of premium spent).

The market fell after February and throughout 2008 to reach a period of relative calm between 2008 and 2010. This same government has since then been working on a more structured and systematic hedging policy in order to have constant cover against all of its subsidies in its commodities exposure.

The above example has shown that acting regularly, even in a rising market, will have the benefit of entering the market at different levels and protecting against further rises. It also shows that allowing for flexibility and dynamic hedging (selling protection when the market is believed to be reaching a high in order to re-enter at a later and lower level) can have benefits. Although this hedging experience was a significant success, there is some degree of risk involved, as the selling or unwinding of the call option was based on a view on the market's evolution in the future. If that government had hedged regularly in advance, the benefit of the hedge would have been even greater as then the entry points would have been during the previous period of calm in 2006 to 2007.

More recently, there has been much media coverage on the hedging strategy of Mexico. This country is an interesting case as it is one of the first governments to have regularly hedged its revenues in oil – every year on similar volumes – in order to protect its budget.

Similarly, Mexico has put in place a hedging strategy to cover both its production and consumption of agricultural products. Its largest exposure is in its domestic consumption of white corn used in tortilla production.

According to the media, Mexico has hedged 4.2 million tonnes of its domestic consumption of corn in 2010[7] and is expected to hedge up to 6.4 million tonnes in the 2011/12 crop season.[8] The hedging is executed through ASERCA, a government agency reporting to the Ministry of Agriculture. Mexico has decided to use only options, buying call options on CBOT corn to cover its domestic consumption, for example. The budget to spend on risk management is set in advance and ASERCA executes on behalf of the government, within the budget and directions provided. The 2010 budget for the total agricultural commodity risk management programme is around USD 842 million, according to ASERCA's director of financial operations.[9]

7 Javier Blas, "Mexico hedges against corn inflation", 22 December 2010, Financial Times.

8 Carlos Manuel Rodriguez, "Mexico subsidizes 40 percent of corn hedging costs", 15 January 2011, Bloomberg.

9 Mica Rosenberg, "Mexico eyes new ideas for grains hedging", 22 December 2010, Commodities Now.

Key considerations

Market impact/liquidity

While commodity markets have developed substantially over the past three to five years, liquidity can still be a limiting factor in some markets.

Lack of depth in the forward markets could constrain large consumers or producers when they look to hedge a substantial portion of their consumption or production further down the curve (say, beyond six months to one year). Coming in to hedge (buy) large volumes could cause the adverse effect of pushing prices higher in a low liquidity environment.

This problem can be handled by carefully choosing counterparties that can warehouse the risk for some time and provide a sensible execution strategy based on their understanding of how much the market can absorb without being distorted.

Executing with a limited number of counterparties may be necessary to avoid the "echo effect" where different counterparties look for the same products and quantity while at the same time discussing it with brokers who then request it from other counterparties again. This could result in a transaction being perceived in the market as much larger than it actually is, thus pushing prices higher.

Basis risk

When hedging with derivatives, the basis risk is the risk that movements in the reference price in the derivative contract will vary from the price changes in the physical commodity being hedged. There are different elements that may cause basis risk:

- Product type: a government that is exposed to barley could be tempted to hedge its exposure with corn (owing to better liquidity), and therefore incur a basis risk between barley and corn price evolution;
- Product specifications: a company buying premium cotton and hedging it with the standard cotton, for example; and
- Geography: government buying wheat from various places in the world and hedging it with a single index like CBOT wheat.

The ultimate aim of a hedging programme is to minimize basis risk as much as practically possible if there is sufficient market liquidity.

Appropriate price indices should be chosen based on the best balance between basis risk and the liquidity of the chosen index. The chosen counterparty should be able to provide the necessary analysis to substantiate this decision.

In most cases, the government will have flexibility to decide where they source their physical commodity and will buy efficiently, i.e. from a relatively cheap source. Therefore, the choice of index cannot be made depending on where the physical commodity will be purchased (as this may be unknown at time of hedging), but rather by choosing an index that best reflects global fundamentals for the product, is transparent and liquid and correlates well with the physical exposure of the government over a period of six to twenty four months. Also, because the government would tend to buy from the cheapest source means that in a rising market, the reference price in the hedge contract is likely to outperform the physical purchase price. In this case, there will be a benefit of excess cash flow from the hedge contract compared with the negative cash flow on the physical purchase contract.

Political risk

Political risk refers to the personal and political implications on the career of individuals initiating and executing the risk management programme.

In most cases, the public would more readily accept the negative cash flows (budget deficits) arising from high prices than those arising from risk management decisions that failed to anticipate lower prices and therefore diverted resources from key development or budget needs into settling hedging contracts. This could provide political ammunition for opposition parties.

Although it is not easily quantifiable, political risk seems to be one of the key reasons that governments' hedging experiences have been, and continue to be, limited.

Critical steps must be taken to avoid such situations. The choice of instruments first must be adapted to the entity that will be hedging. If these are public organizations and the hedging is done at the governmental level, then option structures are probably the most appropriate. The liability is known in advance (is limited to the option premium) and can be budgeted as a form of "insurance" premium. Therefore, the government would still benefit from falling prices and negative perception would be minimized. Next, the internal set up should require a committee-based decision-making process, as opposed to just a few people being responsible. This committee should include members of the various departments and stakeholders involved. Finally, the transparency, discipline and regularity of the hedging would help avoid any allegations that a "view" has been taken. Instead, hedging would be seen as a step taken by the government for risk mitigation.

Physical supply issues: security of supply

Using commodity derivatives can reduce exposure to market volatility and externalize price risk.

However, these are cash settled instruments that are not related to the sourcing and supply of the physical commodity. Therefore, governments should always look at their risk management programmes in conjunction with an appropriate supply strategy.

As with the choice of risk management provider, it is essential to choose a supplier with a strong credit standing who will perform on their contracted obligations. Legal advice should also be sought regarding the procurement contract to ensure that it is as robust as possible so that potential supply disruptions are minimized.

Typically, it may be beneficial for the government to separate the suppliers of the physical commodity from the risk management products and services, as the physical players may not be as competitive on the derivative pricing.

In some cases, there is the potential for an integrated approach whereby the price risk management and physical supply are done simultaneously, i.e. they are integrated into the same contract from a single supplier. For example, buying forward physical wheat on an index (e.g. CBOT wheat) and agreeing on a maximum contract price (which would act like a call option). These solutions can be discussed and implemented with a reputable counterparty that has access and experience in both physical commodities and financial derivatives.

Conclusion

The numerous fundamental factors and emerging trends that characterize the agricultural markets today will likely result in an increasingly tight market vulnerable to supply shocks

and subject to periods of volatility. Therefore, governments can no longer afford to ignore or postpone managing their agriculture price risk exposure.

In this chapter we have identified some key reasons why some governments have not historically employed the instruments and services available in derivatives markets to manage their risks. We have discussed at length an appropriate risk management solution – a systematic hedging programme that governments can adopt. We have also gone into some detail regarding the tools, strategies, processes and logistics that would typically underpin such a risk management programme, illustrated with practical examples.

While we acknowledge that a systematic and disciplined risk management process will not eradicate exposure to a sustained rising price environment, hopefully we have shown that it can help manage against shocks and thus facilitate governments' abilities to set their budgets more confidently and better manage their liabilities resulting from domestic food subsidies.