

John Williams

# Agricultural Supply Chains and the Challenge of Price Risk



# AGRICULTURAL SUPPLY CHAINS AND THE CHALLENGE OF PRICE RISK

This book discusses the issues of integration within food and fibre supply chains and the challenges in managing price risk. The problems of integration and price risk are interwoven in agricultural supply chains with production and supply risk as well as hoarding. However, without supply chain integration through commercial trade markets there can be no forward market upon which forward transactions and the management of price risk can be based. Without a forward market that can reduce opportunistic behaviour, there is likely to be little security of supply, particularly under high production risk and price uncertainty.

Whilst price risk management is possible under certain circumstances, there are many factors that can prevent the development of forward markets or cause them to collapse, thus undermining the ability to manage price risk within acceptable risk and return parameters. Market positions therefore need to be valued and often settled daily due to the risk of contract default. In addition, the issue of currency risk and its management applies to international market positions and transactional exposures.

The book analyses a range of price risk management strategies from forward contracting through to futures and options hedging, and finally to over-the-counter products. Evaluation techniques are developed to aid decision-making. The author concludes that forward market development may be the exception rather than the norm, and that whilst favourable price risk management outcomes may be possible, they can sometimes be caused more by luck than through good management. It is shown how tactics are an important consideration in decision-making to minimize costs and losses.

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# AGRICULTURAL SUPPLY CHAINS AND THE CHALLENGE OF PRICE RISK

*John Williams*

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# PREFACE

This book completes a trilogy that began 20 years ago in the aftermath of grain and wool supply chain deregulation in Australia. Many presumed that the formation of a local grain futures exchange in 1996 would reduce supply chain risk and add security to food value chains. What was generally ignored was an explanation of why the wool futures market had failed to prevent wool regulation during the 1970s and 1980s after the Sydney Greasy Wool Futures Market commenced in 1960.

The first book *Agricultural Price Risk Management* by John Williams and William Schroder (Oxford University Press, 1999) established the theoretical principles of managing price risk and the different local market mechanisms, with particular application to postderegulatory Australian supply chains. There was still the expectation that increased knowledge would assist the adoption of better local management practices to minimize food and fibre supply chain risks. The euphoria of finally having a local grain futures market masked many of the underlying problems, one of which was the existence of various grain export single-desks for another 12 years. Forward market constraints soon forced risk managers back onto international futures markets such as Chicago, which reintroduced the risk management problems of relevancy, parallelism between markets, and currency risk.

Holbrook Working had dominated the agricultural forward market debate for storable products from the 1920s to the 1960s in both the USA and England. There was great emphasis on how commercial trade markets were supposed to develop forward markets that should evolve into



futures markets for the purpose of price risk management. Issues such as risk attitudes, risk management adoption problems under uncertainty, as well as parallelism and currency risk had been examined in Australia prior to deregulation by David Rutledge in the 1970s, as well as Gary Bond and Bernard Wonder in the 1980s. At the same time in the USA, Dennis Carlton and Anne Peck were identifying some of the reasons for the success and failure of futures markets. There was a need to synthesize these findings.

The second in the trilogy *Competition and Efficiency in International Food Supply Chains* by John Williams (Earthscan-Rutledge, 2012) focused on the problems in developing commercial trade markets and integrative forward markets in many countries. Many factors can preclude the effective functioning of forward markets including price distortions, supply chain dysfunction, commingling and commoditization, hoarding and pooling, and corruption. Government policy has an important noninterventionist role in both the development and sustainability of forward markets.

Some have argued that if forward markets and risk management are so difficult, then why bother? That dilemma was resolved by Holbrook Working 80 years ago when he associated forward markets with supply chain security. Whenever strong commercial trade markets lead to forward markets, then agricultural product will be carried forward and provide product availability to the supply chain when needed. Without strong commercial trade markets and integrative forward markets, supply chains can be reduced to opportunistic behaviour with periodic dumping or shortages, which can be worsened by government buying and selling.

This third book focuses on the issues of forward markets, how they work, their function, and why they frequently fail. It explains why risk management succeeds or fails based on the effectiveness of the forward market to offset risk and to provide efficient price signals. The book will explain why supply chain management is interwoven with the management of price risk.

Because effective forward markets can only be established for storable products, the book will be confined to grains, fibre, sugar, coffee, cocoa, animal feed, pulses, vegetable oils, concentrated fruit juice, and dried-dairy products. The application to animal products in some instances will be discussed in Chapter 11.

# ACRONYMS

AA	Against Actual
APW	Australian Premium White wheat
ATM	At-the-Money
AUD	Australian dollar
BRL	Brazilian real
CAD	Canadian dollar
cif	Commission (cost), insurance and freight or destination port price
CME	Chicago Mercantile (Exchange) Group
EFP	Exchange for Physical
FEC	Forward Exchange rate Contract (also known as foreign or fixed)
fob	Free-on-board (ship) or origin port price
GMP	Guaranteed Minimum Price contract
HTA	Hedged-to-Arrive contract
ICE	Intercontinental Exchange
ITM	In-the-Money
JIT	Just-in-Time
OTC	Over-the-Counter
OTM	Out-of-the-Money
P/L	Profit/Loss

✕ Acronyms

RP	Realized Price
ROC	Rate of Change
RSI	Relative Strength Index
USA or US	United States of America
USD	United States dollar

# INTRODUCTION

Uncertainty, risk, and their associated tradeoffs may be the grist for risk psychologists, but the biological uncertainty of agricultural products makes it even more so. Decision making under high uncertainty is prone to frequent mistakes, yet risk management is expected to occur under such adverse circumstances.

There are many functions of price within the supply chain which are frequently destroyed by those who seek to control it through some theoretical equilibrium optimum. Price needs to be separated from pricing in risk management, which has a time factor involved and therefore requires a forward market based on a strong underlying commercial trade market with a sufficient volume of transactions.

There is often a naive perception that such commercial trade markets and forward markets will automatically develop after deregulation has occurred in the supply chain, and that the management of risks within the supply chain, such as price risk, is relatively easy with few tradeoffs. However, the rhetoric rarely matches the reality, with many impediments to integration and management.

Integration within food and fibre supply chains can exist either with vertical ownership or contractual agreements that establish commercial trade markets. Vertical ownership usually requires large investment risk, while commercial trade markets may not be permanent and be frequently unsustainable. The alternative to supply chain integration or commercial trade markets is opportunistic buying and selling behaviour in the spot market.

## 2 Introduction

However, vertical ownership, commercial trade markets and opportunism may co-exist during times of surplus product and seemingly support food and fibre security.

The problem with commercial trade markets is that they are prone to collapse whenever shortages occur, yet they are essential for the establishment of forward markets that can facilitate forward risk management. Without a strong underlying physical forward market, agricultural futures markets are likely to be ineffectual, which then limits the effectiveness of hedging price risk.

Despite the negative impact of direct government intervention on commercial trade and forward markets, there is a definite role for government in ensuring efficiency in supply chains and effectiveness of forward markets. The problem for governments is balancing between under-regulating and excessive intervention, particularly when public institutions need food and fibre procurement. Also, there needs to be strong legal enforcement, but within the confines of functionality and efficiency.

There are many prerequisites for the development of a forward market, which can then lead to many benefits in the supply chain. However, effective forward markets do not simply evolve, and much effort is required to ensure their trading success as their failure rate is extremely high. Even when effective forward markets are established, misinterpretation of forward market signals can be the cause of many errors in strategy selection and implementation.

Supply chain transactions can be so intricate that misinterpreting market position can lead to unexpected risk or wrong strategy implementation. What may appear straightforward in a simple forward transaction can result in confusion over market position when contract default occurs. It might be argued that risk management can be simplified if the correct market position can be identified and understood. However, whilst the retention or transfer of ownership title is vital to market position exposure, it is frequently obscure.

The possibility of agricultural supply default must be taken into account to determine potential market position exposure, otherwise future business operations may be jeopardized. Minimizing the potential and impact of supply default is an important yet uncertain management requirement. Understanding how market position is valued is a vital component of supply chain risk and its subsequent management.

Inadequacies in contractual relationships in food and fibre supply chains inevitably lead to finding other solutions to manage risks such as price risk. The mechanism of price hedging evolved from forward contract default

and has led to the sequential development of futures markets, options markets, and finally over-the-counter products. But there is no panacea for risk management remedies because of risk tradeoffs and transaction costs. Each price risk management strategy has its strengths and weaknesses. Much depends on timing and alignment with efficient forward market signals.

Physical supply is the foundation of food and fibre supply chains. It might be expected that much supply chain risk would be eliminated once harvesting occurs. However, production rarely equates to supply. Emotions, psychology, and group dynamics interweave during and after harvest to prevent the supply of much product to buyers because of price. Many governments even become involved through public hoarding or subsidizing private hoarding. Group pooling and private hoarding are frequently used in lieu of alternate strategies to enhance price postharvest. This delay in product sale has important implications to the ever increasing concern over food biosecurity and supply chain security.

Currency risk is largely neglected whenever government intervention occurs, or in the USA where most international transactions occur in US dollars. This explains the absence of currency discussion in most of the relevant US literature. However, supply chain deregulation has increased the awareness of currency risk both in international and domestic transactions, particularly when ineffectual domestic forward markets cause reliance on international price benchmarks and foreign hedging mechanisms. Currency risk can require adequate risk management strategies to minimize the risk.

There is much presumption that futures markets will always operate effectively to enable physical delivery against the forward contract or to transfer price risk. Agricultural futures markets are only as strong as the underlying commercial trade market. Any weakness in the underlying supply chain can result in serious deficiencies in the futures market which spill over into risk tradeoffs and higher transaction costs. Mandating the cash settlement of forward contracts can be an admission of failure of an effective underlying physical delivery system. Failure of deliverable forward contracts can be synonymous with the failure of price risk management. Attempting the impossible out of an impossible situation rarely benefits anyone other than speculators.

Arbitrage may be vital for international trade, but arbitrage strategies are essential to ensure efficiency in price signal transmission in food and fibre supply chains. Without adequate and regular arbitrage to remove price discrepancies, such temporary discrepancies can become more permanent price distortions, which can lead to political lobbying for government intervention under the mistaken guise of market failure.

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This book is structured to reflect such weakness within food and fibre supply chains, which thereby causes many of the shortcomings in managing price risk. Some might inadvertently conclude that the management of price risk has failed without considering the fragility of agricultural supply chains, the impossibility of controlling supply, and the positive skewness of agricultural prices.

An ability to control supply should lead to greater supply chain integration, which would contribute to less risk associated with price risk management, and which presumably could increase the adoption of price risk management practices. However, controlling agricultural supply has eluded most countries for much of history. Therefore weaknesses in managing price risk will remain with the uncertainty of agricultural supply and the skewness of prices, rather than be caused by any market failure per se. This book is rather unique in focusing on these issues, which will lead to some important conclusions.

# 1

## INTEGRATION AND FORWARD CONTRACTING

Agricultural production is usually expected or assumed to always have a buyer. Consumers are generally expected to always need or be eager to buy what is produced. Rarely is it considered that much of what is produced is not what buyers or consumers want. Some farmers even expect tax-payers to buy whatever surpluses that consumers do not want.

Exact alignment of agricultural production with consumption rarely occurs. Much food and fibre is produced opportunistically in the hope that there is a buyer. Unsold food and fibre languishes in global storage, isolated from buyers and consumers. Even much food that has been sold into the supply chain is often wasted and not consumed.

Such misalignment can result from the long time lags involved with seasonal agricultural production, and is aggravated by continual changes in consumer tastes, technology, biology, and weather conditions.<sup>1</sup> Both supply chains and markets are driven by uncertainty.<sup>2</sup>

Food and fibre supply chains are also characterized by the dynamics of change in production operations and business relationships,<sup>3</sup> international competitiveness,<sup>4</sup> and the continual movement of international prices that are exacerbated by exchange rate relativities. Also, farmers can be both suppliers and consumers of farm outputs and inputs irrespective of the economic status of the country.

Supply chains invariably fail if the willingness of consumers to buy and consume is not matched by the willingness and ability of farmers to produce and supply the associated product.<sup>5</sup> Failure within supply chains can be



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measured by unwanted surpluses, the incidence of contract default caused by production shortfalls,<sup>6</sup> and the unwillingness of hoarders to supply.<sup>7</sup> The fickleness of consumers<sup>8</sup> and the inelasticity of supply<sup>9</sup> can be contributing factors.

Given such dynamism and uncertainty, agricultural supply chain contractual obligations rarely extend more than 12 months except under vertical ownership or renegotiation. Risk usually increases with contract rigidity in the supply chain, which can necessitate a reduction in the time of contractual commitments and an increased need for flexibility.<sup>10</sup>

Determining some comparative advantage and the probability of risk might be considered essential before buyers and sellers commit to integrative contractual relationships. Yet these are rarely determined because of the difficulty in identifying inherent advantages<sup>11</sup> and controlling the risks.<sup>12</sup> Basic emotions such as hope, opportunism, and profit expectations<sup>13</sup> still drive much of the supply chain integration under dynamic uncertainty rather than any longer-term commitment to sustainable relationships. This is particularly the case for farmers struggling with low profitability and for those supply chain intermediaries with expectant and anxious shareholders.<sup>14</sup>

Integration can conceptually range from short term with alliances to long term under ownership. The capital investment associated with a joint venture usually differentiates it from a strategic alliance that may have no capital commitment.<sup>15</sup> There may be forward integration towards the final consumer, or backward integration towards the farmer.

Specialization of integrated supply chains<sup>16</sup> makes it extremely difficult to benchmark efficiency and performance. One objective measure of supply chain efficiency is the existence of a forward market to facilitate forward transactions and to manage risks within the supply chain.<sup>17</sup> However, such forward markets are dependent on market liquidity, which is sometimes only bolstered by the inclusion of nonphysical participants such as speculators.

## Perspectives on integration

A food processor once had a potato supply chain that was perceived to be fully integrated with carefully selected farmer suppliers in a rainfall-secured region. The processor provided the specific product seed varieties, the required agronomic inputs, and the agricultural advice to the farmer, as well as buying all the potatoes that the farmer produced at a pre-arranged contract price that was largely determined by another contract between the food processor and a fast-food retailer.

The question arose as to why this supply chain integrative model could not be applied to other input supplies for the food processor, such as grains and oilseeds. If potato farmers could integrate with food processors through such differentiated products, then what factors were stopping grain and oilseed farmers from doing likewise?

Certain risk parameters of the food processor needed to be known to answer this question. The risk of failure to deliver had been prior determined by the risk policy committee of the food processor at 10 percent. This meant that the food processor had to be assured of delivery of the required product no less than 90 percent of the time. The worst-case scenario for the food processor, which was when major financial losses and factory stand-downs occurred, was when supply and delivery default reached 20 percent.

Such risk policies provide the answer to the food processor question. If individual farmers have more than a 10 percent probability of not being able to deliver grain or meet product specification, then food manufacturers probably will not undertake a supply agreement with individual farmers under such high-risk conditions.

Many farmers have a high probability of not meeting consistent delivery and product specifications, particularly in marginal production regions. End users are more likely under such high risk to adopt opportunistic speculative spot purchase behaviour,<sup>18</sup> but even that assumes that they would undertake high capital investment in such marginal regions.

An alternative strategy available to the food processor or manufacturer is to form contractual relationships with one or more domestic merchants who can accumulate from many diverse regions and deliver the required product when needed. This relationship is often established as a commercial trade market, and it is mutually dependent in that the end user needs the merchant for the purpose of accumulating, warehousing, financing, and delivering the specified product, whereas the merchant relies on the end user for maintaining profitability.

The formation of such commercial trade markets can be perceived to alienate farmers because of selectivity and exclusivity.<sup>19</sup> End users need specific product and reject nonspecific product. Given the risk probabilities with biological agricultural production, luck can be largely associated with product acceptance and bad luck with product rejection. If a farmer through no fault of adequate farming practice produces a biological product that does not meet end user specification, the subsequent rejection can devastate farmer morale and induce anger. Marginal soil or uncertain rainfall regions are unlikely to be selected for supply chain integration because of this improbability of supply guarantee.<sup>20</sup>

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Whilst the potato supply chain model is theoretically ideal, most farmers and end users do not have such integrative advantages or opportunities. The end user is more likely either to have commercial trade agreements with merchants to cover their input supply requirements for the next 12 months, or alternatively, they opportunistically use the spot market to purchase the required product just in time (JIT).

Even the potato supply chain model proved to be unsustainable. Rising farm costs and currency exchange rates ultimately meant that it was far cheaper for the food processor to import potatoes and not integrate with local farmers. Dynamic change and the need for flexibility mattered more than long-term integration. Relative costs, prices, and exchange rates are important considerations in supply chain integration decision making. Any government intervention in supply chains under such circumstances is highly likely to lead to end users either closing operations or avoiding new capital investment, both of which can devastate domestic supply chains and make them import-dependent.

### Markets and uncertainty

Markets require a foundation or physical base such as an agricultural commercial trade market that is part of an intricate food or fibre supply chain. Even indices such as the Commodities Index must be based on a composite of many smaller markets. Any attempt to establish a virtual market such as a forward market for perishable products which is not derived from underlying physical transactions can be reduced to being speculative and will most likely be unsustainable.<sup>21</sup>

Spot markets reflect some urgency and immediacy for buyers and sellers to transact,<sup>22</sup> perhaps because of product perishability, or requirement for cash flow, or a need to satisfy manufacturing throughput or customer demand. Alternatively, forward markets are transactions at some future time, where time has some value relative to a spot transaction.

Buyer and seller integration drives market strength.<sup>23</sup> Greater urgency and immediacy to transact in either spot or forward markets will drive market liquidity, which can be measured by the daily volume of transactions, the depth of bids and offers at prices above and below the current market price, and the number of forward contracts established.

Uncertainty drives supply chain integration and creates markets. Market volume can be determined by the number of buyers who think that prices could rise being equally offset by the number of sellers who think that prices could fall. Ironically, information can frequently cause uncertainty over

conflicting and untimely data, and paradoxically may create market liquidity through contrary behaviour.<sup>24</sup> Different price sentiments in different time frames together with the need to transact physical products combined with opportunism and expectations of profit drives market liquidity.

In contrast, supply and demand certainty can jeopardize both spot and forward markets. If everyone thought that prices were going to rise in the future, there would be no sellers of storable products and no market as reflected in transactional liquidity, except for perishable products. Alternatively, if everyone thought that prices were going to fall in the future, there would be no immediate buyers and again any market would be jeopardized, regardless of whether the product was perishable or storable.

The certainty of price under monopoly or government price control in countries such as India is likely to destroy the functionality of market signals and cause product hoarding in an attempt to force prices higher as well as price manipulation to profit from opportunities, both of which can lead to supply chain corruption.<sup>25</sup> Hoarding causes end user supply frustration and is a symptom of the supply chain problem, not the cause of it.

## The importance of price

The absence of a price mechanism reduces farmers to subsistence, with any transactions confined to bartering or countertrade. It is price that lifts farmers from subsistence into the cash economy. Belittling price can result in entrenching poverty and perpetuating primitive supply chains.

Some argue that price is not important in the global food security debate. However, price and associated price signals shift farmers from subsistence into a cash economy in which surpluses are more likely to be produced. Price can undermine food production sustainability because of its impact on farm profitability. Supply chain efficiency is dependent on transparent and accurate price signals. Contract price was the essence in the potato supply chain case study, and it was price that caused the dissolution of the supply chain integrative relationship.

Agricultural production should not occur without a value being attached by consumers or customers. In economies that have been ravaged by corruptive distortions and bureaucratic restrictions, value might be restricted to the immediacy of feeding the farming families. Value might be the opportunity cost of pricing and income foregone.

Once basic food necessities to overcome hunger are satisfied, price is the motivator to produce, to sell, to invest, and to buy. The corollary suggests that if the price mechanism is destroyed or distorted, then farmers will be

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reduced to subsistence and be isolated from the cash economy and longer-term sustainability. This has implications for policies involving government intervention, hoarding, corruption, and prolonged 'aid'.<sup>26</sup>

If costs of production and capital investment are considered important factors in the global food security debate, then price must be elevated in relative importance. It is the price of inputs that drives the cost of production and often the usage of inputs. As well, it is the price of money as reflected through interest rate movement that determines the amount of capital investment. Such price importance suggests that there may be a need to manage price.

Price is important in supply chain decisions because of the value signals to farmers, merchants, end users, and consumers. Changes in supply and demand need to be transmitted quickly and efficiently to relevant decision makers through price movement, otherwise the supply chain becomes dysfunctional. Price is likely to be more transparent in concentrated commercial trade markets than it is in more decentralized and diverse supply chains.

A forward price is the foundation of commercial trade relationships, and without a forward price, all commercial trade could be reduced to spot market opportunistic transactions. Forward prices reflect the eagerness of end users and merchants to establish commercial trade markets.

The role of buyers and sellers in establishing price depends on the transaction method. A silent or auction market can be devoid of all seller presence, other than to prior establish a minimum price for a spot sale. This contrasts to a commodity exchange whereby buyers, sellers, and their agents can actively transact in spot and forward months. These transactions are non-integrative and opportunistic, and can be contrasted with commercial trade markets that are more integrative with business relationships.

Buyers can bid in active competition, whereas both buyers and sellers can passively offer a price under less competitive circumstances. Offering a price is usually undertaken by sellers who are desperate to become price makers when there is little buyer activity and previous opportunities are gone. Buyer bidding activity is more likely to peak before or at harvest, but then fall quickly away as product life becomes both uncertain and shortened. Product certainty may only exist at harvest time, which explains why it is essential for sellers to facilitate maximum buyer competition, and not to destroy this competition.

Cost, price, yield, and acreage are the primary determinants of farm income and profitability. The greater the dependence on a single price through product specialization, the higher may be the profit risk. In contrast,

enterprise diversification tends to lessen the importance and spread the risk of any singular price. Therefore, product specialization can increase price risk relative to product diversification.

However, it is still debatable as to whether product or price should be the most dominant in decision making, or whether there is a sequence. There cannot be a supply chain without product, but there may be no product without adequate price. The answer probably lies with price driving product decisions, irrespective of whether it arises from the buyer or seller perspective, with the importance of pricing increasing after the decision to produce has been made. Pricing can become more important as product becomes more certain, but this may depend on price movement. Confusion may arise if price is not distinguished from pricing.

The value of a product to a buyer is reflected in its price. Some buyers perceive a high-priced product to be good value, whereas other buyers might perceive a low-priced product to be good value. Buyers can be classified as niche buyers who may be very discerning and price making, or volume buyers who are less discerning and may be opportunistic buyers of last resort through price taking. Niche buyers may have large risk capital investment, whereas volume buyers might have lean low-debt operations.

Niche price-making buyers are more likely to occur before or at harvest, whereas price-taking volume buyers are likely to occur very opportunistically after harvest. The dilemma for farmers is that price-making opportunities usually coincide when there is product uncertainty, whereas price-taking problems usually occur when there is product certainty. Pooling, hoarding, or government intervention will never solve this farmer dilemma.<sup>27</sup>

Hoarding psychology is greatly influenced by price.<sup>28</sup> If prices are not perceived to be 'fair',<sup>29</sup> then some farmers will go to extraordinary lengths to withhold supply from merchants and end users, regardless of cash flow and debt problems. What is produced may be totally disparate to that being supplied.

Even when prices may be deemed 'fair', this is no surety that farmers will sell, because increasing price encourages even greater hoarding under the old adage of why sell today when prices are going to be higher tomorrow. Price, production, supply, and global food security are intricately linked.

As products move along the spectrum from differentiated product at harvest towards undifferentiated commingled commodity in storage, price becomes the only commonality between a buyer and a seller when the product is commoditized.<sup>30</sup> Price dependency for sellers and buyers often distinguishes commodity from a differentiated product. This may imply that managing price risk is far more important for commodities than it is for

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differentiated products that are more likely to have supply chain back-to-back integration. However, merely differentiating products does not remove price risk, and any value added may actually increase the value at risk.

Whether product differentiation or perceptions of value adding actually results in a higher price may be very debatable and be specific to individual supply chains. If the differentiated product or added value merely meets buyer specification, then no price increase is likely to occur. Value to a seller might be quite different from a buyer's perspective. What may be perceived to enhance quality might merely result in better meeting product specifications at the same price. At best, there may be less price discounting because product specifications have been better satisfied, and perhaps less price volatility if there is an opportunity for supply chain integration.

Financial valuations, audits, and settlement of transactions must be performed at market prices in marked-to-market valuations. Immediate value is reflected in the spot market price, however, forward value is measured by the difference between the forward price and the prevailing spot market price adjusted for the time value of money. The possible eventuality of cash settlement in a forward contract needs to be reflected in daily valuation accounting for daily margin variations based on daily price movement.

Price is the essence of international trade because of the ability to arbitrage between low prices in one country and higher prices in another. Arbitrage cannot occur with bartering or countertrade because there are no price differentials. Also, it is the price of commodities such as crude oil which will determine freight costs and the profitability of arbitrage. High oil prices can diminish international trade opportunities and affect global food security. Prices in food deficit countries will need to rise to meet increased freight costs if imports are to occur.

Price may even determine discretionary costs for some producers.<sup>31</sup> Farmers are likely to spend more on fertilizers at high output prices, and restrict such discretionary expenditure at low output prices. The final product with high prices may be completely different to a product at low prices, such as milling wheat compared to feed wheat. Expected output prices, discretionary expenditure, and product differentiation can be intricately linked.

The probability of a particular price occurring will have a huge impact on decision making regarding production, pricing, integration, and investment. Price affects the psychological behaviour of buyers and sellers in most aspects of business operations.<sup>32</sup> Changes in risk attitude can occur with price movement.

Elasticity is a measure of the rigidity or flexibility of supply and demand caused by a change in quantity supplied or demanded given a relative change in price. The flexibility of supply will affect price and demand. Inelastic supply results in a small change in quantity supplied relative to a large change in price, whereas elastic supply has a large response in quantity supplied relative to a small change in price. Alternatively, inelastic demand results in a small change in quantity demanded relative to a large change in price, whereas elastic demand has a large response in quantity demanded relative to a small change in price.

Price reflects buyer and seller eagerness and market sentiment. In a deregulated supply chain, price is a momentary consensus between a singular buyer and seller.<sup>33</sup> No individual buyer and seller is required to know total supply and demand beforehand, or to calculate elasticities of supply and demand, for a price to be negotiated. The momentariness of price suggests that any permanency of market and price equilibrium is impossible because of dynamic variables associated with time.<sup>34</sup> Equilibrium may be an elusive goal for those who seek to control price.<sup>35</sup>

Many countries still have their governments involved with major food and fibre purchases for defence personnel, hospitals, prisons, other government institutions, and frequently as 'buffer' or speculative stocks. Price can drive opportunistic speculative public tendering. If prices are low, public authorities can be encouraged to speculatively buy and hoard with public stocks. Alternatively, governments may buy when prices are rising because of public institutional catering panic or monetary inflation concerns.

Any major buying activity by government will impact domestic prices and private supply chains during both the accumulation and dumping phases, which seriously distorts price signals to farmers, merchants, and end users. The irony is that most government buying drives inflationary prices and increases the motivation to privately hoard in the expectation of even higher prices, both of which can decimate end users who have high investment risk in domestic supply chains.

## Pricing considerations

Whereas price is integral to supply chains and markets, pricing is independent and can be accomplished through peripheral traders such as speculators. A speculator is anyone who takes a market position that is not offset. There does not have to be a physical trader for offsetting to occur, however there must be a buyer and a seller in a liquid market that has relevancy to the underlying supply chain in which pricing is occurring.



## 14 Integration and forward contracting

Pricing in the spot market can only be accomplished by immediately delivering or accepting delivery of the physical product. Forward pricing occurs in a forward market involving a need to buy or sell product at some price and time in the future.

Forward pricing is primarily undertaken to manage price risk, thus removing price variability from the profit equation. Removing one of the major variables in the supply chain enables management to focus on controlling other variables that are more difficult to manage such as supply and costs.

There are preharvest, at harvest, and postharvest implications with pricing. The paradox for many farmers is that it is psychologically easier to undertake pricing before harvest when there is product uncertainty than it is to undertake pricing after harvest when there is product certainty. Pricing through a physical sale after harvest can be such an emotional and difficult decision for many farmers that both pricing and selling responsibility is frequently passed onto a pool manager.

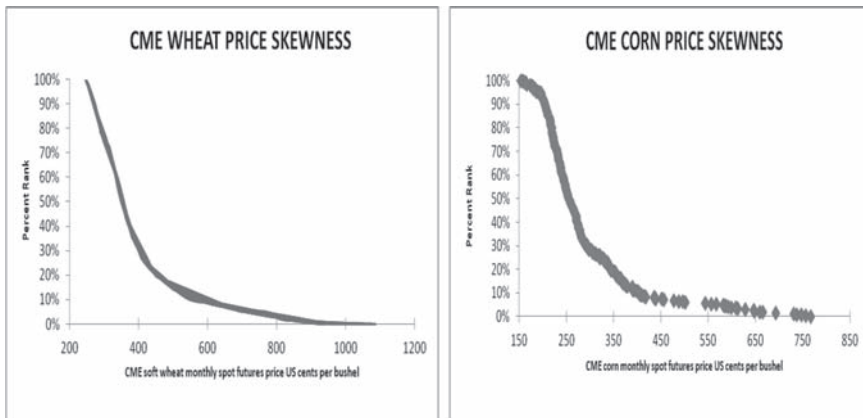
A simple supply contract excludes pricing, but price risk still remains for both the buyer and seller by being external to the supply agreement. Therefore, both the buyer and seller will have price risk in a supply contract until pricing is settled upon usually at delivery time.

Whereas pricing decisions usually cannot be isolated from the cost of production, discretionary cost expenditure decisions can be influenced by prevailing prices and pricing decisions.<sup>36</sup> Price, cost, and pricing are interconnected for some farmers in their decision making, but not for all farmers.

Management decision making on pricing is usually based on individual sentiments and psychological behaviour. Pricing usually depends on price and its movement, trend, and future expectations. Difficult objective analysis is frequently subsumed by easier subjective sentimental behaviour. This usually results in much regret over pricing decision making once hindsight knowledge is attained.

## Factors preventing integration

Integration is often portrayed as being easy and dependent upon successful negotiation.<sup>37</sup> However, there has to be some initially perceived mutual benefit for buyers and sellers before integration is possible, regardless of the skills of negotiation. It is unlikely that any buyer or seller would deliberately integrate if it was disadvantageous for them. Whilst supply chains vary according to industry and product characteristics,<sup>38</sup> there are a number of very specific factors that can prevent mutual benefits and integration in food and fibre supply chains.



**FIGURE 1.1** CME wheat and corn monthly price skewness: 1981–2012

Source: John Williams, 2013

Pearson identified positive skewness in many natural phenomena including commodity prices during the late 19th century.<sup>39</sup> Positive skewness results in low prices for commodities most of the time, with high prices occurring rather infrequently. Regardless of any naturally occurring phenomena, the positive skewness of agricultural commodity prices suggests that surpluses will depress prices most of the time.

Figure 1.1 compares the positive skewness using percent ranking for soft wheat and corn in an analysis of US monthly spot futures prices between 1981 and 2012. The results indicate that soft wheat experienced similar positive skewness to corn over this period.

Major positive skewness has important consequences in supply chain decision making for different market positions. It results in farmers experiencing low prices for most of the time. Farmers will struggle with profitability unless productivity and adequate cost control can outweigh the propensity for low prices. There is a need for occasional price volatility to provide pricing opportunities to enable profitability to occur.

It can be argued that positive price skewness is justification for income support and farm subsidies to counter the high probability of low profitability. However, the alternative is to allow normal price volatility to occur, on the understanding that the occasional price spike provides opportunities for farmers to retain profitability and to ensure the required on-farm investment occurs that secures future production and product supply. The corollary suggests that any policy of price control or suppression of price volatility will result in farmer poverty, on the assumption that there is no farm subsidy provision.

Positive skewness can result in farmers adopting more opportunistic behaviour in spot markets, and generally being reluctant to integrate into food and fibre supply chains in their pursuit of price and profit maximization. Some might perceive that such risk taking is required to remain viable, despite the propensity for prices to fall.

Such behaviour towards price speculation might be also justified by marginal farmers when there is high production and quality-grade uncertainty. The combination of positive price skewness with product uncertainty provides a disincentive to undertake forward contracting that locks in both price and delivery. Some perceive forward contracting to be introducing an opportunity cost at the same time as creating new risks such as delivery default.

One favourable attribute from positive skewness for a farmer occurs when hedging price, because of the propensity for prices to fall, which replaces the need for supply chain integration to manage price risk. However, such hedging does require some price volatility to occur to provide sufficient and regular pricing opportunities.

Supply chain integration and pricing decision making can be examined against trends in both price skewness and volatility over time. Such trend examination may indicate the propensity for farmers not to integrate with supply chains and adopt more speculative opportunistic behaviour.

Table 1.1 depicts the annualized price skewness and volatility from daily CME spot soft wheat and corn futures prices for the period 1983 to 2012.<sup>40</sup> Price volatility was measured by annualized standard deviation.

Farmers need regular occurrences of either negative skewness or price volatility to secure production and supply. The problem for wheat growers is that whereas during 1983–2002 there were five occurrences of negative skewness (1984, 1985, 1988, 2000, and 2001), there were no occurrences of negative skewness during 2003–2012. It might be argued that the increased price volatility in 2007 and 2008 was a response to the decline in negative skewness over the previous 25 years, which was followed by aftershocks in 2010 and 2012. However, the high prices occurred only temporarily, which suggests supply quickly overwhelmed demand through sales of privately hoarded product and government stocks, as well as the removal of export bans and increased new crop production.

This somewhat contrasts with corn that had 10 years with negative skewness between 1983–2002, but only 3 years with negative skewness between 2003–2012. The response from corn price volatility in 2007 and 2008 was muted compared to wheat, with relatively subdued aftershocks. Examining the end usage differences and trends between wheat (flour, feed, and starch) and corn (flour, feed, starch, syrup, alcohol, and ethanol) may explain why wheat is more positively skewed than corn.

**TABLE 1.1** CME annualized wheat and corn price skewness and volatility: 1983–2012

<i>Year</i>	<i>Soft wheat</i>		<i>Corn</i>	
	<i>Price skewness</i>	<i>Standard deviation</i>	<i>Price skewness</i>	<i>Standard deviation</i>
1983	0.7411	19	−0.4404	32
1984	−0.2249	10	−0.0300	31
1985	−0.2394	23	−0.2751	22
1986	0.6593	25	−0.1938	34
1987	0.2431	16	−0.1312	14
1988	−0.0799	47	0.1233	46
1989	0.7058	17	0.0963	19
1990	0.2009	47	0.4721	21
1991	0.7026	41	−0.8996	8
1992	0.7464	43	0.0107	23
1993	0.1426	30	1.2454	24
1994	0.1346	30	0.3089	32
1995	0.1094	59	0.4037	37
1996	0.4701	64	0.1378	71
1997	0.6304	24	−0.1330	17
1998	0.3097	26	0.2383	24
1999	0.3216	13	−0.4456	10
2000	−0.1980	11	−0.2881	19
2001	−0.1037	10	−0.1934	10
2002	0.4177	48	0.4801	24
2003	0.3000	34	−0.6543	12
2004	0.2060	38	0.1448	43
2005	0.0232	16	0.9211	13
2006	0.7189	59	1.2845	52
2007	0.4181	173	0.1955	33
2008	0.1169	183	−0.0264	104
2009	0.2701	44	−0.1889	35
2010	0.2937	115	0.8219	88
2011	0.0911	80	0.0288	53
2012	0.0178	115	0.1243	74

*Source:* John Williams, 2013

Theoretical factors that might shift the mean (average) of the price distribution to the right include new product development, new end usages, consumer demand shifts, or perhaps decreases in transport costs such as shipping. From a farmer perspective, perhaps there is a need to discover more end usages for wheat to enable it to become less positively skewed.

A correlation may be established between decreasing negative skewness and increasing price volatility for both wheat and corn, but this does little to support supply chain integration. Unless there is a major and sustained increase in price volatility, end users may be reluctant to forward integrate when there are increasing pricing opportunities in the spot market. Pricing opportunities and profit maximization are strong motives by management to placate shareholders who may be wearied from persistent inadequate investment returns. Positive skewness can result in rewards outweighing the risks for most of the time, which then encourages opportunism.

Any attempt by end users to lock in forward prices through integration could result in competitors undermining them subsequently during prolonged periods of low prices. Maintaining competitiveness is therefore a major driver for input supply flexibility rather than legal obligation and inflexibility that derives from supply chain integration. Low prices predominate for end users under positive skewness, which creates only the occasional anxiety over high prices. The formation of commercial trade markets is very tenuous under such circumstances and may only be driven by the desire to procure specified product and to ensure quality controls.<sup>41</sup>

Whilst it may be uncertainty of product for end users, and uncertainty of price for farmers, which can drive supply chain integration via forward contracts, there are limits beyond which product uncertainty overwhelms the probability of successful integrative outcomes. The opportunity for price risk management therefore diminishes as the uncertainty associated with production marginality increases.

Variability associated with uncertain marginal production in Russia, Canada, Australia, and Argentina can explain why little supply chain integration occurs for many agricultural products in these countries. The uncertainty of weather and biological variation under dry-land farming may be minimized but not managed, unless irrigation is available. This can be contrasted to USA and Western Europe where greater farm product consistency and supply continuity drives and secures much supply chain integration, which can then be strengthened by product branding and promotion.

Ironically, it can be a small amount of uncertainty that creates disproportionately large risks in agricultural production which prevents supply chain integration.<sup>42</sup> There needs to be much certainty in seasonal variation,

daylight hours, periodic rainfall, and photosynthesis for agricultural production to occur. However, the timing of a relatively small amount of rainfall can determine the success or failure of crop in terms of yield, quality, and product attributes. Uncertainty is a relative concept and cannot be generalized.

End users may avoid supply chain integration and price risk management under high product uncertainty and revert to opportunistic spot purchases, whilst marginal farmers may be more likely to avoid forward contracts prior to harvest because of delivery and transaction cost risk.<sup>43</sup> However, without forward contracts to provide supply chain integration, farmers can become isolated from the supply chain and output may become price-taking commodity.

Product availability drives spot market transactions for end users but only when there are product surpluses, whereas product shortages drive supply chain integration but the lack of product can cause supply chain disintegration. End users want integration during shortage periods, whereas farmers want integration during surplus periods. This makes integration mutually antagonistic and threatens the opportunism of both buyers and sellers. Therein lays the inherent contradiction for integration.

Therefore, supply chain integration and the development of commercial trade markets between end users and merchants paradoxically may only occur when there are product surpluses, which is opposite to what the end user probably wanted. It could be that integration is the second-best or even the third-best solution in strategy preferences for an end user.

Supply chain integration may be more likely to occur under mild production uncertainty, which is a mediocre compromise for buyers and sellers. Both farmers and end users need to perceive some uncertainty before integration may be seriously considered in preference to spot transaction opportunism. This has important consequences for countries that have certainty under price controls, where the only uncertainty lies in price manipulation. There may be little motivation to integrate under such circumstances, which may explain the amount of speculative opportunism that arises from government price controls.

Supply shortages can not only destroy commercial trade markets but damage everyone with contractual obligations associated with the product in the value chain. Supply chain integration usually does not exist in isolation. Commercial trade markets between merchants and end users usually extend forward to freight forwarders, wholesalers, and retailers in a 'circle of trades' through contractual commitments. Any disruption of product continuity and consistency can therefore affect the whole 'circle of trades'. Each contractual arrangement has to be unwound and cash settled at a

mutually agreed price. The associated transaction costs associated with contract default can be high, especially if low market liquidity results in wide bid and offer prices in the cash settlement period.

Under such circumstances, end users can either adopt spot market opportunistic behaviour or be forced into supply chain relationships with merchants who themselves may be forced into opportunistic spot market purchases, but over a wider region. It could be that other factors such as product continuity, specificity, traceability, identity preservation, and quality control drive supply chain integration with merchants more so than any great desire for commercial relationships and price risk management.

Supply chain integration is only made possible if end users are willing to invest in localities close to farmers. Integration is not possible without end users. Regional location of end users may occur where there are local supply surpluses for most of the time, which then leads to positive price skewness and much surety of supply. Alternatively, the benefits from positive price skewness must outweigh any disadvantages resulting from uncertain production and withholding supply, as well as the occasional price volatility. Unless there are perceived mutual benefits, supply chain integration is unlikely to occur between an end user and a farmer, or even a merchant.

End users may tolerate periodic shortages some of the time, provided that they can get product continuity and consistency most of the time. As vulnerability to operations increases, the end user is more likely to relocate to a more certain production locality, particularly when financial risks such as investment and debt are large. There is no government solution for optimum end user location other than to allow freer trade to occur. Pursuing domestic self sufficiency in production and manufacturing under high risk might incur too high a cost for consumers and economic growth.

Decision making regarding selling and pricing involves much emotional anxiety, regret and avoidance for many farmers.<sup>44</sup> If farmers have been previously disadvantaged in supply chain integration through contract default, cash settlement payouts, or legal proceedings, they will usually be reluctant to enter into legal contracts again, or at least until the memory of such events fade or become over-ridden by other selling calamities.

Marginal farmers would be expected to be the most affected by regret and avoidance attached to supply chain default because of weather and biological variation. The reality for most marginal farmers is that they are already speculating on production given some previous probability of product outcome. Their propensity for increased risk may be psychological consistent in an all or nothing approach, but their farming viability might be short-lived if risk exceeded certain limits. Any forward agreement to