PRICE RISK MANAGEMENT IN THE THAI SUGAR INDUSTRY

Pollasit Wattanavong*
Assumption University of Thailand

Abstract

This research studied the risk management of price volatility for sugar in Thailand, due to intense competition from other countries. It considers four hedging instruments and explores which are used (if any) and the criteria used to select these. Data was collected from the owner or manager in 47 Thai sugar mills. The data was analyzed using arithmetic mean, median, mode, interquartile range, and standard deviation.

The findings revealed that a 'futures contract' hedge was used by 14 of the 47 sugar mills. This can reduce the price risk, obtain the highest price, achieve sales targets and control production cost. Of the four decision-making criteria for selecting each of the four hedges, the 'set up cost premium' criterion was most favoured.

The 33 mills that did not use hedging made that decision due to the high initial hedging cost. The risk management strategy used by these very experienced owners and managers was to monitor many factors which affect price, such as demand and supply, world market stock, natural disasters, changes in government policy, climate change, activities of speculators, and currency exchange rates.

บทคัดย่อ

งานวิจัยนี้เป็นการศึกษาการบริหารความเสี่ยงของความผันผวนทางด้านราคาน้ำตาลในประเทศไทย ที่มีสาเหตุมาจากภาวะการแข่งขันที่รุนแรงจากประเทศอื่น โดยพิจารณาถึง 4 เครื่องมือที่ใช้ในการป้องกันความเสี่ยง และทำการสำรวจตรวจสอบว่ามีการใช้เครื่องใดบ้าง มีกฎเกณฑ์ใดเพื่อเลือก และใช้เครื่องมือนั้น ทั้งนี้ผู้วิจัย ได้เก็บข้อมูลจากเจ้าของ หรือผู้จัดการโรงงานผลิตน้ำตาล ทั้งสิ้น 47 แห่ง วิเคราะห์ด้วยค่าเฉลี่ยเลขคณิต มัธยฐาน ฐานนิยม พิสัยอินเตอร์ควอไทล์ และส่วนเบี่ยงเบนมาตรฐาน จากการศึกษาพบว่า โรงงานผลิตน้ำตาล 14 แห่ง จาก 47 แห่ง ใช้สัญญาการซื้อขายล่วงหน้าเป็นเครื่องมือในการป้องกันความเสี่ยง เนื่องจากสามารถลดความเสี่ยงทางด้านราคา ได้ราคาที่สูงที่สุด ยอดขายเป็นไปตามเป้าหมาย และสามารถควบคุมต้นทุนการผลิตได้ สำหรับ 1 ใน 4 กฎเกณฑ์ ข้อที่นิยมใช้ในการตัดสินใจเลือกเครื่องมือ คือ การตั้งต้นทุนที่มีคุณภาพสูง สำหรับ 33 โรงงานผลิต ไม่ได้เลือกใช้การป้องกันความเสี่ยงทางการเงิน เนื่องจากการป้องกันความเสี่ยงมีต้นทุนที่สูง ดังนั้น กลยุทธ์ในการบริหารความเสี่ยงที่ทางโรงงานเลือกใช้คือ ประสบการณ์ของเจ้าของโรงงานหรือผู้จัดการโรงงาน โดยจะพิจารณาปัจจัยต่าง ๆ ที่ส่งผลกระทบต่อราคาสินค้า เช่น ปัจจัยทางด้านอุปสงค์ และอุปทาน ตลาดสต็อกสินค้าโลก ภัยพิบัติทางธรรมชาติ การเปลี่ยนแปลงนโยบายภาครัฐ การเปลี่ยนแปลงทางสภาพภูมิอากาศ การเคลื่อนไหวของนักเก็งกำไร และ อัตราแลกเปลี่ยนเงินตรา

*This is a much condensed version of Mr. Wattanavong's dissertation in part fulfillment for the degree of MSc awarded him by Assumption University.

INTRODUCTION

Commodities, raw or processed or manufactured goods, provide a livelihood for many communities, and generate local and national economies. The dark side is that commodity markets are often volatile, with prices in flux. Developing countries depend on commodities for their exports and government revenue, so price risk is a serious concern (Larson, Panos and Yabuki,1998).

Many commodity prices are notoriously volatile, constituting a major source of instability and uncertainty for firms, communities and nations. Agricultural commodities have many risks: climate and weather, natural disasters, pests, diseases, uncertainties in yields and prices, and imperfect markets. There are also inflated prices and erratic deliveries, tactical-buying that jeopardizes strategic relationships, and foreign demand affecting global supply (Jones, 2003). To these is often added a lack, or low-level use, of hedging instruments such as forwards, futures, options, and swaps (Government of India, 2007-2012). Price volatility affects governments, producers (farmers), traders, processors, and local financial institutions. This price instability has a negative impact on profitability, economic growth, income distribution and poverty alleviation (Larson, Panos and Yabuki, 1998). High price risk commodities are those with high volatility, while low price risk commodities have a relatively consistent price.

Thailand produces many agricultural commodities for export, such as rice, rubber, tapioca, sugar, shrimp, chicken, vegetables, and fruit (Kittipongse, 2004). The sugar industry is very important as it can generate around US$1,400 million per year. However, sugar producer face many problem such as high production cost, uncertain profit outcome, and not having enough currency, because sugar prices are volatile and follow the world sugar market price (Office of the Cane and Sugar Board, 2008). This directly affects the sugar mill production cost and procurers who buy sugar.

There are 47 sugar mills in Thailand, producing three types of sugar: super refined sugar, refined sugar (white sugar), and raw sugar. The crop in 2008 produced a yield of sugar of 7 million tons in total (Office of the Cane and Sugar Board, 2008). Of this, 26% was consumed domestically, and 74% exported, mostly to China, Indonesia, Japan and Malaysia. These sugar exports, about 10% of world total, earned US$1,400 mn.. Thailand's biggest competitors were Australia, Brazil, India, and South Africa. Thailand became the second largest sugar exporter in the world market after Brazil (Litcht,2007). Thus, the Thai sugar industry plays an important role in the Thai economy, and as a major source of foreign income.

The Thai sugar industry is labor-intensive, employing more than one million people annually. About 80% work on sugarcane farms, and 20% are sugarcane harvesters, temporary workers. There were 47 sugar mills in Thailand, employing about 46,000 people. There are also about 30,000 truck drivers (Office of the Cane and Sugar Board, 2008 and Office of Agricultural Economics, 2007). The sugar industry is an important force of

rural development, especially in the Northern and Northeastern regions where new sugar mills have been relocated from the central plains or newly built. These sugar mills contribute directly to employment and income in rural areas. (Table 1)

Table 1: Quantities and Value of Thailand's Sugar Export 2002-2007

Year	Export Quantity (Tons)	Export Value (Million Baht)
2002	4,028,948	29,383.81
2003	5,064,830	38,432.35
2004	4,600,038	32,615.15
2005	3,012,119	28,114.01
2006	2,273,133	28,109.18
2007	4,108,850	39,940.54

Source: Office of Agricultural Economics, 2007

This Table illustrates sugar price volatility. Compare the value and quantity for 2002 with that for 2007: similar quantity, very different value. For 2006, there was a similar value to 2005, but for very different quantities.

The Thai Sugar Industry Act

The Thai government exercised control and coordination of the sugar industry to secure sugar for domestic consumption and to stabilize the revenue of sugarcane farmers and sugar millers, through the Cane and Sugar Act, 1984. The government allocated production quotas to direct sugar to the domestic market and for export to the world market. Quota C is the amount of raw, white or refined sugar which sugar mills can sell to the export and domestic markets after the mills achieve Quotas A and B. (Kittipongse, 2004). Quota C price is determined by sugar millers using the sugar world market price as their reference. Therefore, this study is concerned only with Quota C, as sugar millers and procurers have to face international competition, and thus feel the force of volatile prices for which they need risk management tools.

Many commodities are traded in organized commodity markets, called "exchanges", typically based in major cities such as London and New York. Historical and current data of world sugar prices is used as the basis for selling raw and refined sugar in Thailand. A sample, from 1997-2006, is shown in Table 2 below.

Table 2: Monthly Price Movement of Refined Sugar (London Market)

Year	Highest Month	Lowest Month	Average price US$/ton
1997	345.25	299.48	315.92
1998	298.01	220.52	255.40
1999	231.54	170.38	200.57
2000	270.86	169.06	221.04
2001	279.43	225.83	248.80
2002	238.57	213.52	228.79
2003	244.32	184.95	214.51
2004	260.50	202.16	240.50
2005	330.06	259.02	290.79
2006	481.07	440.54	447.17

Source: Licht, 2007

Table 2 reveals the price volatility, which affects commodity producers and procurers in term of thei operation cost and need for sufficient currency, with the risk of paying a significantly higher price a a later date if sugar has to be bought on the spot market. This would happen if a sugar producer ha no price hedging instrument. Table 2 shows monthly changes, but in reality prices can change from day to day. Figure 1 is a graph showing how volatile prices can be.

Figure 1: Raw Sugar - New York - Daily Price Movement



Source: www. futuresource.quote.com

For another example, Table 3 below shows price movements every single day for just one month (31 days). The standard deviation is equal to 0.73.

Table 3: Raw Sugar Price, Daily, for July 2009 (New York)

Date	1	2	3	6	7	8	9	10	13	14	15	16
Price (Cent/lb)	14.05	13.94	13.24	12.67	12.02	11.81	12.24	12.08	11.52	11.81	11.9	11.61
Date	17	20	21	22	23	24	27	28	29	30	31	
Price (Cent/lb)	11.68	12.15	12.37	11.74	11.61	12.06	11.27	11.4	11.6	12.19	12.3	

Source: www. futuresource.quote.com

These volatile world sugar prices have a significant impact on the incomes of sugar millers and sugar buyers. Coping with price variability presents a challenge to millers and buyers to mitigate and manage this risk that can be so harmful. Price volatility can significantly reduce or eliminate a company's profit margin.

Statement of the Problem

Prices can change between the time of purchase and the time of export, and between planting and harvesting. Volatile prices affect production costing and cause uncertainty of profit outcome of commodity producers and procurers. Price risk refers to volatility, which is how much the price of the agricultural commodity varies over time. If the price is volatile, the producer or buyer can use a risk management instrument, an advanced pricing mechanism such as hedging, or risk higher than expected prices later when the commodity is bought on the spot market. However, there is a low-level use of these instruments as well as a lack of understanding of them (Kan and Mahajan, 2006).

There are four main hedging instruments commonly used for agricultural commodities: forwards contracts, futures contracts, put and call options, and swaps. Four criteria for deciding which to choose are: Tailor-made, Cash transfer, Pricing transparency, and Set-up costs. These derive from previous research and a report by UNCTAD (1998) and Page & Hewitt (2001). Tailor-made, means that an instrument is especially matched to the firm's needs. Cash transfer means that it involves cash for cash. Pricing transparency means that it is very clear exactly what is in the contract. Set-up cost means that the initial cost is very relevant, if too high to seem alterable or for the risk involved.

The research question of this study is:

1. What type of hedging instruments are used by the Thai sugar industry?
2. What are the decision criteria that the Thai sugar industry uses to select a hedging instrument or their strategy for not doing so?

The focus is limited to "Quota C sugar".

LITERATURE REVIEW

Procurement, Price Risk and Hedging

The basic function of a sugar procurement department is to maintain the supply to the manufacturing plant in order to meet demand at a reasonable cost. Commodity procurement identifies the volume needed and the costs of various buying strategies. There are six strategies: the spot market (buy-now); speculating on prices; hedging through buying forwards contracts, futures contracts, and swaps (Bittman, 2001).

Price risk refers to volatility, which is how much the price of a commodity varies over time. The volatility is measured in percentage terms and annualized to evaluate the historical volatility of a commodity (Bittman, 2001) For example, if a commodity varies from $5 to $5.50 over a year, it has an annual volatility of 10%. If the price is volatile, it makes sense to use of a risk management hedging instrument. If no such mechanism is used, this can affect production yield, production cost, or a high risk of paying a significantly higher price at a later date on the spot market (Jones, 2003).

Price risk is a measure of both upward and downward deviations from the mean (average price), and the role of price risk management is not necessarily to maximise profits, but rather to reduce (or smooth) the deviations in price that results from the variability in supply and demand. Pricing and marketing strategies in agricultural commodity forward markets usually contain one or more instruments to manage price and/or currency risk. There are four main price risk hedging instruments: forward contracts; buy and sell futures; buy and sell put and call options; and swaps. Primary commodity producers derive considerable price risk reduction benefit from hedging with either futures contracts or forward cash contracts (Corter, 1999).

Hedging instruments are designed to mitigate the risk of an increase or fall in the price of an item being traded. Hedgers use the futures market to minimize the price risk, and not primarily to speculate for profit. Futures markets, their nature and trading strategies, must be properly understood. A hedging program is unique as it depends on the company's internal specific characteristics, its price policy, and motives for hedging (Sampson and Crowson, 2005).

Price Risk Hedging Instruments

Instruments for managing commodity price risks are varied; they include stabilization programs and funds (at the national or company level), marketing strategies involving the timing of sales and purchases, long-term contracts with fixed prices, forward contracts, the use of futures or options to hedge prices through commodity exchanges, over-the-counter (OTC) markets, and the use of swaps (UNCTAD,1998). The choice depends on overall costs and benefits, and expectations of future price movements (Elam, 1988). The hedger uses a futures contract, which exhibits the highest price correlated to the underlying cash market. As a general rule, the choice of futures contracts is the closest delivery month (Spahr and Sawaya, 1981). Futures contracts are widely used for

risk management in numerous industries.

Instruments such as futures and options differ in their characteristics, and the costs and benefits they offer. Since optimal hedge ratios often result in recommendations that use fractions of futures and options contracts, it is important to remember that contracts cannot be partially used. The lack of fractional contracts is especially problematic for relatively smaller importers and processors with limited underlying positions. The details of each instrument are as follows:

Forward Contracts

Forward contracts are agreements to purchase or sell a specified amount of a commodity on a fixed future date at a predetermined price. Physical delivery is expected and actual payment occurs at maturity (the future date specified in the contract). If the actual price at maturity (the spot price) is higher than the price in the forward contract, the buyer makes a profit, and the seller suffers a corresponding loss. If, on the other hand, the spot price is lower, then it is the buyer who loses and the seller who profits. A major advantage of forward contracts is that the establishment of a predetermined price eliminates the risk of price changes for both the buyer and the seller. (UNCTAD, 1998)

Forward contracts are individually tailored arrangements between two parties for the delivery of a particular commodity or financial asset. These are typically used by large operations for their specific risk-management needs. They represent an obligation on both parties, and performance of the contract is mandatory. A forward contract calls for the exchange of a predetermined quantity of the commodity at a given price on a future date. Once the contract has been signed, the parties must offset their positions on the settlement date. The flexibility of negotiating the terms of the contract have to be weighed against the potential negative effects arising from low liquidity (Wagner, 2001). Forward contracts are the most basic of the derivative assets used for hedging. They are between two parties, the buyer (long) and seller (short), that obligate both parties to engage in a transaction to be executed at a future date. The buyer agrees to purchase an asset from the seller at the predetermined future date for a specified price (Hull, 2000).

To take an example, if a trader holds (or purchases in the spot market) a certain commodity, he can insure against adverse price movements by selling the same amount of that commodity in the forward market at the prevailing forward price. In this case, he would be holding a "short position" in the forward market (when a person buys forward or futures contracts, that person is said to have gone "long" or to be holding a "long position"). When the forward contract matures, the trader sells the commodity at the specified price, thereby avoiding the risk of a price decline in the intervening period. This enables him to fix the amount of revenue from the future sale of the commodity at the time that the forward contract is signed, therefore locking in the price, and, of course, his profit margin (UNCTAD, 1998).

There are two important features of the forward contract. First, no cash transfer occurs

when the contract is signed. The seller of the commodity is obliged to deliver the commodity at maturity, but the buyer pays no money upfront (except for transaction fees). Second, since the sole guarantee that a forward contract will be honoured is the reputation of the two parties entering the agreement, there is an inherent credit or default risk: the counterpart of the forward transaction may fail either to deliver the commodity or to pay the agreed price at maturity (UNCTAD, 1998).

A large part of the world's cotton is traded through three- to twelve-month forward contracts. Ghana sells a large part of its cocoa forward. Colombia sells most of its coffee through one-year forward contracts with roasters. Rubber-exporters from Malaysia and Indonesia sell principally through forward contracts (UNCTAD, 1998). (Table 4)

Table 4: Advantages and Disadvantages of Forwards Contract

Advantage	Disadvantage
1. Tailor-made for the needs of the contracting parties 2. Ensures a physical market for the commodities produced (or, for a buyer, delivery of the commodities needed) 3. Can often make production or pre-export finance possible	1. Difficult to reverse the initial decision 2. Major counterparty risk 3. Lost possibility of profiting from favorable spot market developments 4. Pricing is not transparent

Source: Author

Futures Contracts

Futures contracts, like forward contracts, are agreements to purchase or sell a given quantity of a commodity at a predetermined price, with settlement expected at a future date. However, there are some specific characteristics of these contracts. For example, unlike forward contracts, a futures contract does not necessarily imply physical delivery in fulfillment of the agreement. Although the contract can be used to make or to take physical delivery, the usual outcome is the offsetting of the contract on or before maturity by an equivalent reverse transaction. On commodity exchanges, this involves the buying at different times of two identical contracts for the purchase and the sale of the commodity, each cancelling the other. This is possible because all transactions are guaranteed through a central clearing house. Thus, a producer who wishes to hedge has an obligation towards the clearing house, not towards a consumer or speculator (UNCTAD, 1998).

Futures contracts are traded on exchanges and cannot be bought or sold over-the-counter (Hull, 2000). They are highly standardized agreements that specify exact quantity, quality, delivery periods, and delivery location for an asset. The only aspect to be negotiated is the price. This allows for a simple purchase and sale agreement and eliminates much of the expense in negotiating a forward contract.

Example of hedging with futures contracts

Assume a commodity producer knows in January that he will sell 150,000 lbs of Arabica coffee in 6 months' time. The price in January for a September futures contract (a con-

tract that reaches its maturity, that is, stops trading in September) is 86 cts/lb, a price that is sufficiently satisfying to the producer. Thus he can more or less lock in this price by selling four "Coffee C" September futures contracts (of 37,500 lb each) on the New York Coffee, Sugar and Cocoa Exchange. The price for the futures contract is the price for a standard quality, and the producer knows that for his coffee he normally gets this price. Yet, six months later, in July, prices have fallen. The producer sells his coffee on the spot market in New York for 71 cts/lb. The price of the September contract has declined also, to 71 cts/lb. This means that the producer is able to buy four September contracts for 71 cts/lb, and use these to offset the four contracts he had sold, for which he had received 86 cts/lb. He thus makes a profit of 15 cts/lb on the futures market. The effective price he receives for his coffee is therefore 86 cts/lb: with his sale of four futures contracts in January he effectively "fixed" the price of his coffee six months before the physical sale took place. Had the producer been unable to find a client in New York, he could have delivered his coffee to an exchange-approved warehouse in New York, and thus offset his sale of four futures contracts through physical delivery; again, the effective price he would have received for his coffee would have been 86 cts/lb. This is only attractive if the coffee the producer has for sale does not command a premium on the physical market. But even if the producer knows that for his coffee he normally receives a premium in comparison to the standard quality, the commodity exchange can be used to fix his sales price, as long as the price for his coffee on the spot market and that of the futures contract move in tandem. (Table 5)

Table 5: Advantages and Disadvantages of Futures Contracts

Advantage	Disadvantage
1. No need to negotiate contract specifications 2. Minimal counterparty risk 3. Initial position can easily be reversed 4. Delivery is not necessarily implied	1. Working capital is frozen up in margins 2. Lost possibility of profiting from favorable spot market developments 3. Prices of the hedged product and the futures contract may diverge

Source: Author

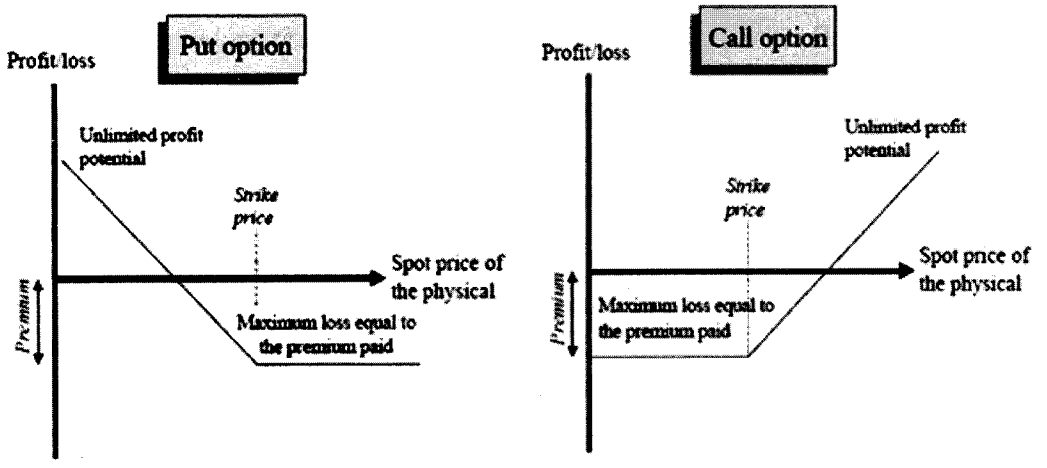
Options

Options are price risk hedging instruments that do not lock in prices, but protect those who buy them against unfavourable price movements while retaining the possibility of profiting from favourable ones. An option contract is the right (but not the obligation) to purchase or sell a certain commodity at a pre-arranged price on or before a specified date. For this contract, the buyer or seller of the option has to pay a premium to his counterpart at the time of contracting; if the option is not used, the premium is the maximum cost involved. If an option gives the right to buy at a pre-set price, it is termed a "call option" (UNCTAD,1998)

This right to buy at a pre-set price is attractive for those who think that the market price will increase: it enables them to buy at the lower price. It gives price protection to consumers and to processors and traders for the cost of the commodities they purchase. If an option gives the right to sell at a pre-set price, it is a "put option". This protects the seller

against a price decline. Options can give the right to buy or sell a certain amount of a physical commodity, or more commonly they give the right to buy or sell a futures contract. This avoids the complicated delivery problems that characterize options on physicals. The date on (or before) which the buyer can chose to buy or sell the commodity or the futures contract is called the "maturity" or "expiration" of the option contract. For exchange-traded options, the date is usually the maturity date of the underlying futures contracts, while on the OTC market, there can be a wide variety of maturities up to five years (UNCTAD,1998). (Figure 2)

Figure 2: Chart of Put option and Call option



Source: UNCTAD, 1998

Risk-management strategies that combine put or call options with a position in the underlying commodity result in payoff functions similar in shape to simple payoffs of option contracts. Buyers and producers with long cash positions can either buy put options, or sell call options, depending on their attitude to risk and expectations of future price movements. Short cash positions can be hedged by buying call options or selling put options (Wagner, 2001). An option is the right, but not the obligation, to buy or sell a particular asset on or before a specific date for a specific price. The two basic types of options are calls and puts. A call option gives the holder the right to buy the particular underlying asset. A put option gives the holder the right to sell the underlying asset (Bittman, 2001). Options exist for many different underlying assets; however, this discussion will focus on options on commodity futures contracts, since these are the main type used by agricultural end-user hedgers (Hawes, 2003). (Table 6)

Table 6: Advantages and Disadvantages of Options Contracts

Advantage	Disadvantages
1. Available in standardized form on exchanges, and tailor-made over-the-counter 2. No "funding risk": the costs of protection are known upfront 3. Possibility of benefiting from favorable price movements	1. Up-front premiums can be expensive, especially in times of volatile prices 2. Selling options can be highly risky 3. Option sellers need to pay margin calls

Source: Author

Swaps

Swaps were developed on the OTC market as a long-term price risk management instrument. With swaps, producers can effectively fix (lock in) the prices they receive over the medium to long term, and consumers can fix the prices they have to pay. No delivery of commodities is involved: the mechanism is purely financial. In a swap agreement covering a specified volume, two prices are involved. One is variable expressed in relation to a published price index. The other is fixed at the time of the swap agreement (UNCTAD, 1998). Commodity risk management instruments with maturities greater than a year are very difficult to acquire. With the increasingly global character of business operations, an increasing need for securing the repayment of loans or the profitability of investments, the deregulation of financial markets and the introduction of new techniques in the financial risk management markets, commodity swaps have been increasing (UNCTAD, 1998)

Swaps are often attractive to lenders or investors, as they provide security for the cash flow of the company to which they are lending money, and thus the ability of the company to repay a loan or to pay a dividend is improved by providing a long-term custom-designed hedge. A commodity swap contract obliges two parties to exchange a floating price for a fixed price (or vice versa) for a given amount of a commodity at specified time intervals. Commodity swaps have been more frequent in the oil industry (Kan and Mahajan, 2006). (Table 7)

Table 7: Advantages and Disadvantages of Swaps

Advantages	Disadvantages
1. Combination of price hedging and securing investments 2. Long-term 3. Tailor-made 4. No or less-strict margin calls 5. Low administrative burden 6. Known counterparty	1. Counterparty risks 2. Positions are difficult to reverse 3. High design/set-up costs 4. Difficult to assess the "fair" price for the deal 5. Possibility of benefiting from favorable price movements may be lost

Source: Author

Theories and Previous Research

Research in Australia, showed that producers can trade futures and options contracts for wheat, feed barley, sorghum and canola to help fix the sale or purchase prices of grain in advance so as to reduce the impact of unfavourable movements in the physical market (Page and Hewitt, 2001).

Sahadevan (2002) studied the contract specifications and mechanics of futures trading and price discovery in commodities exchanges in India, how successful they were in providing price hedging through spot and futures contracts. He found that commodity derivatives play a crucial role in price risk management, especially in an agriculturally dominated economy. The market volume and depth were not significantly influenced by the return or the volatility of futures or spot buying

Manfredo, Richards, and McDermott (2003) examined the influence of risk management

strategies on cooperative financing performance, namely the return on assets of grain merchandising cooperatives of various sizes which used hedging instruments. The conclusion was that the use of options contracts in establishing a floor price for grain prices, and also support for the use of some type of revenue protection through exchange traded price risk management instruments (futures and options), were successful when combined with insurance.

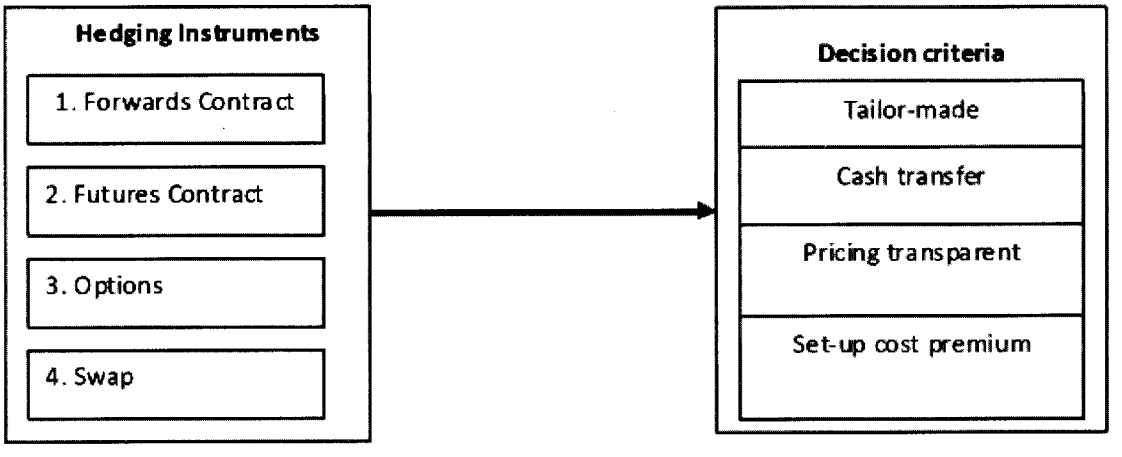
Kissler and Pozzi (2004) described price risk management tools used in hedging strategies by utilizing futures and options contracts to protect cash from adverse price movement in the Milk industry. This enables a dairyman to choose a good fit in using the Futures and Options market as a tool to reduce the risk to their milk income. Findings explain that the use of a put option hedge gives the dairyman more controlled use of the futures and options market.

Bakovic (2007) studied option contracts to see how options normally considered a main tool for speculation, can successfully be used for price risk control. He found that an option contract can provide incentives to economic development, by establishing an appropriate legal framework for futures trading. Options not only provide insurance against price risk that is conditional on an event (receiving the bid, having a successful harvest, making the loan, making the stock offering) but they also avoid any penalty if the event does not occur. Options provide protection against both price and quantity risk and are often a better tool than futures contracts.

RESEARCH METHODOLOGY

Derived from the literature review is a conceptual framework for this present research, crystalising the four hedging instruments and four decision criteria, listed in Table 8 below:

Table 8: The Conceptual Framework for this Research



Source: derived from UNCTAD, 1998.

A Mainly Quantitative Methodology

The methodology is mainly a quantitative questionnaire but completed by the researcher during semi-structured interviews with an owner or manager from each of the 47 sugar mills in Thailand, all involved with pricing and selling, and aware of the financial risk involved. This was possible as the entire target population was only 47, This way, the researcher could gain a deeper understanding of which price risk management instruments are used, and why. The interview questions were both closed (for factual and statistical information) and open-ended (to elicit attitudes, preferences, knowledge, chosen criteria, and risk management).

The focus of the interviews was on the use of four hedging instruments to manage price risk. Four criteria, for why these were used (or not):

Tailor-made; Cash transfer; Pricing transparent; Set-up cost/ premium.

Interviewees were asked to rate each criterion on a 10-level rating scale (adapted from Kittpongse 2004). The researcher classified the answers and chosen ratings in order to reveal the decision-making selection of each hedging instrument and the sugar procurement strategy.

Data Analysis Methods

The data was subjected to descriptive statistics such as mean, median, mode, standard deviation and interquartile range (Q3-Q1). Under each factor there are many answers which will be arranged according to their level of mean values (from high to low), plus the percentage of those mills which use hedging instruments (Kittpongse, 2004). Most calculations were made using Microsoft Excel 2003.

Standard Deviation, STDEV, assumes that its arguments are a sample of the population. The standard deviation is calculated using the "n-1" method. The Interquartile Range represents the central 50% of the data. Data is sorted from lowest to highest, and the data points divided into 4 sets, Q0, Q1, Q2, Q3, Q4. Q0 is the Minimum value, Q1 or Q (0.25) is the first quartile or 25th percentile, Q2 or Q(0.5) is the median value or 50th percentile, Q3 or Q(0.75) is the third quartile or 75th percentile, and Q4 is the Maximum value. The interquartile range is calculated as Q3-Q1 or: = QUARTILE (G: G, 3)-(QUARTILE (G: G, 1)

There are two criteria for data analysis. First is Tendency of Possibility of each issue, which means the highest frequency of views of all respondents. The mode of each criterion is:

0	=	no decision for that criteria
1-2	=	lowest level of decision for that criterion
3-4	=	low level of decision for that criterion
5-6	=	moderate level of decision for that criterion
7-8	=	high level of decision for that criterion
9-10	=	highest level of decision for that criterion

Second is the Interquartile range, which is the level of decision criteria of respondents. From the six levels in the 0-10 scale above, the researcher set the standard of interquartile range for data analysis as follows:

0 - 1.66	=	lowest level of decision criteria
1.67 - 3.33	=	lower level of decision criteria
3.34 - 5.00	=	low of decision criteria
5.01 - 6.67	=	moderate level of decision criteria
6.68 - 8.34	=	high level of decision criteria
8.35 - 10.00	=	highest level of decision criteria

DATA ANALYSIS AND FINDING

Each sugar mill had a roughly 70/30% split between export/domestic destination for its sugar, and each produced raw and refined sugar. Sixteen sugar mills have a production capacity of less than 10,000 tons of sugarcane per day. Twenty two have a production capacity 10,000-20,000 tons, and nine have more than 20,000 tons.

Of all 47 Thai sugar mills, only 14 (30%) used hedging instrument, and 33 (70%) do not. Of the four possible types in this study (Forwards, Futures, Option, Swap) all 14 used the Futures Contract hedging instrument to manage the price risk. These 14 mills do not share the same production capacity, as three have less than 10,000 tons of sugarcane per day, eight have between 10,000 to 20,000 tons, and three have more than 20,000 tons.

The objective of a Futures contract is to secure the highest price under the prevailing circumstances, achieve selling targets, and control the estimated production cost in each year. The 33 sugar mills that do not use hedging instruments choose this negative option due to the greater expense of hedging in the world market, and if they make a wrong decision, that could lead to more loss of profit. They use their experience and monitor the technical and fundamental factors in the world market in order to forecast future sugar prices, and take a risk on that.

From the data collecting, the result of the four decision criteria is as Table 9.

Table 9: Rating of Decision Criteria with Arithmetic Mean and Standard Deviation - for the 14 Sugar Mills using a Future Contract Hedging Instrument

Respondents	Rating of Decision Criteria			
	Tailor Made	Cash Transfer	Price Transparent	Set Up Cost/Premium
No. 8	3	3	1	6
No. 9	3	3	1	6
No. 16	3	3	1	6
No. 19	3	3	1	6
No. 20	3	3	1	6
No. 23	9	6	6	10
No. 25	9	6	6	10
No. 26	3	3	1	6
No. 27	3	3	1	6
No. 35	7	6	6	8
No. 36	7	6	6	8
No. 38	9	6	6	10
No. 39	9	6	6	10
No. 43	9	6	6	10
Arithmetic Mean	**5.71**	**4.50**	**3.50**	**7.71**
Standard Deviation	**2.89**	**1.56**	**2.59**	**1.90**

The arithmetic mean of the Set Up Cost/Premium was the highest at 1.70 with a standard deviation of 1.90, meaning that this was classified as the highest criterion when selecting a hedging instrument. Opinions of all 47 respondents were analysed and the results are shown in Table 10.

Table 10: Descriptive Statistics of Four Decision Criteria for Selecting Each Hedging Instrument

Decision criteria	Mean	Median	Mode	Interquartile Range (Q3-Q1)	Standard Deviation (SD)
Set up cost/premium	7.71	7.00	Moderate (6.00)	High (7.0)	1.90
Tailor made	5.71	5.00	Low (3.00)	Low (5.0)	2.89
Cash transfer	4.50	4.50	Low (3.00)	Low (4.5)	1.56
Price transparent	3.50	3.50	Lowest (1.00)	Low (3.5)	2.59

From the decision criteria, it was found that Set up cost/premium is at a higher level of decision criteria than the other three. The reason for selecting this top criterion is that the initial margin of hedging in the world market is around 20-25% of the amount of sugar. Most sugar mills do not want to pay so much. They used their experience to forecast the world sugar price. Factors which are their main concern are the effect on price by world demand and supply, the stock in the world market, natural disasters affecting competitors (especially Brazil, India, and Australia), changes in Government policy, climate and regulations, availability of new substitutes, activities of speculators, and currency exchange rates.

CONCLUSION AND RECOMMENDATIONS

Much data was discovered from analysis and interpretation of the interviews, and their subjection to quantitative statistical tools, as reported above.

There are six strategies available for commodity procurement: the spot market, speculating on prices, hedging through buying forwards, futures, options, and swaps. It is recommended to commodity procurers that in buying Quota C sugar they should select futures contracts as a strategy to manage price and save money.

Those sugar mills that do not yet use hedging, rely on their knowledge and experience of several factors which affect the world sugar market price. By knowing the cost of sugar production, a sugar mill can determine at what prices it might consider the strategy of using forward pricing for a portion of their crop. Thus, it is imperative that Thai sugar mills know their cost of production when deciding to hedge. Whatever their exposure, there is no way to eliminate their risk but they can certainly manage it. This is important to understand, because commodity price volatility also provides opportunity for gain: a secondary goal is to strike a balance between risk and return. The primary objective of hedging is not to make money, but to minimize risk, and this includes using hedging to minimize losses. This is to practice risk management. If no advanced price mechanism is used there is a high risk of paying a significantly higher price at a later date if sugar has to be bought on the spot market.

There are further opportunities for future research. Price risk management could be studied for other commodities in Thailand such as rice, corn, rubber, tapioca and starch. This could result in optimising the buying strategy.

References

Bakovic T. (2007, *Option Hedging as A Mean of Price Risk Elimination,* Faculty of Economics, University of Zagreb.

Blank, S. C., Carter, C. A., and Schmiesing, B. H. (1991), *Futures and Options Markets – Trading in Commodities and Financials,* Englewood Cliffs, NJ: Prentice Hall

Bittman, James B. (2001), *Trading and Hedging with Agricultural Futures and Options,* New York: McGraw-Hill.

Corter, C.A. (1999), *Commodity futures markets: a survey,* The Australian Journal of Agricultural and Resource Economics, 43:2.

Dennis Kissler & Paul Pozzi (2004), *Milk Hedging Strategies Utilizing Futures & Options,* Chicago Mercantile Exchange.

Elam, E. (1988), *"Estimated Hedging Risk with Cash Settlement Feeder Cattle Futures".* Western Journal of Agricultural Economics 13 (July): 45-52.

Licht (2007) International Sugar and Sweetener Report, F.O. Licht.

Government of India (2012), Risk Management in Agriculture, 2007-2012, Delhi, Gov-

ernment of India.
Hawes, C. R. (2003), *Value at Risk: Agricultural Processor Procurement and Hedging Strategies,* Agribusiness and Applied Economics, Fargo, North Dakota
Hull, J.C. (2000), *Options Futures, and Other Derivatives,* Upper Saddle River, NJ: Prentice Hall.
Holt, M. T., and McKenzie, A. M. (1998), *"Market Efficiency in Agricultural Markets".* AAEA Annual Meeting, Salt Lake City, UT.
Jones K. (2003), *"An Evaluation of Food and Commodity Procurement Strategies: Insights from Case Studies",* Michigan State University.
Kan M. G.,. Mahajan N. (2006), *An introduction to market-based instruments for agricultural price risk management,* Food and Agriculture Organization, United Nations Rome.
Kittipongse, Sumipan (2004), *Major Factors Affecting the Implementation of The 1984 Thai Sugar Policy,* National Institute of Development Administration.
Larson, D.F., Panos V., Yabuki N. (1998), *Commodity Risk Management and Development,* The World Bank Development Research Group Rural Development.
Manfredo M., Richards T., and McDermott S. (2003), *Risk Management Techniques for Agricultural Cooperatives: An Empirical Evaluation,* NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, St. Louis, Missouri, April 21-22.
Office of the Cane and Sugar Board (2008), A Study of Sugarcane Price Determination by Regions. Journal of Sugar Industry. 2007-2008.
Office of Agricultural Economics (2007), Raw Sugar; Monthly Export Quantity and Amount, Bangkok.
Page, S. and A. Hewitt (2001), *World commodity prices: still a problem for developing countries,* Overseas Development Institute.
Rolfo, J (1980). *"Optimal Hedging Under Price and Quantity Uncertainty: The Case of a Cocoa Producer".* The Journal of Political Economy 88 (Feb): 100-116.
Sampson, R., Crowson, P. (2005), Managing metals price risk with the London Metal Exchange, LME, London.
Sahadevan K.G., (2002), *Derivatives and Price Risk Management: A Study of Agricultural Commodity Futures in India,* Indian Institute of Management Lucknow, May.
Spahr, R. W., and Sawaya, W. J. (1981), *"A Pre-Hedging Strategy for the Feedlot Operation".* Western Journal of Agricultural Economics 6 (July): 31-41.
UNCTAD (1998), *A survey of commodity risk management instruments,* Report by United Nations Conference on Trade & Development secretariat.
Wagner R. (2001), *Risk Management Strategies for Grain Traders and Processors,* North Dakota State University of Agriculture and Applied Science.
www.futuresource.quote.com
www.oae.go.th www.ocsb.go.th