Price Risk Management Strategies in Commodity Markets

Nontasak Janchum[1], Sangrawee Witoonpan[2], Chalita Cheewaviriyanon[3]

Abstract

Commodity prices have been unusually volatile in recent years, and such volatility widely impacts the majority of stakeholders in commodity supply chains. A salient example of this is natural rubber, the main economic crop for the south of Thailand, whose price movement is considered to be the main issue in the industry. Based on a literature review, we concluded that commodity Price Risk Management (PRM) is dominated by developed countries where markets have well-developed infrastructures. However, providing effective solutions for agricultural commodity markets in less-developed countries is still challenging. This paper seeks to explore PRM strategies based upon a review of the literature related to price risk and its management strategies in developing countries commodity markets. Following this literature review, five main PRM strategies were adopted in commodity markets, namely stocking, price hedging, pricing in advance, negotiation, and portfolio management. Both the advantages and disadvantages of these particular PRM strategies will be discussed in this paper. For example, the price hedging strategy has an advantage in avoiding

[1] Lecturer in faculty of Management Science Suratthani Rajabhat University.
E-mail: nontasak.jan@gmail.com

[2] Lecturer in faculty of Management Science Suratthani Rajabhat University.
E-mail: sangrawee.w@gmail.com

[3] Lecturer in faculty of Education, Suratthani Rajabhat University.
E-mail: chalita.chee@gmail.com

negative impacts from price movements, but requires effective PRM tools to manage price risk. The findings of this study have a number of practical implications. Certain commodity market stakeholders, such as farmers, professional traders and policymakers, could gain greater understanding utilizing the range of PRM strategies discussed in this paper, and may be able to apply them to their specific contexts.

Keywords: Risk, Uncertainty, Commodity Price, Risk Management Strategy

Corresponding Author: Nontasak Janchum
E-mail: nontasak.jan@gmail.com

กลยุทธ์การบริหารความเสี่ยงทางด้านราคาในตลาดสินค้าโภคภัณฑ์

นนทศักดิ์ จันทร์ชุม[1], แสงรวี วิฑูรย์พันธุ์[2], ชลิตา ชีววิริยะนนท์[3]

บทคัดย่อ

ในช่วงหลายปีที่ผ่านมาราคาสินค้าโภคภัณฑ์มีความผันผวนอย่างมาก ความผันผวนที่เกิดนั้นได้ส่งผลกระทบต่อผู้ที่เกี่ยวข้องกับโซ่อุปทานสินค้าโภคภัณฑ์ ยางพาราจัดเป็นสินค้าโภคภัณฑ์ชนิดหนึ่งที่จัดเป็นพืชเศรษฐกิจหลักในภาคใต้ของประเทศไทยและการเปลี่ยนแปลงของราคาเป็นปัญหาที่สำคัญของอุตสาหกรรมยางพารา วรรณกรรมเกี่ยวกับการจัดการความเสี่ยง (PRM) ส่วนมากมีการศึกษาในบริบทของประเทศที่พัฒนาแล้วซึ่งโครงสร้างพื้นฐานทางด้านการจัดการความเสี่ยงทางด้านราคามีความทันสมัย แต่ทว่าการบริหารจัดการสินค้าโภคภัณฑ์ทางการเกษตรอย่างไรให้มีประสิทธิผลในประเทศที่กำลังพัฒนายังคงเป็นเรื่องที่ท้าทาย บทความนี้ได้รวบรวมกลยุทธ์ทางด้านการจัดการความเสี่ยงทางด้านราคา (PRM Strategies) โดยวิธีการทบทวนวรรณกรรมที่เกี่ยวข้อง เรื่องความเสี่ยงทางด้านราคาและกลยุทธ์ทางด้านการจัดการความเสี่ยงทางด้านราคามุ่งเน้นตลาดสินค้าโภคภัณฑ์ในประเทศกำลังพัฒนา ผลของการทบทวนวรรณกรรม พบว่า ตลาดสินค้าโภคภัณฑ์ใช้ 5 กลยุทธ์ที่สำคัญในการจัดการความเสี่ยงทางด้านราคา คือ การสต็อกสินค้าเพื่อเก็งกำไร (Stocking) การถ่ายโอนความเสี่ยง (Price Hedging) การเจรจาตกลงราคาซื้อขายล่วงหน้า (Pricing in Advance) การเจรจาต่อรอง (Negotiation) และการจัดการพอร์ตโฟลิโอ (Portfolio Management) ข้อดีและข้อเสียของกลยุทธ์ต่างๆ มีการวิจารณ์เพื่อเป็นประโยชน์

[1] อาจารย์ประจำ คณะวิทยาการจัดการ มหาวิทยาลัยราชภัฏสุราษฎร์ธานี
E-mail: nontasak.jan@gmail.com
[2] อาจารย์ประจำ คณะวิทยาการจัดการ มหาวิทยาลัยราชภัฏสุราษฎร์ธานี
E-mail: sangrawee.w@gmail.com
[3] อาจารย์ประจำคณะครุศาสตร์ มหาวิทยาลัยราชภัฏสุราษฎร์ธานี
E-mail: chalita.chee@gmail.com

ต่อผู้อ่าน โดยเฉพาะผู้ที่เกี่ยวข้องกับโซ่อุปทานสินค้าโภคภัณฑ์ ได้แก่ เกษตรกร พ่อค้า และผู้กำหนดนโยบาย บุคคลกลุ่มดังกล่าวจะเกิดความเข้าใจในการบริหารจัดการความเสี่ยงทางด้านราคาในตลาดสินค้าโภคภัณฑ์มากขึ้นและสามารถนำกลยุทธ์เหล่านี้ไปประยุกต์ใช้กับบริบทของตนเองได้

คำสำคัญ: ความเสี่ยง ความไม่แน่นอน ราคาสินค้าโภคภัณฑ์ กลยุทธ์การบริหารความเสี่ยง

ชื่อผู้ติดต่อบทความ: นนทศักดิ์ จันทร์ชุม
E-mail: nontasak.jan@gmail.com

Introduction

Highly volatile commodity prices have been an important phenomenon in recent years, and as a consequence there has been increasing interest in PRM because of such volatility. Therefore, price risk has become one of the main issues, if not the most important issue, in agricultural commodity markets, ranging from producers (Sherafatmand, Yazdani, & Moghaddasi, 2014), to commercial traders (Berling & Rosling, 2005), to users (Tang, 2015), to consumers (James, 2007), and to financial investors (Deng, Zhang, & Zhao, 2009). An important issue is how stakeholders who are exposed to risk are able to manage it (Morgan, Cotter, & Dowd, 2012). It is obvious that this situation has attracted the attention of many stakeholders in commodity communities, such as practitioners, researchers and policymakers. Several crucial examples are related to this phenomenon, ranging from adding the excessive volatility of commodity price issues to a series of the G20 meeting agendas in 2009, 2010 and 2011 (Devlin, Woods, & Coates, 2011), investigating the potential causes of the phenomenon from the supply and demand perspective (Roache, 2012) and the perspective of speculative behavior (Korniotis, 2009), to providing some feasible solutions for commodity consumers.

To illustrate the level of commodity price volatility, historical prices of natural rubber have been selected, as it is considered one of the major economic crops of Thailand. Its export value is the highest amongst agricultural products. More than six million Thais participate in NR industries (Nobnorb & Fongsuwan, 2015); this is just under ten per cent of the Thai population (Delarue & Chambon, 2012). Figure 1 shows the volatility of monthly prices in the natural rubber industry in the past 20 years, from August 1997 - June 2017.

It is clearly seen that the price has significantly fluctuated several times in this period. It starts from the period of stable prices from 1997 to 2001. Then,

prices constantly increase to almost treble of that of 2001, in 2006. After that, the prices drop dramatically to around half of their peak in 2006, before spending the next two years recovering to the level of 2006 by the middle of 2008. Unsurprisingly, prices plummet to just less than half of their highest value in 2008, due to the world financial crisis. However, surprisingly, they rocketed for the next three years to reach a level of almost quadruple their lowest point during the crisis, or almost double that of the old peak. Then, prices significantly decrease to about a half in 2012 from their peak of 2011, before dropping again, but less dramatically, to around one fifth of 2011's highest price in 2015. After that, the prices start fluctuating at low levels between 2015 and the present, 2017. All in all, this is evident that natural rubber is one commodity where prices have been volatile in recent years. However, this paper does not only focus PRM in natural rubber, but it does also include that of other commodities, such as coffee, soybean, cocoa, sugar, corn and wheat.

Figure 1: Natural Rubber Price Movements

Source: Indexmundi (2017)

Almost all stakeholders in commodity supply chains are exposed to similar levels of price risks regardless of levels of economic development, if price transmissions along the chains are significant. For example, according to Newman (2008) (in her research on coffee prices transmission from the Chicago Board of Trade (CBOT) into two low-income countries', namely Tanzanian and Ugandan, coffee chains), it is suggested that prices in the future exchange market (CBOT) play a crucial role as a benchmark price in the whole coffee chains. In addition, this paper found that there are asymmetric implications from the price transmission on different stakeholders in the chain. Stakeholders in the up streams are more likely to have negative impacts from price declines than positive ones from rises. In other words, the price in local markets changes quicker when the price in the future exchange market falls than when it upsurges. As a consequence, local traders will get worse prices if they lack appropriate risk management tools when the coffee price plummets.

Therefore, the phenomenon of commodity price volatility in recent years is considered vital, while its implications on various stakeholders in supply chains are significant. As a result, this paper seeks to gather together some important PRM strategies, then discusses their pros and cons, so that commodity supply chain stakeholders can gain a better, more comprehensive understanding of PRM.

The next section introduces some relevant concepts of risk and PRM.

Price Risk Management

Prior to discussing PRM strategies, it is important here to clarify exactly what is meant byrisk and PRM. This sectionis divided into three subsections. Firstly, the differences between risk and uncertainty are clarified. Secondly, the definitions of risk management and its process are introduced. Finally, risk

management practice is explained in terms of attitude and perception in decision makers, comparing this to the model of expected utility in economics.

Risk and Uncertainty

One of the ways to distinguish risk and uncertainty is to consider probability. Risk is different from uncertainty by its ability to be quantified in terms of objective probability. Variables of risk can be identified in the form of *objective probabilities,* whilst those relating to uncertainty are unknown (Knight, 1964). Instead of being considered in an objective way, uncertainty can be defined as *a subjective probability* form. However, both risk and uncertainty result in managerial situations becoming more complex and unclear.

Whereas rational decisions need a certain environment to form the problem into solvable mathematical formulae, risk and uncertainty drive it away. In the nature of unclear situations, the particular values of related variables are uneasy to determine. As a consequence, the managerial situation is, often, not pictured clearly. Therefore, it is challenging to provide a solution to the problem.

Risk attitudeis one of the important factors to describe the differences in the ways that people make decisions in relation to risk and uncertainty (Blais & Weber, 2006). It is a factor internal to the decision maker that can explain to what extent one prefers to take a risk. There are three types of personal risk attitudes - *risk aversion, risk taking and risk neutrality.*

In contrast, *"Risk perception refers to people's subjective impression of riskiness" (Weber, 2009, p. 1009).* Unlikerisk *attitude,* which is considered to be a trait of an individual, *risk perception* is an individual's interpretation of the level of risk from external environments. The perception is another vital factor that can be used to explain why individuals make different decisions under the same circumstances (Pennings & Garcia, 2004). This factor also drives changes in risk

preferences and clarifies why investors who have the same *risk perception* tend to select the same risky choices (Weber & Milliman, 1997).

Risk Management

A growing amount of literature relating to risk management has been published in recent years. However, there are several different definitions of *risk management* in keeping with different research fields. One definition relating to the process of decision making notes that:

> *"Risk management is a discipline that ensures efficient and effective utilization of project resources, which supports decision-making based on information, and which aims to reduce uncertainties and their negative effects to a more manageable level." (Demir & Bostanci, 2010, p. 1587)*

One of the comprehensive definitions in supply chain management, the risk management process is defined as:

> *"An inter-organisational collaborative endeavour utilising quantitative and qualitative risk management methodologies to identify, evaluate, mitigate and monitor unexpected macro and micro level events or conditions, which might adversely impact any part of a supply chain" (Ho, Zheng, Yildiz, & Talluri, 2015, p. 6).*

Moreover, according to Ho et al. (2015), supply chain risk can be classified into five types of risks: macro, demand, supply, manufacturing, and infrastructural. *Price risk*, which is the main focus of this paper, is classified as financial risk in the infrastructural category. Consequently, the process of PRM in this paper refers to supply chain risk management and can be divided into four stages: *identification, assessment, mitigation, and monitoring,* as shown in Figure 2. The process of supply chain risk management is used as a conceptual framework to review the relevant literature and to identify the focus of this paper.

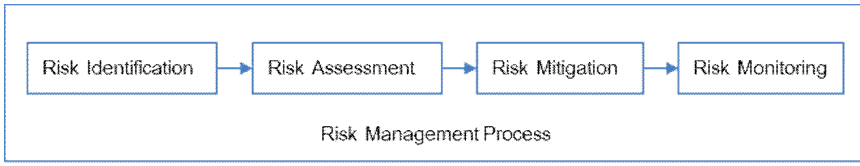


Figure 2: Risk Management Process

Source: Ho et al. (2015)

Regarding *risk identification,* a considerable amount of literature has highlighted the importance of price risk in commodity supply chains. Banterle and Vandone (2013) noted that the prices of agricultural commodities have become volatile in recent years, which in turn leads to market participants experiencing difficulties in their trading activities. Berling and Rosling (2005) pointed out that in inventory management, even though the level of impact on a particular product is still unclear, price risk is considered to be the main risk amongst all risks to which they are exposed. Deng et al. (2009) added that price risk is not only considered as the major risk for investors, it is the main focus of global investment regulators as well. Tang (2015) indicated that price risk has now become one of the major recognised risks in the restaurant industry. All in all, price risk has become the main focus of a range of stakeholders in many industries.

In terms of *risk assessment* (the second stage of the risk management process), the amount of literature focusing on commodity prices has also increased significantly in recent years. Perhaps this is the consequence of the uncertain business climate following the financial crisis in 2008. For example, Sainidis, Robson, and Heron (2013) noted that manufacturers located in the UK and classified as SMEs are the most negatively impacted by the increasing cost of production compared to the flexibility of production, performance of product delivery and quality of products. These negative impacts originate partly from the

input costs of raw materials that have risen since 2008. A considerable amount of literature has been published on price risk modelling based on quantitative methods (Ni, Chu, Wu, Sculli, & Shi, 2012). Furthermore, there is no consensus on the quantitative-based measurement of price risk, for instance, the method that focuses on both negative and positive aspects (Capitani & Mattos, 2012).

With regard to the third stage of the risk management process: *risk mitigation,* this can be divided into four main risk mitigation *measures: risk avoidance, risk reduction, risk transfer, andrisk retention* (Aven & Kristensen, 2005; Hlaing, Singh, Tiong & Ehrlich, 2008; Matulevicius, Mayer & Heymans, 2008). In commodity markets, much of the current literature on price risk mitigation pays particular attention to risk transfer using market-based tools, e.g. Tomek and Peterson (2001) and Revoredo-Giha and Zuppiroli (2013). Although there have been questions about the performance of some tools (such as the use of futures and options contracts) in terms of profitability, Gemech, Mohan, Reeves, and Struthers (2011) argued that using these tools results in other non-financial benefits, such as enhanced capabilities available in resource allocation. Furthermore, there is an issue concerning the futures market's efficiency regarding the hedging purpose. In her study, Newman (2009) finds that a variety of strategies of PRM, such as forward contracting and price hedging, have been adopted by stakeholders in coffee supply chains in Uganda and Tanzania, and she raised the issue of inequality of access to PRM tools between players in the supply chains.

As pointed out above, *risk monitoring* is the final stage of the risk management process. It is mainly used to monitor whether risk management implementation is consistent with the risk management plan (Al-Tamimi & Al-Mazrooei, 2007). A good example of the common use of risk monitoring can be found in banking. Rosman (2009) noted that risk monitoring is a vital process

that helps banks guarantee that effective risk management is implemented. Butt, Nazir, and Daniel (2012) also found that risk monitoring is considered a crucial instrument of practical use in Pakistan's banking sector.

This paper places emphasis on the stage of price risk mitigation in terms of important PRM strategies, and will be discussed in Section 3.

Price Risk Management Theory and Practices

Expected utility theory explains how individuals can manage price risks in a rational way. Nonetheless, it is now well established from a variety of studies that the practice does not always follow the theory. According to (Weber, 2006), this is because individuals have psychological reasons that lead to decision making based on an individual's experiences received from occurring events rather than from statistical descriptive models. The models include both occurring and non-occurring events, especially those considered rare *orone-offs*. Additionally, individuals who make decisions based on their experiences are likely to underestimate rare events, while others who make decisions based on descriptive models are likely to overestimate them (Hertwig, Barron, Weber, & Erev, 2004). Another alternative reason explaining why people behave differently from the expected utility theory in terms of PRM, are the limitations of decision makers' knowledge or resources in PRM.

The next section of this paper reviews the literature on PRM, both from theoretical and practical perspectives.

Price Risk Management in Theory

The expected utility theory is a decision tool for choosing amongst available choices under risk based on the utility and probability of individual choice. This decision tool is commonly used in several ways in different disciplines, for example, as a descriptive model in psychology(de Castro,

Teodoro, de Castro & Parsons, 2016), and as a prescriptive model in management science(Bleichrodt, Pinto, & Wakker, 2001)and a normative model in economics and finance(Schilirò, 2017).

In portfolio theory, risk-taking behaviours are examined in a rational way. The risk behaviour of an individual is determined by expected returns calculated from the log function of returns, expected risks derived from the variance of past time series relating to price, and risk attitude defined as a convex function of risk takers and a concave function of risk-averse investors (Ayub, Shah, & Abbas, 2015). This theory is able to explain that investors' decisions to invest in a security are based on the objectives of maximising profit or minimising risk. This theory is commonly used within investment communities and by economists.

Nevertheless, there are some limitations in explaining real behaviour when people make their decisions in practice. Risk behaviour at the individual level is sometimes inconsistent with the expected utility for various reasons. For instance, an individual does not completely understand a problem when confronted with it, as in the expected utility theory. Moreover, the way an individual interprets probability information in practice is different from how they do it in theory (Karni, 2014).

Price Risk Management in Practice

In reality, individuals are likely to rely only on rationality when making their decisions. Based on Prospect Theory, people tend to feel more losses than gains for the same magnitude of results. They use the expected point, rather than a neutral point in the expected utility theory, as a reference point to separate the respective domains of losses and gains. Furthermore, people are likely to be loss aversion; they refute the state of loss and taking risks, i.e. they are risk-seeking when they feel losses, and risk-aversive when they feel gains (Walasek & Stewart, 2015).

From a psychological point of view, risk decision behaviours are determined by an individual's risk feelings. This can explain why different people may have different risk-taking behaviours in the face of the same situation. Individual risk attitudes, risk perceptions and value expectations are factors that determine a person's risk preference behaviours. Moreover, changes in risk-taking behaviours are relevant to changes in risk perception, but not to changes in risk attitude (Weber & Milliman, 1997).

The next section introduces PRM strategies and discusses their pros and cons.

Price Risk Management Strategies

PRM strategies play an important role in trading within commodity supply chains as they are the key determinants of business performance (Newman, 2009; Ni et al., 2012). There is a range of PRM strategies that supply chain players may select from, for example, stocking, price hedging, price forwarding, or a mix of these to create a managed portfolio. Nonetheless, the formation of management strategies in small businesses tends not to be explicit (d'Amboise & Muldowney, 1988). Therefore, bringing them together and discussing their pros and cons is considered a necessary task.

Different PRM strategies may have different advantages and disadvantages. Consequently, adopting a particular strategy may lead to different results for business performance. In other words, selecting appropriate management strategies from the trade-off of costs and benefits of possible alternatives is a challenging task (Tomek & Peterson, 2001). Neyhard, Tauer, Gloy, Marchant, and Bosch (2013) pointed out that commodity traders need to gain insight into different PRM strategies, especially their costs. Tang (2015) adds that a particular strategy's performance is likely to fluctuate depending on

certain business circumstances. Therefore, this section discusses both the advantages and limitations of given PRM strategies, so that an in-depth understanding of particular PRM strategies can be achieved.

Types of Price Risk Management Strategy

This section reviews the five selected PRM strategies: namely stocking, price hedging, price forwarding, negotiation and portfolio management, (as illustrated in Table 1). The advantages and disadvantages of each individual strategy will be clarified as follows.

Table 1: PRM Strategies

	PRM strategies	**Sources**
1)	Stocking	Joseph, Irwin & Garcia (2015)
2)	Price Hedging	Taušer & Cajka (2014)
3)	Price Forwarding	Henderson, Hobson & Kentwell (2002)
4)	Negotiation	Moon, Yao & Park (2011)
5)	Portfolio Management	Hammoudeh, Malik & McAleer (2011)

Stocking

Stocking is one of the basic trading methods used in commodity markets, by holding the stocks for reselling later (Joseph, Irwin, & Garcia, 2015). Stocking is the obvious strategy chosen by physical commodity traders because their main business activity is buying, then, reselling commodity products. When they buy commodity products from their suppliers without hedging (transferring) the price risk, they are considered to be stock holders. As a result, the stocking strategy is one of the main commodity trading strategies that physical commodity

traders adopt, particularly in markets that lack effective PRM tools. Moreover, this strategy is a risk-taking strategy as adopters are exposed to the risk of price declines.

Advantages

The obvious benefit of stocking commodity products is that there is no need for additional PRM tools in its implementation. Traders have the ability to balance supply when there is plenty, such as at peak production times or harvest seasons, then resell holding stock during times of less supply. With this strategy, stock holders may gain the benefit of better prices. Therefore, they may enhance profits from price differences subtracted from the costs of stocking (Joseph et al., 2015).

Disadvantages

Apart from the storage costs of the stock-holding strategy (Rampini, Sufi, & Viswanathan, 2014), there are also other issues that need to be considered. The first issue is the requirement for warehouse capacity to maintain the quality of products in the physical holding (Anastassiadis, Feil, Musshoff, & Schilling, 2013). Furthermore, this may include warehouse insurance for safety reasons. Finally, one of the most important issues in commodity trading is merely the volatility of prices. There is no guarantee of an increased price after the period of buying and storing commodities (Ramanujam & Vines, 1990).

Price Hedging

Price hedging or full hedging is the ideal PRM strategy for a risk-averse trader. This is because an individual can focus on his/her core business in physical trading, without the concern of price risk. In order to prevent future price changes, commodity market participants can use a natural hedge (sell their stock holding) or PRM tools to fix targeted prices. As a result, using PRM tools in

hedging is considered a provisional trading mechanism for a physical market (Tauser & Cajka, 2014).

Advantages

An advantage of managing price risk by price hedging is to freeze in a profit of trading. This is practical when the price is higher than what is expected, relative to the known producing costs (Kim, Brorsen, & Anderson, 2010). As a result, the business is able to capture the selling opportunity if the trading is profitable.

Another advantage of this strategy is to make the cash flow of the business stable for future management (Dinica & Armeanu, 2013). Although some commodity products cannot be resold immediately, hedging the price risk via PRM tools in futures exchange markets is one potential way to transfer the risk to other parties. This is because the price of derivative contracts, such as futures or options contracts, are mostly related to those in cash markets (Chung-Chu, Yi-Hsien, Tsai-Jung, & Shuo-Li, 2012).

Disadvantages

The hedging performance of PRM tools, such as futures contracts, is one of the most significant current discussions in PRM. In cases when commodity products are unable to be sold immediately, they need proper price risk hedging tools such as forward or futures contracts. Although movements of prices between cash and derivative markets are expected to be consistent (Chung-Chu et al., 2012), in the real world of trading, price movements between the two markets may be varied (Dinica & Armeanu, 2014). As a consequence, price hedging may not be perfectly implemented in this case. Additionally, using PRM tools means incurring transaction costs. Therefore, the trade-off between advantages and incurred costs needs to be considered in detail, particularly when profit margins are small.

Price Forwarding

Similar to the stoking strategy, price forwarding is another risk-taking strategy, but rather than focusing on the buying side, it concentrates on the selling side. It trades transactions that occur when market participants sell commodity products in advance before they produce or buy them, or when PRM tools are used to hedge price risk in quantities that are greater than that of their holding. Futures, options and forward contracts are common PRM tools used to employ the price forwarding strategy. Therefore, price forwarding adopters need to be able to use some types of PRM tools.

Advantages

The clear benefit of forward selling is to use it during periods of decreased prices. Selling commodity products in advance of such periods gives the opportunity to sell at greater prices (Henderson, Hobson, & Kentwell, 2002), and buy them later at lower prices to gain extra profits for traders in addition to usual profit margins. Moreover, traders may gain indirect benefits in business competition by buying at above-market prices that their competitors may not be able to compete with.

Moreover, price forwarding by physical traders may affect price movements in their favour. According to Chen, Feng, Peng, and Ye (2014), previous trading may impact on the subsequent price of a particular asset. Therefore, price forwarding might result in a drop in prices in futures markets if business partners hedge derived price risk from forward contracts, by selling in these futures exchange markets.

Disadvantages

On the other hand, forward selling without holding physical stocks may expose traders to the risk of incurring losses from increased prices. In addition, forward contract arrangements usually come with costs, as their business

partners may transfer the price risk to other parties with other financial tools, such as forward, futures or options contracts. Such tools may incur transactional costs alongside occasional maintenance costs that are often, in turn, passed to forward contractors. Moreover, in developing markets, PRM tools tend to be under-developed.

Negotiation

Another common method to set a trading price in a supply chain is *negotiation* (Moon, Yao, & Park, 2011). Instead of relying on PRM tools available in the markets, this strategy depends on their business counterparts to manage price risk. The trading price is set by the negotiation process between a seller and buyers in a process of bilateral negotiation. Negotiation is a PRM strategy employing market power in supply chains or relationships with business partners to gain a competitive advantage in terms of price. Furthermore, market information also plays an important part in negotiation (Wilcox & Abbott, 2006).

Advantages

In an emerging market where formal PRM tools are scarce or even non-existent (Capitani & Mattos, 2015), the informal trading or hedging mechanism plays a vital role in PRM. To access these tools, negotiating ability is a key success factor. As a consequence, negotiations both in gaining effective PRM tools or in better trading prices, represent certain ways of gaining a competitive advantage in trading in such a market. As a result, those who have market power tend to gain a competitive advantage in such a market.

Disadvantages

One of the downsides of implementing a negotiation strategy is the ability to gain bargaining power. It is the key factor of a negotiating strategy and, in commodity trading, trading volume tends to relate to such market power. As a

result, small or start-up businesses are less likely to be able to adopt this strategy. Therefore, only large traders who have bargaining power can adopt the strategy. In addition, traders require good negotiating skills and comprehensive market information to gain a better position in negotiation (Blount, Thomas-Hunt, & Neale, 1996).

Portfolio Management

In order to adapt to particular market circumstances, a portfolio management strategy takes a market position based particular market circumstances. Instead of using market power or relationships, commodity traders may adopt a portfolio management strategy to manage price risk. This strategy utilises market-based PRM tools to gain a competitive advantage in the market. However, the strategy requires competency in understanding market prices as it seeks to optimise profit or minimise price risk from market movements. Moreover, it needs a range of PRM tools and proper warehouses to utilise this strategy.

Advantages

Instead of relying on one strategy in operating a business, this strategy utilises several strategies depending on particular market circumstances to gain a competitive advantage. Therefore, utilising several strategies, i.e. a portfolio of activities, gives benefits in several aspects. Maximising profits from a variety of price movements is ideal for portfolio management (for instance, stocking when prices are rising, and price forwarding when prices are falling). However, it is difficult to implement in practice as price movements are difficult to forecast.

For many years, the finance industry has paid much attention to seeking the most profitable techniques. For instance, Hammoudeh, Malik, and McAleer (2011) indicate that traders can be guided by VaR (it is one of the techniques

used to measure price risk) in order to assess the most appropriate PRM strategy for a particular business situation.

Disadvantages

One of the main limitations in adopting portfolio management in practice is the lack of PRM tools to facilitate trading, particularly in agricultural commodity markets. It also requires individual tools to work efficiently. This seems to be an important issue during periods of price volatility where price co-integration between spot markets and futures exchange markets seems to be broken up (Taylor, Tonsor, & Dhuyvetter, 2013), or forward contract default might have taken place in physical commodity trading (Jones, Raper, Whipple, Mollenkopf, & Peterson, 2007).

Conclusion

This paper highlights the importance of price risk that stakeholders in supply chains can be exposed to in commodity markets. The paper first introduced the relevant concepts of risk and PRM. This work contributes to existing knowledge in PRM by highlighting selected PRM strategiesfound in a range of literature that are considered to be significant to physical commodity trading, particularly in developing countries. After bringing these together, the PRM strategies were discussed in terms of both their pros and cons. This is considered a second contribution to the existing knowledge of PRM by facilitating a greater, in-depth understanding of individual PRM strategy. Based on the discussion, it was shown that more effective PRM strategies tend to require more advanced PRM tools. For example, portfolio management strategy needs a proper warehouse or sales involving consignment contracts, forward contracts or futures contracts. As a consequence, this paper contributes to the existing knowledge of PRM by providing a greater understanding of the PRM strategies.

Apart from its contribution to the academic literature, the paper can make a contribution to the work of professional traders such as commodity merchants and processors, as well as to other commodity market stakeholders such as farmers and policymakers. Regarding future work, further studies need to be carried out in order to assess the performance of the particular PRM strategies proposed in this paper in conjunction with real commodity prices in specific industries.

References

Al-Tamimi, H. A., & Al-Mazrooei, F. M. (2007). Banks' risk management: a comparison study of UAE national and foreign banks. **The Journal of Risk Finance, 8**(4), 394-409.

Anastassiadis, F., Feil, J.-H., Musshoff, O., & Schilling, P. (2013). **Analysing Farmers' Use of Price Hedging Instruments: An Experimental Approach.**

Aven, T., & Kristensen, V. (2005). Perspectives on risk: review and discussion of the basis for establishing a unified and holistic approach. **Reliability Engineering & System Safety, 90**(1), 1-14.

Ayub, U., Shah, S. Z. A., & Abbas, Q. (2015). Robust analysis for downside risk in portfolio management for a volatile stock market. **Economic Modelling**, **44**, 86-96.

Banterle, A., & Vandone, D. (2013). **Price volatility and risk management: The case of rice.** Paper presented at the Proceedings in Food System Dynamics.

Berling, P., & Rosling, K. (2005). The effects of financial risks on inventory policy. **Management Science**, **51**(12), 1804-1815.

Blais, A.-R., & Weber, E. U. (2006). A domain-specific risk-taking (DOSPERT) scale for adult populations. **Judgment and Decision Making**, **1**(1), 33-47.

Bleichrodt, H., Pinto, J. L., & Wakker, P. P. (2001). Making descriptive use of prospect theory to improve the prescriptive use of expected utility. **Management Science**, **47**(11), 1498-1514.

Blount, S., Thomas-Hunt, M. C., & Neale, M. A. (1996). The price is right—or is it? A reference point model of two-party price negotiations. **Organizational Behavior and Human Decision Processes, 68**(1), 1-12.

Butt, H. A., Nazir, M. S., & Daniel, A. (2012). Are foreign banks more vigilant than domestic banks regarding risk management? **American Journal of Scientific Research (83)**, 109-117.

Capitani, D., & Mattos, F. (2012). **Risk measurement in commodities markets: How much price risk do agricultural producers really face?** Paper presented at the The 2012 Annual Meeting, Seattle, Washington.

Capitani, D., & Mattos, F. (2015). **Feasibility of new agricultural futures contract: a study in the Brazilian rice market.** Paper presented at the The 2015 Agricultural & Applied Economics Association's and Western Agricultural Economics Association Annual Meeting,, San Francisco, California.

Chen, J., Feng, L., Peng, J., & Ye, Y. (2014). Analytical results and efficient algorithm for optimal portfolio deleveraging with market impact. **Operations Research, 62**(1), 195-206.

Chung-Chu, C., Yi-Hsien, W., Tsai-Jung, Y., & Shuo-Li, C. (2012). Asymmetric dynamic hedging effectiveness: Evidence from Taiwan Stock Index Futures. **African Journal of Business Management, 6**(34), 9671-9680.

d'Amboise, G., & Muldowney, M. (1988). Management theory for small business: Attempts and requirements. **Academy of Management Review, 13**(2), 226-240.

de Castro, P. A. L., Teodoro, A. R. B., de Castro, L. I., & Parsons, S. (2016). Expected utility or prospect theory: Which better fits agent-based modeling of markets? **Journal of Computational Science**, **17**, 97-102.

Delarue, J., & Chambon, B. (2012). La Thaïlande: premier exportateur de caoutchouc naturel grâce à ses agriculteurs familiaux. **Économie rurale**, **330**(4), 191-213.

Demir, H., & Bostanci, B. (2010). Decision-support analysis for risk management. **African Journal of Business Management**, **4**(8), 1586-1604.

Deng, X., Zhang, Y., & Zhao, P. (2009). Portfolio optimization based on spectral risk measures. **International Journal of Mathematical Analysis, 34**(3), 1657-1888.

Devlin, W., Woods, S., & Coates, B. (2011). **Commodity price volatility.** Australian National Treasury.

Dinica, M.-C., & Armeanu, D. (2013). Optimal risk management at metals market. **Actual problems of the economy, 145**(7), 298-305.

Dinica, M.-C., & Armeanu, D. (2014). The optimal hedging ratio for non-ferrous metals. **Romanian Journal of Economic Forecasting, 17**(1), 105-122.

Gemech, F., Mohan, S., Reeves, A., & Struthers, J. (2011). Market-based price-risk management: Welfare gains for coffee producers from efficient allocation of resources. **Oxford Development Studies, 39**(1), 49-68.

Hammoudeh, S., Malik, F., & McAleer, M. (2011). Risk management of precious metals. **The Quarterly Review of Economics and Finance, 51**(4), 435-441.

Henderson, V., Hobson, D., & Kentwell, G. (2002). A new class of commodity hedging strategies: A passport options approach. **International Journal of Theoretical and Applied Finance, 5**(3), 255-278.

Hertwig, R., Barron, G., Weber, E. U., & Erev, I. (2004). Decisions from experience and the effect of rare events in risky choice. **Psychological Science, 15**(8), 534-539.

Hlaing, N., Singh, D., Tiong, R., & Ehrlich, M. (2008). Perceptions of Singapore construction contractors on construction risk identification. **Journal of Financial Management of Property and Construction, 13**(2), 85-95.

Ho, W., Zheng, T., Yildiz, H., & Talluri, S. (2015). Supply chain risk management: a literature review. **International Journal of Production Research, 53**(16), 5031-5069.

Indexmundi. (2017). **Commodity Price Indices**. Retrieved August 05, 2017. Retrieved fromhttp://www.indexmundi.com/commodities/?commodity=rubber&months=180&currency=thb

James, T. (2007). **Energy Markets: Price Risk Management and Trading.** Chichester: John Wiley & Sons.

Jones, K., Raper, K. C., Whipple, J. M., Mollenkopf, D., & Peterson, H. C. (2007). Commodity-procurement strategies of food companies: A case study. **Journal of Food Distribution Research, 38**(3), 37-53.

Joseph, K., Irwin, S. H., & Garcia, P. (2015). Commodity storage under backwardation: Does the working curve still work? **Applied Economic Perspectives and Policy, Forthcoming**, 1-22.

Karni, E. (2014). Axiomatic foundations of expected utility and subjective probability **Handbook of the Economics of Risk and Uncertainty** (Vol. 1, pp. 1-39).

Kim, H. S., Brorsen, B. W., & Anderson, K. B. (2010). Profit margin hedging. **American Journal of Agricultural Economics, 92**(3), 638-653.

Knight, F. H. (1964). **Risk, Uncertainty and Profit**. New York: Reprints of Economic Classics.

Korniotis, G. M. (2009). **Does Speculation Affect Spot Price Levels? The Case of Metals with and without Futures Markets**. Division of Research and Statistics and Monetary Affairs, US Federal Reserve Board.

Matulevicius, R., Mayer, N., & Heymans, P. (2008). **Alignment of misuse cases with security risk management**. Paper presented at the The 3rd International Conference onAvailability, Reliability and Security, 2008 (ARES 08).

Moon, Y., Yao, T., & Park, S. (2011). Price negotiation under uncertainty. **International Journal of Production Economics, 134**(2), 413-423.

Morgan, W., Cotter, J., & Dowd, K. (2012). Extreme measures of agricultural financial risk. **Journal of Agricultural Economics, 63**(1), 65-82.

Newman, S. A. (2008). **The Role of International Commodity Exchanges in Price Formation and the Transmission of Prices and Price Risk along International Coffee Chains.** NCCR Trade Regulation, World Trade Institute.

Newman, S. A. (2009). Financialization and changes in the social relations along commodity chains: The case of coffee. **Review of Radical Political Economics, 4**(41), 539-559.

Neyhard, J., Tauer, L., Gloy, B., Marchant, M. A., & Bosch, D. J. (2013). Analysis of price risk management strategies in dairy farming using whole-farm simulations. **Journal of Agricultural and Applied Economics, 45**(02), 313-327.

Ni, J., Chu, L. K., Wu, F., Sculli, D., & Shi, Y. (2012). A multi-stage financial hedging approach for the procurement of manufacturing materials. **European Journal of Operational Research, 221**(2), 424-431.

Nobnorb, P., & Fongsuwan, W. (2015). ASEAN and Thai rubber industry labor mobility determinants: A structural equation model. **Research Journal of Business Management**, **9**, 404-421.

Pennings, J. M. E., & Garcia, P. (2004). Hedging behavior in small and medium-sized enterprises: The role of unobserved heterogeneity. **Journal of Banking & Finance, 28**(5), 951-978.

Ramanujam, P., & Vines, D. (1990). Commodity prices, financial markets and world imcome: a structural rational expectations model. **Applied Economics, 22**(4), 509-527.

Rampini, A. A., Sufi, A., & Viswanathan, S. (2014). Dynamic risk management. **Journal of Financial Economics, 111**(2), 271-296.

Revoredo-Giha, C., & Zuppiroli, M. (2013). Commodity futures markets: Are they an effective price risk management tool for the European wheat supply chain? **Bio-based and Applied Economics, 2**(3), 237-255.

Roache, S. K. (2012). **China's Impact on World Commodity Markets (12/115).** International Monetary Fund.

Rosman, R. (2009). Risk management practices and risk management processes of Islamic banks: a proposed framework. **International Review of Business Research Papers, 5**(1), 242-254.

Sainidis, E., Robson, A., & Heron, G. (2013). **Realigning the manufacturing priorities of SMEs as a result of the 2008 UK economic downturn.** Paper presented at the British Academy of Management Annual Conference (BAM 2013), Aintree Racecourse, Liverpool.

Schilirò, D. (2017). Economics versus Psychology. Risk, Uncertainty and the Expected Utility Theory. **Journal of Mathematical Economics and Finance, 3**(1), 77-96.

Sherafatmand, H., Yazdani, S., & Moghaddasi, R. (2014). Futures markets development as a price risk strategy in Iran's dates. **European Journal of Experimental Biology, 4**(1), 327-333.

Tang, C.-H. (2015). Determinants of commodity price risk exposure in the restaurant industry: An analysis by commodity price cycles. **International Journal of Hospitality Management, 45**, 121-129.

Tauser, J., & Cajka, R. (2014). Hedging techniques in commodity risk management. **Agricultural Economics/Zemedelska Ekonomika, 60**(4), 174-182.

Taylor, M., Tonsor, G., & Dhuyvetter, K. (2013). **Determination of factors driving risk premiums in forward contracts for Kansas wheat**. Paper presented at the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting and Market Risk Management. St. Louis, MO.

Tomek, W. G., & Peterson, H. H. (2001). Risk management in agricultural markets: A review. **Journal of Futures Markets, 21**(10), 953-985.

Walasek, L., & Stewart, N. (2015). How to make loss aversion disappear and reverse: Tests of the decision by sampling origin of loss aversion. **Journal of experimental psychology: general**, **144**(1), 7-11.

Weber, E. U. (2006). Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). **Climatic Change, 77**(1-2), 103-120.

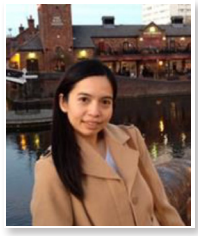
Weber, E. U. (2009). Risk Perception. In M. W. Kattan (Ed.), **Encyclopedia of Medical Decision Making** (pp. 1009-1011). London, UK: Sage.

Weber, E. U., & Milliman, R. A. (1997). Perceived risk attitudes: Relating risk perception to risky choice. **Management Science, 43**(2), 123.

Wilcox, M. D., & Abbott, P. C. (2006). **Can cocoa farmer organizations countervail buyer market power?** Paper presented at the American Agricultural Economics Association Annual Meeting, Long Beach, California.

ประวัติแนบท้ายบทความ

Name and Surname: Nontasak Janchum
Highest Education: PhD (Business and Management Research)
University or Agency: Northumbria University
Field of Expertise: Price Risk Management, Natural Rubber Supply Chain, Management Information System
Address: Faculty of Management Science, Suratthani Rajabhat University
E-mail: nontasak.jan@gmail.com



Name and Surname: Sangrawee Witoonpan
Highest Education: PhD (Business and Management Research)
University or Agency: Northumbria University
Field of Expertise: Logistics Management, Statistics, Research Methodology and Methods
Address: Faculty of Management Science, Suratthani Rajabhat University
E-mail: sangrawee.scm@gmail.com

Name and Surname: Chalita Cheewaviriyanon
Highest Education: PhD (Education and Communication)
University or Agency: Newcastle University
Field of Expertise: Computer for Education, Machine Learning, Early Childhood Learning
Address: Faculty of Education, Suratthani Rajabhat University
E-mail: chalita.chee@gmail.com