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*Future trading*

# COMMODITY FUTURES MARKETS - HEDGING OPPORTUNITIES FOR ONTARIO PORK PRODUCERS

by Larry Martin, John Groenewegen and Karl Meilke

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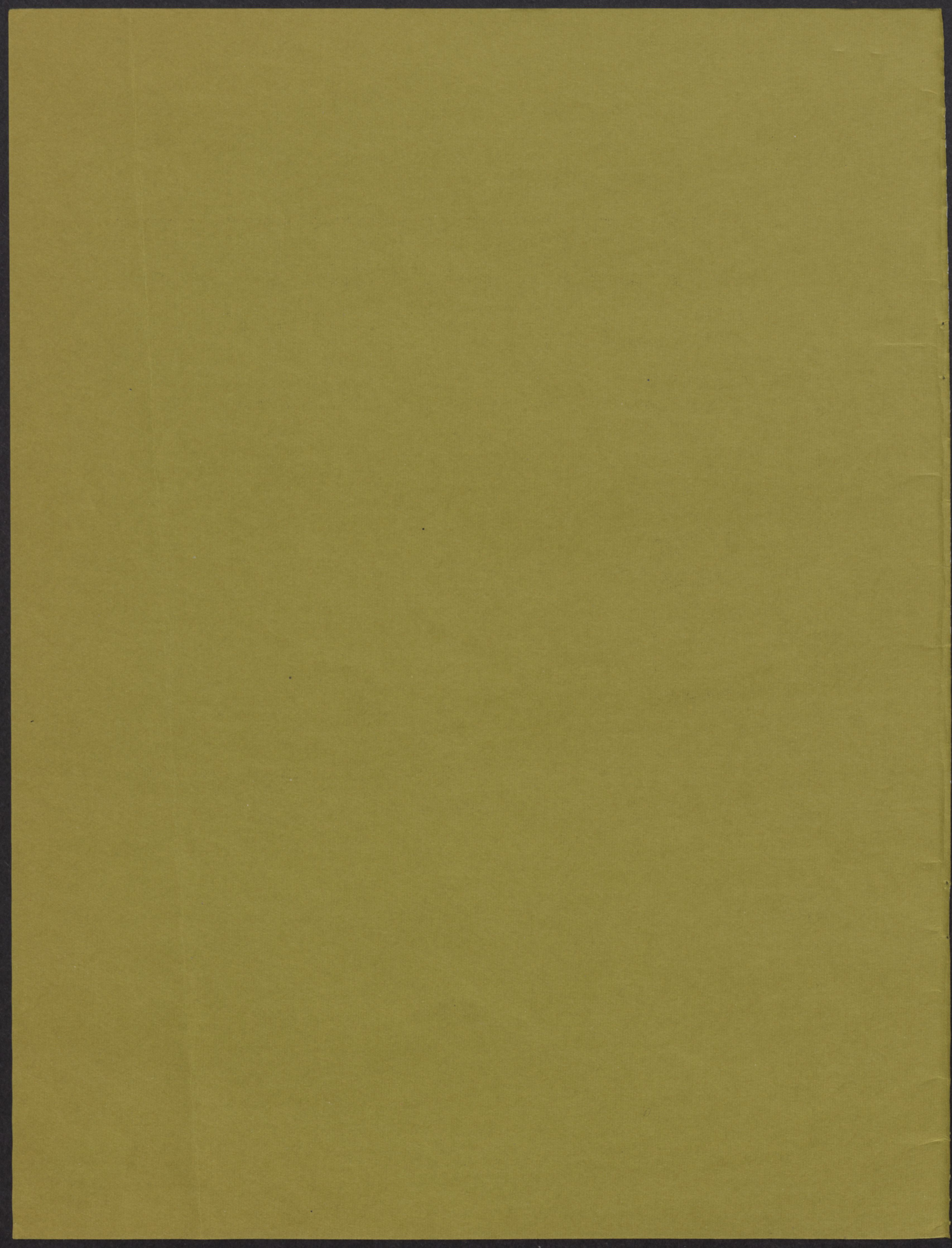
School of Agricultural Economics and Extension Education  
Ontario Agricultural College  
University of Guelph

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## FOREWORD

This report is the second in a series on potential use of commodity futures markets by Ontario farmers. The series of reports represents a long range program of research aimed at helping to improve marketing decisions made by farmers.

The authors appreciate and acknowledge the helpful comments of Professors T. F. Funk, J. H. Clark and E. L. Menzie of the School of Agricultural Economics and Extension Education on an earlier draft of this report. Also, the reviews of Mr. Dayre Peer and Mr. Jerry Bluhm of the Ontario Pork Producers Marketing Board were helpful in clarifying parts of the manuscript.

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Larry Martin  
John Groenewegen  
Karl Meilke  
January, 1976

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## ABSTRACT

Hog producers operate in a market characterized by considerable price risk, which arises from the cyclical nature of the market for pork. The live hog futures market presents a potential mechanism to reduce this price risk through hedging.

The mechanics of trading and hedging in live hog futures are explained and the relationship between futures and Ontario cash hog prices are analyzed. Based on weekly cash and futures prices from 1969 through early 1975, a number of alternative hedging strategies which could be selected by Ontario pork producers are analyzed. Most of these strategies may be regarded as selective hedging strategies in that they are based on decision rules whereby the producer would hedge under some conditions but not under others. The decision rules are based on the relationship between the cash price at Toronto and a futures price.

All the strategies are based on a situation under which a producer initiates a hedge when he places 50 lb. weanling pigs on feed. Each hedge is carried over a 12 week period which is assumed to be the time necessary to raise 50 lb. weanlings to market weight.

The analysis shows that, based on the period from 1969 through early 1975, all of the selective hedging strategies would have resulted in decreased price risk and average market prices which were higher than those which would have been received by selling at cash market prices. A strategy which called for hedging all hogs would have resulted in the greatest reduction in price risk, but would have resulted in lower average market prices than selling in the cash market.

The selective hedging strategies are adopted to consider the hog cycle. The analysis shows that during the periods of cyclical price declines faced by the industry in 1969 and 1973-74, hedging in the futures market would have presented relatively substantial opportunities to profit and reduce the risk of a price decline by hedging.

Several additional factors that must be considered by a producer in developing a hedging strategy are presented.

## COMMODITY FUTURES MARKETS - HEDGING OPPORTUNITIES

## FOR ONTARIO PORK PRODUCERS

Larry Martin

John Groenewegen

Karl Meilke\*

## 1.0

## INTRODUCTION

Pork producers in Ontario are presently facing considerable risk and uncertainty in their operations. Some risk has always been associated with the market for pork because of its cyclical nature; however, new sources of uncertainty have been added in recent years because of the increased volatility of feed grain prices, the general inflation of most input prices and the increasing need for borrowed capital.

While government appears to be attempting to add some degree of stability to the market for pork by devising stabilization programs, it is not yet clear if and to what extent such programs will be effective. As a result, some producers have begun to search for alternative marketing strategies which will aid them in reducing the effects of risk and uncertainty. One alternative which has evoked interest among some producers is the live hog futures contract which is traded at Chicago. Producers wish to know whether the Chicago futures market can be used successfully to hedge Ontario pork? If so, how can it be done? Are there any conditions which serve as signals as to when it can be used? How effective is it in reducing price risk and increasing returns for pork production?

The purpose of this paper is to provide information resulting from a study which has analyzed Ontario cash and Chicago futures prices over the period from 1969 through early 1975 with the general objective of providing answers to the above questions.

1.1 Objectives of the Study

The paper has the following specific objectives:

1. To explain the mechanics of hedging with the hog futures contract;
2. To analyze the relationship between Chicago futures and Ontario cash prices for hogs;
3. To isolate market factors which can be useful in developing hedging strategies for Ontario pork producers. In this context a strategy means a decision rule which allows the producer to make a decision to hedge with a relatively high probability that the hedge will have a favourable outcome;

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4. To analyze the outcomes of various hedging strategies that can be employed by Ontario producers in terms of their effects on returns per cwt. of hogs produced and in the variability of expected prices;
5. To point out a number of problems with using futures.

### 1.2 Organization of the Study

In order to accomplish these objectives, the remainder of the paper is organized as follows. In section 2.0, the mechanics of futures trading are briefly examined. This section deals with the question of how to trade. It discusses the buying and selling of futures contracts, the agencies through which trading is accomplished, the financial requirements of trading, aspects of the live hog futures contract and delineates the difference between hedging and speculating in futures.

In section 3.0, various aspects of the economic relationships between futures and cash prices are discussed in an effort to provide a background for developing hedging strategies for Ontario producers.

In section 4.0, the hedging strategies analyzed in this study are delineated and the outcomes of each strategy in terms of its effects on returns and price risk for hog production are presented.

In section 5.0, the hedging strategies are adjusted and further analyzed to incorporate information on the hog cycle.

In section 6.0, some additional aspects of hedging in hog futures which the Ontario producer must be aware of are discussed.

Finally, in section 7.0, the results of the study are summarized.

## 2.0 MECHANICS OF FUTURES TRADING<sup>1/</sup>

A necessary prerequisite for making use of a futures market is a fundamental understanding of the nature of such a market and a knowledge of how to go about trading in it. A brief description of the mechanics of futures trading follows. The discussion presented here<sup>2/</sup> is not complete, but attempts to examine only the most basic elements.

### 2.1 The Live Hog Futures Contract

The essence of futures trading is that buyers and sellers of futures contracts commit themselves to accepting or making delivery of a specified quality and quantity of a commodity at a specified location and at an agreed price in the future - i.e. futures trading is trading in future commitments, not in an actual commodity.

Trading in live hog futures began in 1966 at the Chicago Mercantile Exchange. The contract specification is for 30,000 pounds of U.S. number 1 or 2 live barrows and gilts weighing between 190 to 230 pounds, delivered at Chicago. Deliveries are also allowed under the contract for hogs of lower grade, and they can be delivered at Omaha, East St. Louis, Sioux City and St. Paul. The contract contains specific discounts for under grade deliveries and deliveries made at locations external to Chicago. Contracts are traded for delivery in February, April, June, July, August, October and December of a given year. Futures contracts can be traded for as long as fourteen months into the future - i.e. there is always trading in contracts for the next nearest future in any two years. For example, in late September and early October of 1975, futures were traded for both October 1975 and 1976 delivery. When trading in October 1975 futures were concluded (on about October 20), trading in December 1976 contracts was initiated.

### 2.2 Long and Short Positions

The positions of traders in futures contracts are described as long or short. When a trader buys a contract, his commitment is to accept future delivery of hogs. His position is described as being long futures. When a trader sells a contract, his commitment is to make future delivery of hogs. This position is described as being short futures.

These terms as applied to futures positions are analogous to similar positions in the actual commodity. If a farmer has 150 hogs on feed, he is long hogs. If a packer requires, but has not yet purchased, a certain quantity of hogs for his slaughter facility in the future, he is short that quantity of hogs.

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<sup>1/</sup> The reader who is fully conversant with the mechanics of futures trading can safely by-pass section 2.0.

<sup>2/</sup> For a much more thorough examination, see Hieronymous [2].



### 2.3 Offsetting Contracts and the Motives of Speculators and Hedgers

As noted above, the essence of futures trading is that traders commit themselves to making or taking delivery of a commodity at a future date. However, deliveries are seldom made or taken against contracts. The reason for this is inherent in the motives of futures traders and the mechanism of trading contracts.

In general terms, there are two classes of futures traders - speculators and hedgers. Speculators are people who risk their money in an effort to forecast price changes. They attempt to profit from their price forecasting ability. If a speculator buys a futures contract, he is in effect saying that he believes the current futures price is too low and he is attempting to profit from a price increase. If he sells a futures contract, he is saying that he feels the current futures price is too high and he is attempting to profit from a price decline. In either case he has no real interest in accepting or making delivery of the actual commodity. His motive for trading futures is solely to profit by a change in price.

The Exchange on which the contract is traded allows the speculator the opportunity to profit (or lose) on his forecasting ability by permitting him to offset his contract. In other words, if the speculator buys an April 1976 live hog contract, he can later resell it. The Exchange maintains a clearing house which keeps records of the positions of all traders. If a trader initially buys April futures and later sells an equal number of April contracts, the clearing house offsets the contracts so that the trader has no set commitment to either make or accept delivery. The speculator thus makes his profit (or takes his loss) on the change in price between his decisions to buy and then sell or sell and then buy futures contracts.

The hedger's motive for trading futures is different. His objective is to protect himself against a decline in the market price of hogs. For example, a farmer who places 50 pound weanlings on feed faces the risk that the market price for finished hogs will decline during the approximately three month growing period. On the assumption that if the market price of hogs declines, futures prices will also decline (an assumption that will be discussed in later sections) he can attempt to offset his price risk by selling futures. Then if both the market and futures price declines while the hogs are being fed, the farmer can gain at least a part of the loss in market price on the decline in futures prices.

Again, the hedger likely has no interest in actually delivering against the futures contract he has sold. In the case of an Ontario producer, actual delivery at Chicago could be nearly impossible at worst and expensive at best when the costs of shipping hogs to Chicago, and the tariffs and health inspection procedures at the Canadian-U.S. border are considered. However, because of his ability to offset his contract, the producer does not need to make delivery. He can sell the hogs for the current market price when they reach market weight and buy back his futures contract. Then if market and futures prices have declined while the hogs were being fed, he realizes his price protection by taking a profit on his futures transactions. Of course if both market and futures prices increase

during the feeding period, the producer will face a loss on his futures position which offsets the gain on his cash position. Either way, as long as both market and futures prices move together, hedging will allow the producer a chance to lock in a price.

The important point from the above discussion is that while futures contracts are binding commitments to make or accept delivery in the future, the trader can offset his initial commitment when he sells (buys) a contract by subsequently buying (selling) another contract for the same delivery month. Because of the opportunity to offset contracts, the trader does not face the problem of delivery, but rather takes his gains or losses from any change in futures price which takes place between his decisions to buy and sell or sell and buy.

#### 2.4 The Commodity Broker

All trading in live hog futures is done by open outcry on the floor of the Chicago Mercantile Exchange during specified business hours. Only Exchange members are permitted to engage in trading contracts. The Exchange limits the number of memberships. This means that non-member traders must conduct their transactions through a member of the Exchange.

A number of Canadian companies are members of the Chicago Mercantile Exchange with registered floor traders who conduct transactions for their customers.<sup>1/</sup> A non-member who wishes to trade must do so by contacting a futures commission agent and establishing an account. The commission agent has electronic equipment which can put him in contact with the floor trader almost instantaneously. Information on opening accounts, the types of orders which can be placed, and financial requirements, are available from any bona fide futures commission agent. However there are some basic financial considerations which are common to all commission houses. These are discussed below.

#### 2.5 Margin Requirements and Commissions

The basic financial requirements for trading live hog futures fall into two categories - margin deposits and commission fees. Margin deposits are required by the Exchange to ensure the financial integrity of the trader. The margin deposit is a fraction (usually from five to twenty percent) of the value of the contract. At the time of this writing, nearby live hog futures were trading at around \$60 per cwt. (live weight). Hence for one contract of 30,000 pounds the value of the contract was \$18,000. If the full value of the contract were required, the financial requirements for trading futures would be prohibitive for most people. Thus to facilitate trading the Exchange requires that only a fraction of the contract's

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Futures trading in the United States is closely regulated by the Commodity Futures Trading Commission. Companies who conduct transactions for customer accounts must meet minimum financial requirements as specified by law. The Commission enforces regulations which are aimed at safe guarding customer accounts and preventing manipulation of futures markets.

value be deposited.

The margin deposit normally consists of two parts - the initial requirement and the maintenance requirement. At present the total margin requirement per contract for a speculative trade is \$1,250. Of this, \$750 is initial and \$500 is maintenance. It should be clearly understood that the margin requirement is not a fee paid by the trader; rather it is a working capital fund from which the trader's losses are deducted or to which his profits are added. Perhaps the best way to understand how the margin operates is with an example. Let us say that a trader sells a futures contract at \$60 per cwt. and deposits his margin of \$1,250. Each \$1.00 change in the contract price results in a \$300 change in the value of the contract. Hence if the price increases to \$61.50, the seller has lost \$450 - i.e. since he sold the contract at \$60.00 (total value of \$18,000), if he bought it back at \$61.50, it would cost a total of \$18,450. If the seller chooses to buy back the contract at \$61.50, he would receive only \$800 from his original margin deposit. If he chose not to sell and the price continued to rise such that his loss exceeds \$500, he would be required to deposit an additional \$500 with the commission house. In this way the initial margin (\$750) is always maintained.

If, on the other hand, the trader had originally sold a contract at \$60 and the futures price declined to, say, \$55, his effective profit would be \$1,500. If the trader decides to buy back the contract at \$55, he would receive his original \$1,250 plus his profit of \$1,500.

It should be noted that some commission firms give a bona fide hedger a small break on margin. Essentially they require only the initial deposit (presently about \$750). This means that if the hedger sells a contract and the price increases, the hedger must replenish the margin immediately.

The commission fee is a payment made to the commission agent for conducting transactions. At present the commission fee for live hog futures is \$40 (or about \$.16 per hundred weight of pork) per round turn per contract. Round turn refers to the fact that most futures contracts are offset - i.e. \$40 is charged for first buying and then selling or selling and then buying a contract.

## 2.6 Hedging in Live Hog Futures

As indicated in section 2.3, the essence of hedging is to offset the risk of price change or to "lock in" a price. The technical definition of a hedge is to take a position in futures which is equal and opposite a cash position. As indicated above, this means that if a farmer has 150 hogs on feed which will be marketed in February, he is said to be long in the cash position. To hedge these hogs against a price decline, he would sell one February futures contract. In this event he has a futures position (short one futures contract) which is opposite his cash position (long 150 hogs).<sup>1/</sup>

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<sup>1/</sup> To be clear, there is no requirement that the producer must be fully hedged. A producer could have 350 hogs to be sold in February. If he sells only one contract, he is equal and opposite (has hedged) 150 hogs. On the other hand, if he has only 75 hogs and sells one contract, he has essentially hedged only 75 hogs and is speculating on the remainder of the contract.

In reality, there are at least three outcomes of a hedge. The best outcome occurs when cash and futures prices decline together. This can be illustrated with an example.

Assume that a producer places 150 weaners on feed in mid-November and plans to sell them in early February. In November the price of market hogs at Toronto is, for example, \$80.00 per cwt. and February futures are trading at \$60.00 per cwt. (which is equivalent to about \$78.00 on a carcass weight basis).<sup>1/</sup> If the producer wishes to hedge his hogs, he sells one February contract. Assume now that by February the market price at Toronto falls to \$72.00 per cwt. and the February future falls to \$53.85 (about \$70.00 on a carcass weight basis). The producer has, in effect, lost \$8.00 per cwt. because of the decline in market price, but gains \$8.00 (less the commission fee and interest on margin deposit) in the futures market by buying back the contract. By adding the gain on futures to the price received for his hogs, his net price for hogs is \$80.00 (again less the commission and interest on margin deposit). Hence he has "locked in" a price very close to the initial futures price. This transaction is summarized in tabular form below.

<u>Date</u>		<u>Futures Position</u>
November	Farmer places 150 hogs on feed	Sell February futures at \$60.00 (\$78.00)
February	Sells hogs at \$72.00	Buys February futures at \$53.85 (\$70.00)
	Net price for hogs	Profit on futures transaction \$8.00
	Market price \$72.00	
	+ Profit on	
	Futures 8.00	
	\$80.00	

The second potential outcome occurs when both the market and futures price rises during the growing period. By maintaining the same example, assume now that the market price increases to \$88.00 per cwt. and futures increase to \$66.15 (about \$86.00 on a carcass weight basis). In this case, the producer would have gained \$8.00 per cwt. because of the increase in market price but lost \$8.00 on his futures position if he buys a contract when the hogs are sold. Clearly, the hedge in this case would have been disadvantageous, but the producer would still have been able to "lock in" a price of \$80.00 (\$88.00 market price minus \$8.00 loss on futures).

The above examples are "perfect hedges" in the sense that market and futures prices changed by amounts which allowed the initial price to be locked in. For this to happen with regularity, market prices at Toronto and futures prices at Chicago must move in perfect harmony. In reality,

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<sup>1/</sup> Throughout this paper a factor of 1.30 is used to convert the U.S. price to a carcass equivalent - i.e. \$60.00 x 1.30 = \$78.00. It should also be noted that in the empirical analysis of hedging strategies, U.S. prices are expressed on a carcass weight basis and adjusted for fluctuations in exchange rates between Canada and the U.S.

they rarely do. Hence, the hedger cannot expect to lock in the exact initial price. The worst situation which can result occurs when the market price at Toronto declines while futures prices are increasing. For an example, we can take the worst outcome from the two situations presented above - i.e. the market price falls to \$72.00 and the futures price increases to \$66.15 (\$86.00 carcass weight basis). In this situation, the producer loses because of the decline in market price and loses \$8.00 on the futures transaction. As a result, his net price is \$64.00 (\$72.00 minus the \$8.00 loss on futures). When this happens, and it has on occasion in recent years, hedging is neither profitable nor useful in reducing the risk of a price decline.

The above examples lead to the conclusion that the pork producer has two objectives in considering hedging. The first is to use the futures market to increase his returns. The second is to reduce his price risk. In the next section we turn to a fundamental analysis of market and futures price relationships which help to provide a basis for prescribing hedging strategies for the Ontario pork producer which may aid him in using futures to attain both these objectives.



## 3.0

## ECONOMIC CHARACTERISTICS OF LIVESTOCK FUTURES

That hog production is a risky operation comes as no surprise to those engaged in it. Part of the riskiness is due to the hog cycle. Toronto prices and North American production of pork from 1966 through early 1975 are shown in Figure 3.1.<sup>1/</sup> It can be seen that there has been an inverse cyclical relationship between production and prices - i.e. as production increases, price decreases and vice versa.

At present, farmers make decisions regarding how much pork to produce based on their expectations about the future profitability of pork production. In other words, existing producers expand their operations and new producers enter pork production when they expect profitability to be high. Similarly, they reduce production when they expect profitability to be low. The fact that the hog cycle has persisted for well over a century in North America is an indication that producers, in the aggregate, do not do a particularly efficient job of forecasting or forming expectations. In fact, it would appear that production decisions are based on the assumption that current high or low profitability levels will persist into the future. This is evident from the fact that production always increases after a period of high prices and always declines after a period of low prices. If this were not so, i.e. if producers were better able to anticipate cyclical price movements, production and prices would have been stabilized.<sup>2/</sup>

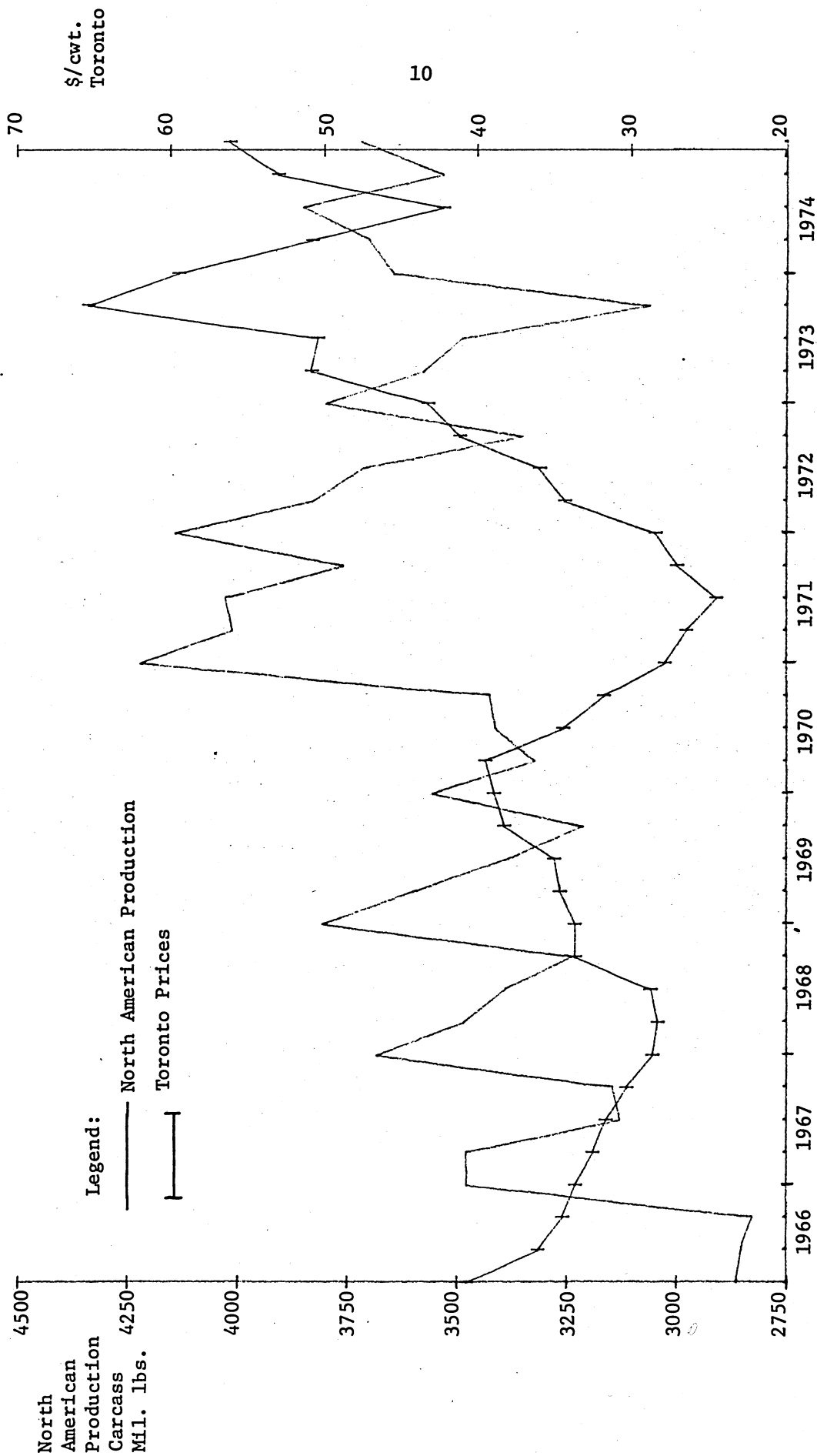
The persistence of the hog cycle has always been a source of risk and uncertainty for hog producers. Risk has increased in recent years because of the inflation of input prices, growing instability in the feed grain sector, increased capital intensity of pork production, and the resulting (from all three of the above factors) reliance on borrowed capital. These factors mean that the pork producer finds his operation increasingly vulnerable to the risk of a decline in the price of pork.

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<sup>1/</sup> Toronto prices are shown in relation to total North American production on the ground that the price in Ontario is related to the rest of the North American market. Research has shown that there is close correlation between the production cycle in Eastern Canada and the U.S. and Western Canada and that prices at spatially separated markets on the continent move in fairly close harmony because of the ability to trade between countries. (See [5] and [9]).

<sup>2/</sup> This explanation is, of course, oversimplified. There are other factors which contribute to fluctuations in production. One of these is variations in feed grain prices. Since profitability in pork production is related both to the price received for pork and the cost of producing it, and since feed is the major cost of producing pork - particularly in the short run - then events in the feed grain sector have substantial repercussions on hog prices. A second factor is the behaviour of lending institutions which appear to be more eager to loan money for expanding hog facilities when pork prices are high than when they are low. To the extent that this is true, the availability of capital increases the production cycle.

FIGURE 3.1: North American Pork Production and Toronto  
Prices 1966-1974, Quarterly



Given the above, producers increasingly need protection against price risk and need to find a better way to determine future price expectations when making production decisions. Hopefully the futures market can fulfil some of this need. But there are a number of things the producer should know about futures before he enters the futures market. One of these is the basic mechanics of trading, which was discussed in section 2.0. The second is that he must know how futures prices are related to his local (Ontario) market. Third, he should know about the relationship between the various futures prices. Finally, he should know about the relationship between futures prices and the hog cycle. These are the factors which are important in forming a hedging strategy. They are discussed below.

### 3.1 Futures Prices in the Live Hog Market and the Concept of Basis

Until the introduction of live cattle futures in 1964 and live hog futures in 1966, many students of futures markets felt that one necessary prerequisite for a successful futures contract was that the commodity should be storable. In fact, one early analysis of the livestock contracts (Skadberg and Futrell [8]) predicted their early demise on the ground that live hogs and live cattle are not storable. The fact that these futures have persisted for ten years, and indeed have grown in trading volume, has caused a retrenching among analysts regarding the prerequisites for a successful futures contract, and regarding the nature of futures prices. One knowledgeable analyst (Hieronymous [3]) has suggested that only one question need be asked to determine whether a futures contract, or some form of forward pricing, is necessary. That question is: Is there a need for a risk-shifting system? If the answer is yes, then some kind of forward contracting system will evolve.

The fact that the volume of trading in livestock futures has constantly increased over recent years indicates that, to date, no better forward contracting system has gained widespread use. But the growth of livestock futures has created a new concept of futures price relationships. With storable commodities, e.g. grains, it has generally been accepted that futures prices during the post-harvest storage period differ by approximately the cost of storage. That is, the price of March corn futures normally exceeds the price of December futures by the cost of storage from December to March. In the case of livestock futures, since livestock are neither produced at one period of the year nor storable, no such relationship holds. As a result, livestock futures are regarded as pure forecasts of actual market prices in the future.<sup>1/</sup> That is, the level of futures prices for a given delivery month at any point in time may be regarded as futures traders' best estimate of what the market price will be in that month. Thus, for example, the price of August 1976 live hog futures may be less than December 1975 futures if speculators anticipate that more hogs will be marketed in August than in December. Clearly, these forecasts are often wrong because of uncertainty about future supply and

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<sup>1/</sup> The question of how well livestock futures forecast will be dealt with in a later section.

demand. However, as time passes and August approaches, more is known about conditions in August. The August futures price becomes a better forecast until, in August, the futures price is very nearly the same as the actual market price at the contract's delivery point - i.e. Chicago.

The important factor from the above discussion is that a futures price for a given delivery month can be viewed as the market's expectation of actual cash prices in the delivery month. Because a producer can hedge on futures, he can use the futures price as an expectation on which to base production decisions. Theoretically, as was shown at the end of section 2.0, he can lock in the futures price for his hogs by hedging.

However, as was also shown in section 2.0, hedging in Ontario may not allow a price to be locked in with certainty because of price variations between Chicago and Ontario. Thus the Ontario producer needs to know, if possible, what the relationship between the cash price in Ontario and the futures price at Chicago will be at the end of his hedge - i.e. when he sells his hogs - in order to form an expectation about the price he will receive with a hedge. The difference between cash and futures price is called basis - i.e. basis is simply the difference between Chicago futures prices and a local market cash price at some point in time. To the extent that basis is predictable, then the hedger is able to predict the price he will actually receive for his hogs if he hedges.

Theoretically the basis at the end of a hedge should be related to transportation costs. For example, if a producer is hedging hogs to be marketed in February, since (as discussed above) the February futures price should be approximately equal to the cash price in Chicago at the beginning of February, then the difference between the futures price and the cash price at Toronto should be equal to the cost (including tariff charges) of shipping hogs between the two markets.

In practice, this relationship holds on average, but is complicated by a number of factors on specific dates. The most important of these is the fact that Canada is sometimes a net exporter of hogs to the U.S., sometimes a net importer and sometimes there is no trade. When Canada is a net exporter, Canadian prices (expressed in Canadian dollars to adjust for fluctuations in exchange rates and expressed in carcass weight) should be less than the U.S. price by transport and tariff costs (about \$4.00 - \$5.00 per cwt.). When Canada is a net importer, Canadian prices should be greater than the U.S. price by transport and tariff costs. But when Canada is neither importing nor exporting large amounts, the Canadian price can fluctuate anywhere between the export floor and import ceiling as set by the U.S. market and transport and tariff costs. This represents a potential range of variation of as much as \$10 per cwt. around the U.S. price.

The importance of basis and basis fluctuation for allowing a producer to lock in a price by hedging is substantial. The more variation there is in basis, the less assurance there is that a given price can be locked in. Perhaps a few examples will help to illustrate the point. The examples are presented in detail in Table 3.1.

#### Example 1. Predictable Basis

Let us begin with an example of how it should work. Assume that the

TABLE 3.1: Three Examples of the Effects of Basis  
Variation on the Certainty of a Hedge

Date	Cash Position	Futures Position	Expected Price	Ending Basis	Net Price Received
<u>Example 1. Predictable Basis</u>					
Sept. 15	Farmer places 150 hogs on feed	Farmer sells one December contract @ \$75.00	\$75.00 + 2.00 av. basis \$77.00		
Dec. 1	Farmer sells hogs @ \$70.00	Farmer buys one December contract @ \$68.00		\$2.00	\$70.00 for hogs + 7.00 profit on futures \$77.00
<u>Example 2. Declining Basis</u>					
Sept. 15	Farmer places 150 hogs on feed	Farmer sells one December contract @ \$75.00	\$75.00 + 2.00 av. basis \$77.00		
Dec. 1	Farmer sells hogs @ \$70.00	Farmer buys one December contract @ \$73.00		\$-3.00	\$70.00 for hogs + 2.00 profit on futures \$72.00
<u>Example 3. Increasing Basis</u>					
Sept. 15	Farmer places 150 hogs on feed	Farmer sells one December contract @ \$75.00	\$75.00 + 2.00 av. basis \$77.00		
Dec. 1	Farmer sells hogs @ \$70.00	Farmer buys one December contract @ \$65.00		\$5.00	\$70.00 for hogs +10.00 profit on futures \$80.00



normal or expected basis between December futures and the Toronto cash price at the beginning of December is \$2.00 - i.e. the Toronto price is normally \$2.00 above the December futures price on Dec. 1. A producer sells a December contract in mid-September against weanlings he has just placed on feed and plans to market on December 1. The futures price (in carcass equivalents) in September is \$75.00 per cwt. By using the futures price and the expected basis, this means that the farmer should expect to receive \$77.00 per cwt. for his hogs on December 1 by hedging.

Now assume that on December 1, the farmer sells his hogs and completes his hedge by buying back the futures contract. Further assume that the market price at Toronto is \$70.00 and the price of futures has declined to \$68.00. The farmer has effectively locked in the expected price of \$77.00 - i.e. he received \$70.00 for the hogs and realized a profit of \$7.00 on the futures contract. Note also that the basis was the expected \$2.00 - i.e. the Toronto price exceeded the futures price by exactly \$2.00 when the hedge was completed. Hence, he was able to lock in his expected price because the expected basis was realized.

#### Example 2. A Declining Basis

In this example everything is as in example 1 except that now we assume that the futures price falls to only \$73.00 on December 1. In this case, by completing the hedge as planned on December 1, the producer is able to attain a net price of only \$72.00 instead of the expected \$77.00 - i.e. he receives \$70.00 for his hogs and gains \$2.00 on the futures contract. Note now that the basis has declined in this situation such that it is -\$3.00, i.e. Toronto is \$3.00 under the future instead of being \$2.00 above as expected.

The worst extreme of this situation was pointed out in the last example of section 2.0. In that case the cash price at Toronto was falling during the feeding period while the futures price was increasing. Under these circumstances the hedged producer has not reduced his price risk but rather increased it because he is effectively losing in both the cash and futures market. It should be noted that this extreme can and has occurred if a hedge is initiated when the Toronto price exceeds those in the U.S.

#### Example 3. An Increasing Basis

The third example is more pleasant. Again all factors are the same as in example 1 except that now the futures price on December 1 has fallen to \$65.00 instead of \$68.00. In this case, the producer would receive a net price for his hogs of \$80.00 - i.e. \$70.00 for the hogs and a gain of \$10.00 on the futures contract. Note again that the final basis was \$5.00 instead of the expected \$2.00 - i.e. on December 1 the Toronto price exceeded the futures price by \$5.00. In this case, the hedger is better off than he expected because he was able to gain on the basis.

There are two important points from the above discussion. First, knowledge of basis is fundamental to being able to form an expected price by hedging. Second, even if the hedger has this knowledge, the fact that basis can and does fluctuate in Ontario means that hedging is an imperfect way to provide price risk insurance.

In developing and analyzing hedging strategies for this study, we

have followed the simple expedient of using average basis for the period from 1969 through 1973, to calculate expected basis and expected prices received with a hedge.<sup>1/</sup> A simple average probably means little because of the many factors which can affect basis. However, until further analysis of basis can be undertaken, averages are the best information available. The resulting expected basis for each of the seven delivery months are presented in Table 3.2. Note that when basis is positive, (e.g. \$1.69) it means that, on average from 1969-73, the Toronto cash price at the beginning of the month was greater than the futures price. When it is negative (e.g. \$-1.24) it means that on average the Toronto cash price was lower than the futures price.

TABLE 3.2: Average Basis for Each Live Hog  
Contract at Toronto 1969-1973

Contract Month	Basis
February	\$0.66
April	0.70
June	-1.24
July	-1.08
August	0.73
October	3.45
December	1.69

### 3.2 Hedging and the Hog Cycle

As was noted earlier, much of the risk and uncertainty in hog production arises from the cyclical nature of the market for hogs. Furthermore, it was noted that since futures prices are forecasts, they can be viewed as an alternative to cash price trends in forming price expectations upon which producers can base production decisions. The immediate question arises as to how well livestock futures forecast and, therefore, how well they provide insurance against price risk. The answer is not yet entirely clear - partly because they are still relatively new and partly because they were not heavily traded in early years.<sup>2/</sup> However, a recent study of the beef futures market (Leuthold [4]) found that beef futures appear to be worse predictors of future cash prices than are present prices. In

<sup>1/</sup> Data before 1969 were not used in calculating the average basis because hog futures were very thinly traded and the resulting futures prices were not felt to be representative.

<sup>2/</sup> It is generally presumed that as trading volume increases in a futures market, the forecasting ability is enhanced. This argument has at base the assumption that a large volume of speculative trade will bring with it well informed opinions which, on average, will provide relatively efficient forecasts.

other words, the cash price of beef in November is a better forecast of the cash price in April than is the April futures price in November. Furthermore, in an analysis of hedging strategies for Arizona cattle feedlot operators, Menzie, et. al. [6], concluded that beef futures tended to be over priced during the downward part of the beef cycle and under priced during the upward part. As a result, while beef futures provided considerable protection against price risk, the Menzie study concluded that producer returns from hedging were only enhanced as prices move downward.

Data on hog futures tend to support this conclusion. This fact will be very important for our analysis of hedging strategies and will be addressed in section 5.0.

### 3.3 The Foundation of Hedging Strategies Analyzed

The discussion to this point has highlighted the fact that producers have two objectives in hedging. The first is to obtain protection against a price decline. The second is to enhance their returns. In obtaining these objectives, we have noted that it is important to understand the concept of basis, how variation in basis can affect the outcome of a hedge, and to understand the relationship between futures prices and the hog cycle.

As was noted in section 3.1, the worst possible outcome of a hedge can arise when the Toronto cash is higher than the futures price when a hedge is initiated - i.e. when hogs are placed on feed. In this circumstance the risk of an adverse basis change is greatest. Because of this relationship, the beginning basis at the initiation of a hedge - i.e. the difference in Toronto cash and Chicago futures price twelve weeks before hogs are marketed - is used to develop the hedging strategies analyzed in this study.

The validity of selecting beginning basis as a signal to trigger hedges should be clear from the two charts in Figure 3.2 which were developed from data over the period from 1969 through 1974. The top chart in Figure 3.2 shows the relative outcomes of hedging versus not hedging over subsequent 12 week periods. That is, a hedge was initiated each week during 1969 through 1974 and the hedge was maintained for twelve weeks. After twelve weeks, hogs were "sold" at the existing Toronto price and the futures contract was simultaneously bought back at the existing futures price. If the price received by hedging was greater than the existing market price when the hogs were sold, the additional gain by hedging is shown below the "zero" line. If the price received by not hedging - i.e. by selling hogs in the cash market - was greater than the price received with a hedge, the additional gain provided by the cash market is shown above the zero line. Perhaps this will be clearer with two examples. During the second week in January, 1969 a hedge was initiated by selling an April futures contract. The contract was held for twelve weeks. Then hogs were sold and the futures contract purchased back. It can be seen that for this hedge the net price received on the cash market exceeded the price received by hedging by approximately \$4.50 per cwt. On the other hand, for the hedge initiated during the second week in January 1970, the hedger would have received approximately \$2.00 per cwt. more by hedging than by simply selling on the cash market.

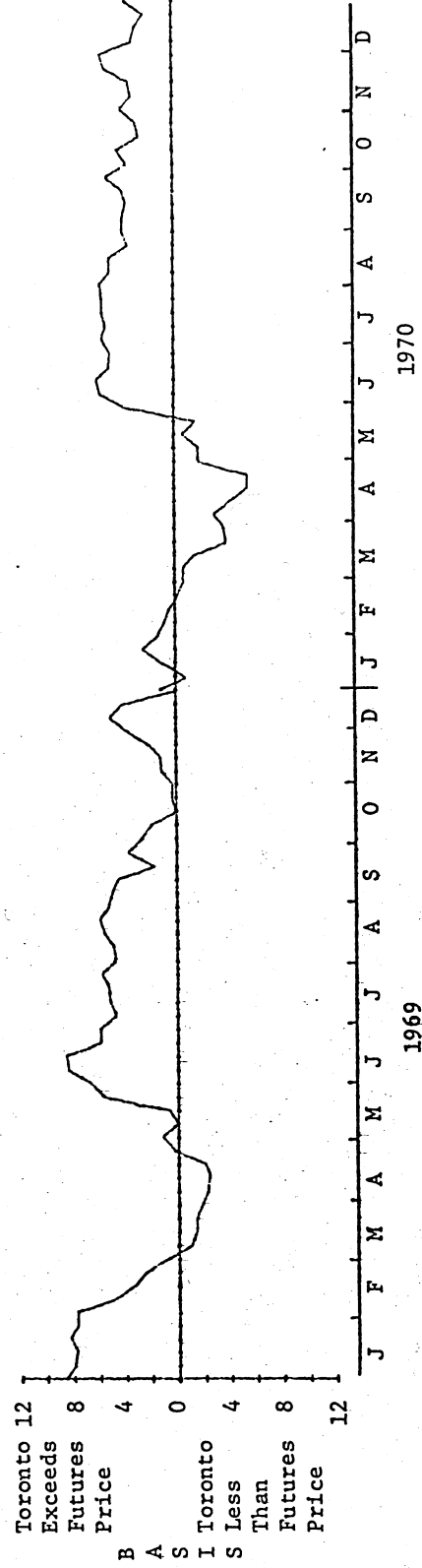
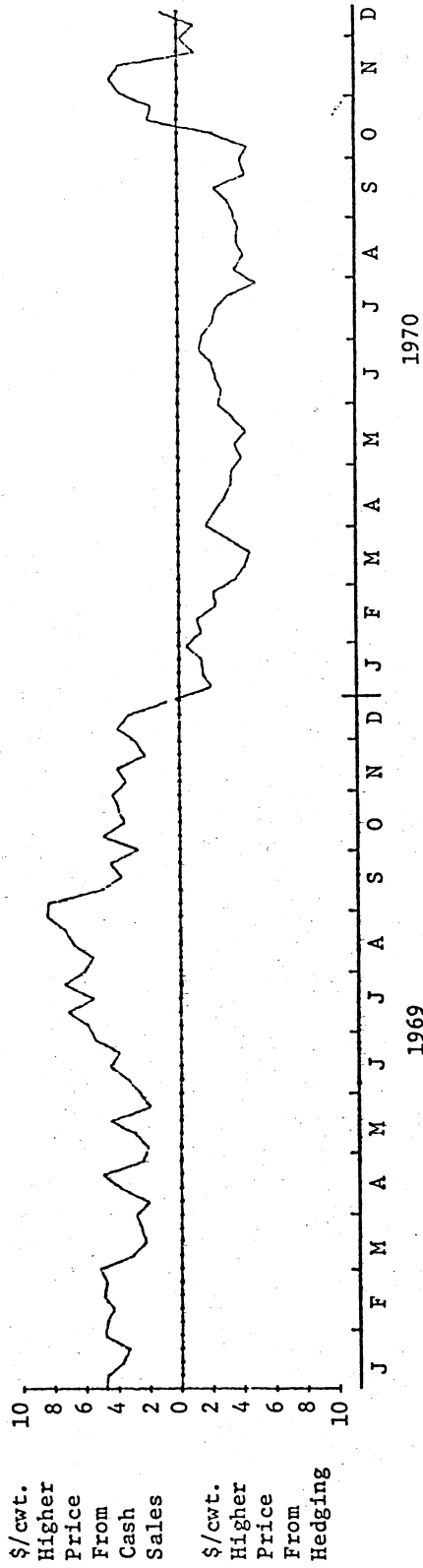
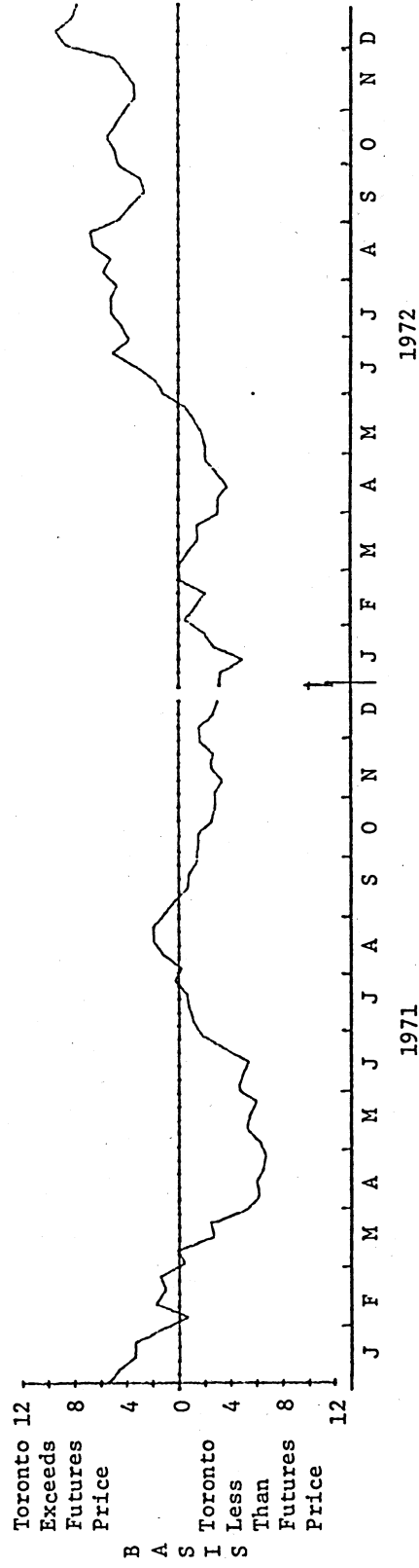
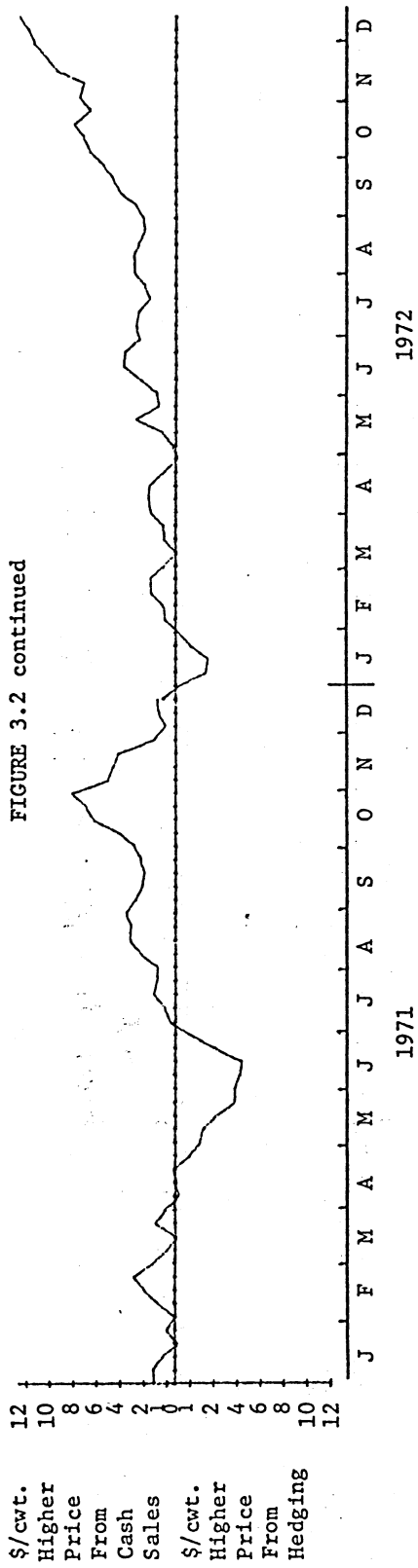


FIGURE 3.2: Relative Outcome of Hedged Versus Unhedged Positions  
and Toronto Basis, 312 Weeks 1969-1974

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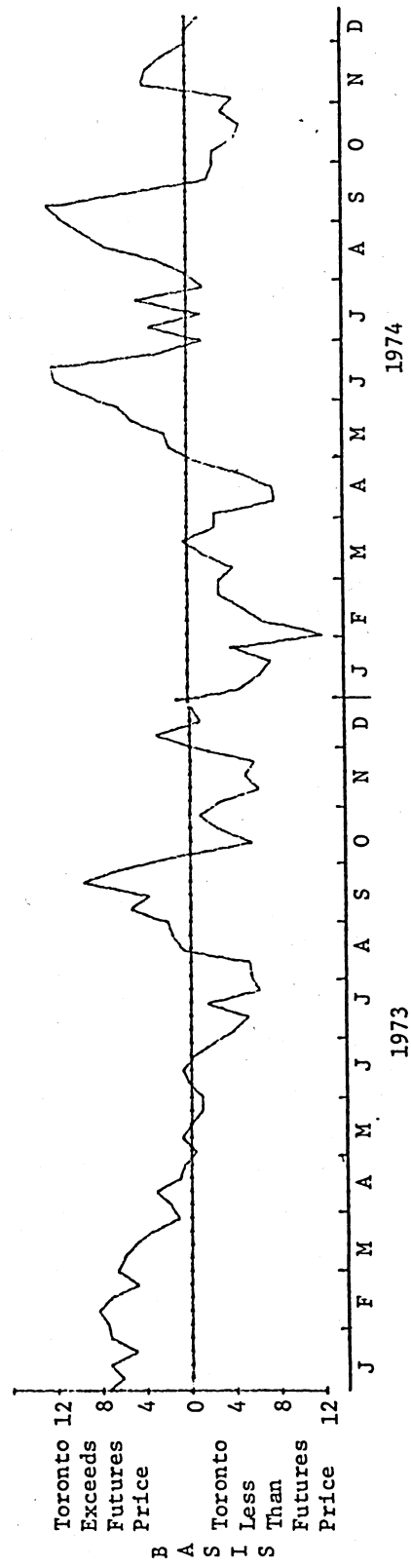
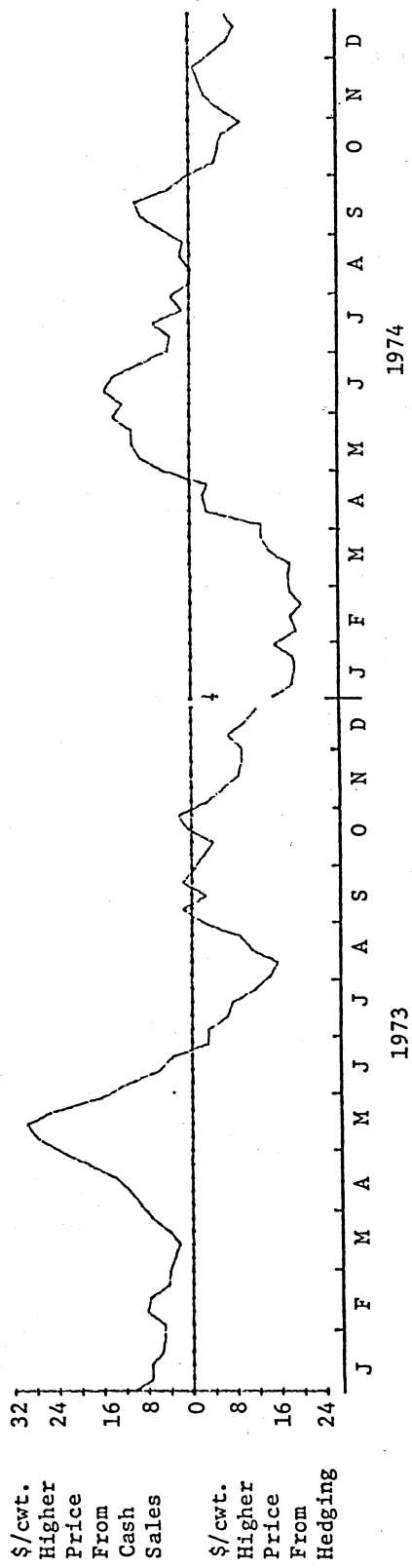
FIGURE 3.2 continued



cont'd.



FIGURE 3.2 continued



The second graph shows the Toronto-Chicago basis at the beginning of each hedging period. In this graph, when the futures price exceeds the Toronto cash price, the basis is below the zero line. When Toronto exceeds Chicago futures, the basis is above the zero line. Thus during the first week of 1971 the Toronto price exceeded the futures price by \$5.25 per cwt. During the first week of 1972, the futures price exceeded the Toronto price by \$3.25 per cwt.

Inspection of these charts shows that there is a distinct relationship between the basis at the beginning of a hedge and the outcome of the hedge. When the Toronto cash price exceeds the futures price, in most cases the hedge returns a lower price than do cash sales. When the futures price exceeds Toronto, hedges often return a higher price than do cash sales.

Because of this relationship between basis and the outcome of hedging, the Toronto-Chicago basis is used as the foundation for alternative hedging strategies analyzed below.

## 4.0

## ANALYSIS OF HEDGING STRATEGIES

Hedging strategies derived from beginning Toronto-Chicago basis are developed and analyzed in this section. In all, twelve strategies were analyzed over the 312 week period beginning the first week in 1969 and ending the last week in 1974.<sup>1/</sup> The strategies were analyzed in terms of a producer placing weanling pigs on feed. Pigs were "placed" each week over the 312 weeks, and held for 12 weeks, at which time they were sold on the open market. At the time the pigs were placed each strategy was used to decide whether to hedge. If a decision to hedge was indicated by the strategy, a futures contract for the delivery month immediately succeeding the time the hogs were to be marketed was sold the same day pigs were placed on feed. The gain or loss on futures was then added to or subtracted from the market price to determine returns to hedging.

It should be pointed out that the approach used in this analysis is not a particularly good reflection of actual farm situations. Very few producers consistently place hogs on feed each week. Farrowing patterns are seasonal, as are the times when weanling hogs are placed on feed. The consistent weekly approach was adopted in this analysis in order to make maximum use of the limited amount of futures price data which are available.

4.1 The Hedging Strategies

Since the objectives of hedging are to reduce price fluctuations and to increase returns, each strategy requires a decision rule which signals when a hedge should be initiated. The decision rule must also provide a price expectation in order to analyze the risk reducing affects of each strategy. The strategies are explained below.

Strategy I - Pure Cash

The hedging strategies require a base against which to compare their outcomes. The obvious base to use is a pure cash market strategy - i.e. simply selling hogs in the cash market. In the pure cash strategy, the cash price at the beginning of each twelve week feeding period was used as the price the producer expected to receive for his finished hogs. For example, if in a particular week the Toronto cash price is \$58.00 per cwt., then \$58.00 is the price the producer expects to receive for hogs placed on feed that week. This is done on the ground that, as was pointed out in section 3.0, this appears to be the way most producers form price expectations.

Strategy II - Full Hedge

Strategy II is the opposite of strategy I. In this case hogs were hedged in each of the 312 weeks. The producer's expected price with this strategy is based on the futures price at the beginning of the feeding period plus or minus the average Toronto-Chicago basis (as shown in Table 2.1). Examples of expected prices which would result from hedges with the

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<sup>1/</sup> The last week in 1974 is the last week that hogs were placed on feed. Hence the data actually cover the period through April 1975.

TABLE 4.1: Examples of Estimating Expected Prices When Hedging

	Futures Contract Sold	Futures Price	Average Basis	Expected Price
1.	February	\$60.00	\$0.66	\$60.66
2.	April	60.00	0.70	60.70
3.	June	60.00	-1.24	58.76
4.	July	60.00	-1.08	58.92
5.	August	60.00	.73	60.73
6.	October	60.00	3.45	63.45
7.	December	60.00	1.69	61.69

alternative futures contracts are shown in Table 4.1.

In the first example, a hedge is initiated in mid-November by selling February futures. If the price of February futures is \$60.00 then the expected price is the futures price plus the expected basis (\$0.66) or \$60.66. In this example, the expected price is higher than the futures price because, on average Toronto is above Chicago in February.

In example 3, a hedge is initiated in mid-April by selling June futures. Again assuming that the June futures price is \$60.00, the expected price for this hedge is \$58.76 (\$60.00 minus the average basis of \$1.08). Expected price is lower than the futures price for this hedge because Toronto is, on average lower than Chicago in June.

The remaining examples in Table 4.1 show how expected price is calculated for hedges using all seven live hog futures contracts.

#### Strategy III - Hedge Determined by Initial Basis

Strategy III is a selective strategy which incorporates a decision rule triggered by the Toronto-Chicago basis at the initiation of the hedge. For this strategy, a hedge is initiated only when the Toronto cash price is less than \$.50 (price expressed in carcass weight and in Canadian dollars) above the futures price at the beginning of each twelve week feeding period. This means that any time the Toronto price is less than the relevant futures price or less than \$.50 above the futures price at the beginning of the feeding period, a hedge is initiated. If the Toronto price exceeds the futures price by more than \$.50, the producer doesn't hedge and simply sells in the cash market. Expected price in this strategy is calculated by using the futures price plus or minus the average basis when a hedge is indicated by the strategy. When a hedge is not indicated, expected price is the cash price at the beginning of the feeding period.

In order to make this strategy more clear, three examples are shown in Table 4.2. The examples all relate to situations which could occur in mid-April when the June futures contract is the appropriate one for hedging.

In the first example, the cash price at Toronto is \$58.00 and the June futures price is \$60.00 when weanlings are placed on feed. This means

TABLE 4.2: Examples of How Hedges are Triggered and Expected Prices Calculated in Strategy III

	Toronto Cash Price	June Futures Price	Basis	Decision	Expected Price
1.	\$58.00	\$60.00	\$-2.00	Hedge	\$58.76
2.	57.00	56.50	.50	Hedge	55.26
3.	52.00	50.50	1.50	Don't Hedge	52.00

that the current basis is \$-2.00. With strategy III, this basis would signal a hedge since Toronto is under the futures price. Expected price is the futures price minus the average June basis of \$-1.24 or \$58.76.

In the second example, Toronto is at \$57.00 and the futures price is \$56.50 when weanlings are placed on feed. Therefore, basis is \$+.50. Again, strategy III would signal a hedge and the expected price is \$55.26 (\$56.50 minus the average June basis of \$1.24).

In the third example, Toronto is at \$52.00 and the futures price is \$50.50. Now basis is \$1.50. With strategy III, there would be no hedge since Toronto exceeds the futures price by more than \$.50. Expected price in this situation is the initial cash price of \$52.00. The initial cash price is used as the expected price since the producer, by using strategy III, expects to receive a higher price for his hogs by selling in the cash market than in the futures market and the best indication he has is the existing futures price.

#### Strategies IV to XII - Hedges Determined by Initial Basis

The remaining strategies are modifications of strategy III. The only difference is that the hedging decision in each case was determined by a varying value of the beginning basis. In each successive strategy the decision to hedge was triggered by a \$.50 reduction in the initial basis. As in strategy III, expected price in IV through XII is the sum of the futures price and the average basis when a hedge is indicated and is the cash price when no hedge is indicated. Returning to Table 4.2, this means that with strategies IV through XII, example 2 would not result in a hedge since the basis is higher than the level necessary to trigger a hedge. In each strategy the expected price for example 2 is the initial cash price of \$57.00. Similarly, with strategies IX through XII, example 1 would not result in a hedge since the initial basis of \$-2.00 is greater than the trigger level. In these strategies, expected price for example 1 would be the initial cash price of \$58.00.

The trigger levels necessary to initiate a hedge for each strategy are presented in Table 4.3.

#### 4.2 Analysis of Results

Given the objectives of hedging, analysis of the results of hedging strategies must focus on two questions. How do the various strategies



TABLE 4.3: Basis Trigger Levels for Strategies IV Through XII

Strategy	Initial Basis (Toronto Cash Minus Chicago Future at the Beginning of Twelve Week Feeding Period <sup>1/</sup> )
Strategy IV	\$ .00
Strategy V	-.50
Strategy VI	-1.00
Strategy VII	-1.50
Strategy VIII	-2.00
Strategy IX	-2.50
Strategy X	-3.00
Strategy XI	-3.50
Strategy XII	-4.00

<sup>1/</sup> To be clear, these mean (as for example in strategy VI) that a hedge is initiated if the Toronto cash price is less than the futures price by \$1.00 or more at the beginning of the feeding period.

affect average returns? How much variation occurs in expected price?

Our approach to analyzing these questions can be best explained by use of the graph in Figure 4.1 which shows the potential outcomes of hedging as compared to selling in the cash market. Assume that point A in Figure 4.1 represents the outcome by selling in the cash market over our 312 week period. At A the producer will receive an average price of R, and the variation around expected prices will be V. If a hedging strategy results in an outcome with average returns and variation in expected prices which falls in quadrant 1, the strategy will be clearly superior because it results in higher average returns and less price risk (i.e. less variation in expected prices).

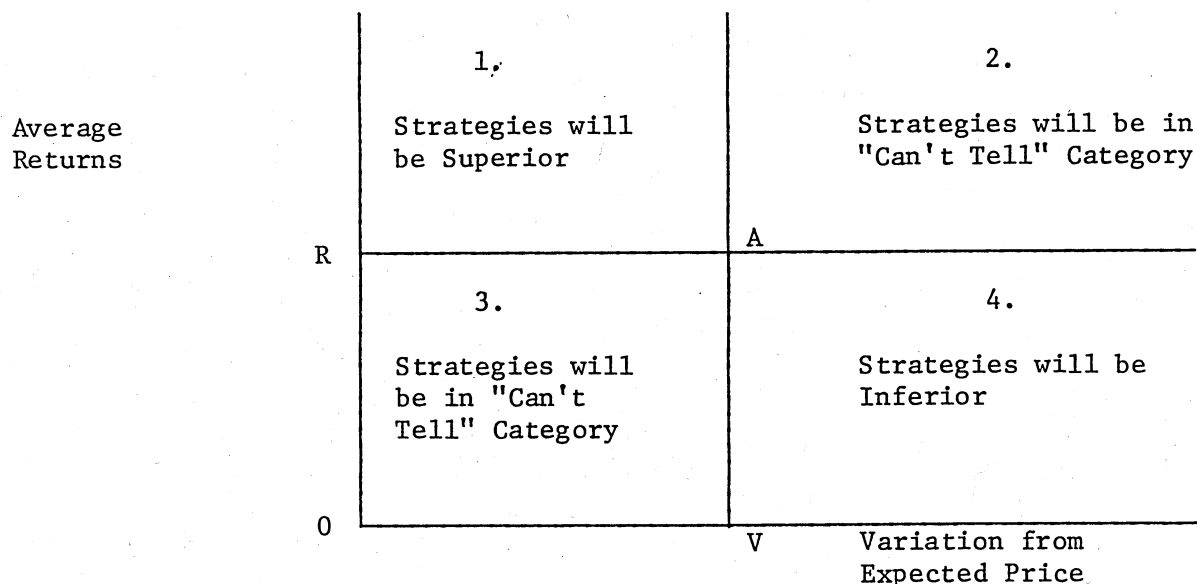
If a strategy falls in either of quadrants 2 or 3, it is not possible to tell whether it is superior or inferior since this judgement depends on the individual producer's response to risk and returns. In quadrant 2, average returns are greater, but so is the price risk. In quadrant 3, price risk is lower, but so is the average return.

If the strategy falls in quadrant 4, the strategy is clearly inferior since this means that average returns are lower and price risk is higher.

The results of the analysis of the twelve hedging strategies are presented in Figure 4.2 in graphical form. In this analysis the variation from expected price is expressed as the standard deviation of the difference between the actual price received and the expected price.

The results can be summarized as follows. Strategy I, the pure cash market strategy, resulted in an average return of \$40.06 per cwt. over this period with a variation from expected price of \$4.22 (point C in Figure 4.2).

FIGURE 4.1: A Framework for Comparing Hedging Strategies to an Unhedged Position



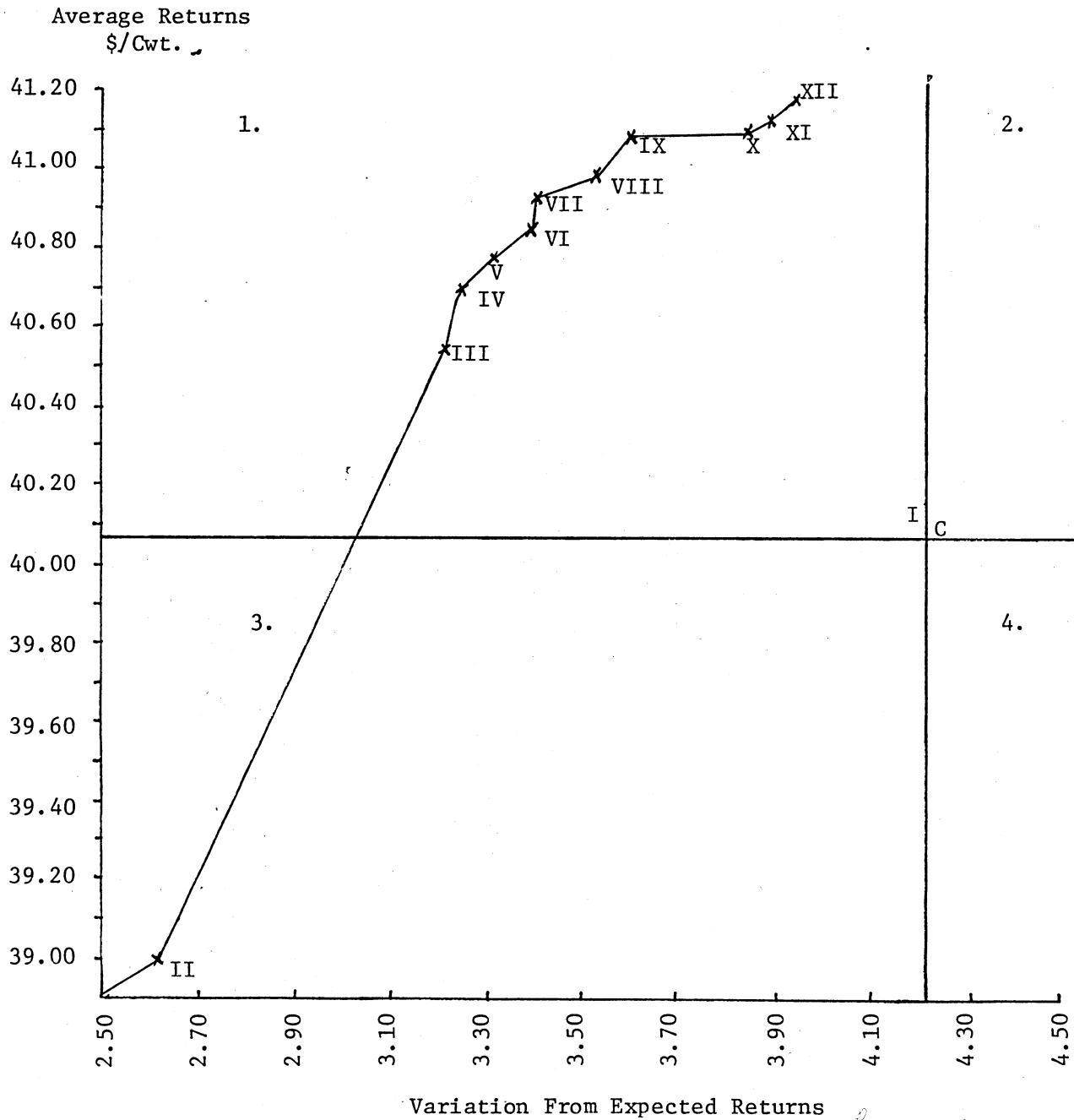
In other words, if a producer had placed hogs on feed every week from the beginning of 1969 through the end of 1974 and sold them twelve weeks later, the average price he would have received over the 312 weeks was \$40.06. The standard deviation of the difference between the cash price at the beginning and the end of the successive twelve week periods was \$4.22.

Strategy II, the pure hedging strategy, resulted in lower average returns (\$38.99 per cwt.) but substantially reduced price risk since the standard deviation from expected price was only \$2.62. This means that the pure hedging strategy falls in the "can't tell" category (quadrant 3). The acceptability of this strategy depends upon the producer's reaction to risk and returns.

All of the selective strategies fall in quadrant 1 and are clearly superior to the pure cash strategy. They all result in higher returns and lower price risk than the pure cash strategy. It is also clear that as the strategies are adjusted to trigger hedges when basis becomes more negative, the average returns are increased, as is the deviation in expected price. For example, strategy IV (hedge when the Toronto price is less than or equal to the futures price) resulted in an average return of \$40.54 per cwt. and a standard deviation from expected price of \$3.24. Strategy XII (hedge when Toronto is \$4.00 or more below the futures price) resulted in an average return of \$41.14 per cwt. and a standard deviation from expected price of \$3.92. Hence, those strategies triggered by a relatively large basis resulted in the largest increase in average returns, but they had more price risk associated with them. This would be expected since the wider basis strategies imply that a higher relative price is to be aimed at if a hedge is initiated.

Another important question about the various strategies is the

FIGURE 4.2: Average Returns and Price Variation of Selective Hedging Strategies, 312 Weeks



number of times they resulted in hedges over the 312 week period and the proportion of hedged positions which returned a profit. These are presented in Table 4.4 along with the average return and deviation from expected prices.

TABLE 4.4: Outcomes of Hedging Strategies, 1969-1974

Strategy		Number of Hedges	Number of Profitable Hedges	Percentage of Hedges With Profit	Average Return	Deviation From Expected Price
Strategy I	(No Hedge)	-	-	-	\$40.06	\$4.22
Strategy II	(Full Hedge)	312	117	37%	38.99	2.62
Strategy III	(\$+ .50 basis)	173	86	49	40.54	3.22
Strategy IV	(\$ .00 basis)	160	82	51	40.65	3.24
Strategy V	(\$- .50 basis)	153	80	52	40.70	3.26
Strategy VI	(\$-1.00 basis)	140	78	56	40.84	3.40
Strategy VII	(\$-1.50 basis)	128	76	59	40.92	3.41
Strategy VIII	(\$-2.00 basis)	109	66	60	40.98	3.54
Strategy IX	(\$-2.50 basis)	97	66	68	41.08	3.61
Strategy X	(\$-3.00 basis)	77	55	71	41.08	3.85
Strategy XI	(\$-3.50 basis)	65	51	77	41.11	3.89
Strategy XII	(\$-4.00 basis)	55	48	87	41.14	3.92

The data in Table 4.4 show that those strategies in which hedges are triggered by a relatively wide negative basis resulted in the fewest hedges. For example, with strategy III hedges would have been initiated in 173 of the 312 weeks. With strategy XII hedges would have been initiated in only 55 weeks. At the same time the probability of initiating profitable hedges increases markedly as the level of basis necessary to trigger a hedge is widened. With strategy III only 49 percent of the hedges were profitable. With strategy XII, 87 percent were profitable.

The data also show the relationship between the strategies and average returns. All of the selective strategies (III through XII) resulted in higher average returns than either the pure cash or complete hedging strategies. As was shown in Figure 4.1, the average return increases with each successive strategy. Hence, the greatest increase in return can be obtained with a hedge which is initiated when the Toronto price is relatively low compared to the futures price.

Similarly, the later strategies result in greater deviation around expected prices. This is not surprising in view of the way in which

expected prices are calculated. As fewer hedges are initiated, the strategies rely more heavily on the cash price as the expected price. Hence, as the strategies involve fewer hedges, the price risk increases since more reliance is placed on the cash market.

Another point that is implicit in Table 4.4 is the potential loss that can occur if a hedge is initiated when the Toronto cash price is greater than the futures price. This can be seen by comparing strategies II and III. With strategy II, a hedge was initiated every week and only 117 or 37 percent of these hedges were profitable. With strategy III, 173 hedges were initiated and 86 or 49 percent were profitable. This means that in 139 of the 312 weeks, the Toronto cash price exceeded the futures price by \$.50 or more. Had hedges been initiated during these 139 weeks, only 31 or 22 percent would have been profitable. This points out the danger (as was alluded to in the last example in section 2.0) which a hedger faces of an adverse basis change when the Toronto cash price is above the futures price.

#### 4.3 Net Costs and Returns from Hedging Strategies

While strategies III through XII resulted in higher average returns than the pure cash strategy, it is necessary to take into account the costs of hedging before making a complete evaluation of the strategies. The costs of hedging fall into two categories - commission on the futures contract and interest on margin deposit. As indicated in section 2.0, the commission per futures contract is \$40 or about \$.16 per hundred weight of pork (carcass weight) and the margin deposit for a hedger is presently \$750.

The margin deposit presents some difficulty in evaluating as a cost since margin must be replenished if the futures price increases after the contract has been sold. For the purposes of this analysis, it was assumed that a reasonable estimate of the average margin deposit per contract is \$1,000. The cost of the margin deposit is the interest paid if the margin is borrowed, or the interest foregone if the margin had been used in an alternative investment. In order to reach an estimate of this cost, an interest rate of 10 percent per annum was used. Since the hedging strategies called for the margin to be deposited for 12 weeks per hedge, the total cost of interest per contract can be estimated at \$23. That is, \$1,000 at 10 percent interest over 12 weeks. Hence the interest cost of a contract per hundred weight of pork is \$.09. This results in a total cost per hundred weight of pork for each contract traded of \$.25 (\$.16 for commission and \$.09 for interest on margin).

Using this cost, the total cost and net returns from hedging can be estimated for the twelve strategies. The results are presented in Table 4.5. Interpretation of Table 4.5 will be aided if the reader recalls the manner in which the hedging strategies were formulated. First, each strategy was compared over 312 consecutive weeks. It was assumed that 150 hogs were placed on feed each week and marketed after 12 weeks. Assuming that hogs are marketed at 165 lbs. carcass weight, this represents 77,220 hundred weights of pork over the 312 weeks (150 hogs per week times 312 weeks times 165 lbs. per hog). Then, since in strategy II, hogs were hedged each week, the cost of hedging was \$.25 per hundred weight. This

TABLE 4.5: Net Returns and Total Cost of Hedging  
for Twelve Strategies, 1969-1974

Strategy	Gross Gain in Price per cwt. From Pure Cash Strategy	Cost of Hedging per cwt. (1969-74)	Net Return From Hedging per cwt.	Net Return From Hedging Over 312 Weeks
Strategy I (No Hedge)	0	0	0	0
Strategy II (Full Hedge)	\$-1.07	\$.25	\$-1.32	\$-101,920.40
Strategy III (\$+ .50 basis)	.48	.14	.34	26,254.80
Strategy IV (\$ .00 basis)	.59	.13	.46	35,521.20
Strategy V (\$- .50 basis)	.64	.12	.52	40,154.40
Strategy VI (\$-1.00 basis)	.78	.11	.67	51,737.40
Strategy VII (\$-1.50 basis)	.86	.10	.76	58,687.20
Strategy VIII (\$-2.00 basis)	.92	.09	.83	64,892.60
Strategy IX (\$-2.50 basis)	1.02	.08	.94	72,586.80
Strategy X (\$-3.00 basis)	1.02	.06	.96	74,131.20
Strategy XI (\$-3.50 basis)	1.05	.05	1.00	77,220.00
Strategy XII (\$-4.00 basis)	1.08	.04	1.04	80,308.80

coupled with the fact that the average market price over the 312 weeks was reduced by \$1.07 per hundred weight from the pure cash strategy means that the total loss incurred with strategy II was \$1.32 per hundred weight or \$101,930.40 over 312 weeks.

In strategy III, hedges were triggered when the Toronto cash price exceeded the futures price by \$.50 per cwt. or less. In total this strategy resulted in 173 hedges. In calculating the cost of hedging, the 139 weeks when hedges did not occur need to be accounted for. This means that the hedging cost per cwt. is calculated only for those weeks when hedging occurred. Hence the hedging costs per cwt. of pork marketed under strategy III were lower than for strategy II. The same logic holds for strategies IV through XII. Since fewer hedges occurred with each successive strategy, it follows that the cost of hedging over the 312 weeks was lower.

The information in Table 4.5 indicates that strategies III through XII all would have resulted in substantial net returns above hedging costs during the 1969-74 period. As would be expected, the strategies which incurred the fewest hedges and resulted in the greatest gains in price received were the most profitable.

#### 4.4 Hedging for Less Than or More Than Twelve Weeks

As has been indicated, all the strategies discussed above were initiated twelve weeks before hogs were to be marketed. One can question whether the results would change if hedges were held for different lengths of time. In fact, we would expect different outcomes because when hedges are placed for shorter periods, less fluctuation in prices would occur and, when hedges are placed for longer periods, more fluctuation in prices would occur. To check this possibility, strategies I (pure cash), II (full hedge) and VIII (hedge when Toronto is \$2.00 or more below futures) were analyzed for hedges of six, eight, ten, twelve and fourteen week durations.

The results are presented in Table 4.6. These show that in all cases the hedging strategies were useful in reducing price risk since the hedging strategies resulted in lower deviations from expected prices. However, as expected, less benefit in reducing price risk is gained relative to the pure cash strategy in the shorter duration hedges than in the longer duration hedges.

At the same time, greater gains in average revenue resulted from the selective strategy (strategy VIII) as the duration of hedges was lengthened. For a six week hedge, only \$.17 per cwt. on average was gained over the pure cash strategy. For a 14 week hedge, the average gain in revenue was \$1.09 per cwt. with strategy VIII. This would suggest that the greatest possible gains from hedging, at least to some limit, occur with relatively long hedges. This would imply that hedging might be even more beneficial to the producer who adopts a flexible hedging strategy of using basis to initiate hedges even before weanlings are placed on feed.

The pure hedging strategy (strategy II) clearly becomes less appealing in terms of potential gain over the pure cash strategy as the hedging period is lengthened. It can be seen that average returns decrease with this strategy as the hedging period is lengthened. However, for the producer who views hedging as a method to reduce price risk, the pure hedging strategy provides less deviation from expected price than either strategy I or strategy VIII - particularly when the hedging period is lengthened.

TABLE 4.6: Outcomes of Strategies I, II and VIII for Hedges of Six, Eight, Ten, Twelve and Fourteen Week Duration, 1969-74

Duration of Hedge and Strategy	Number of Hedges	Number of Profitable Hedges	Percentage of Hedges With Profit	Average Return (per cwt.)	Deviation From Expected Price	Gain in Average Return From Pure Cash Strategy (per cwt.)
Six Weeks:						
Strategy I	0	0	0%	\$40.06	2.76	\$0
Strategy II	312	131	42	39.55	2.62	-.51
Strategy VIII	108	57	52	40.23	2.77	.17
Eight Weeks:						
Strategy I	0	0	0	40.06	3.32	0
Strategy II	312	124	39	39.35	2.62	-.71
Strategy VIII	105	59	56	40.41	3.01	.35
Ten Weeks:						
Strategy I	0	0	0	40.06	3.79	0
Strategy II	312	118	37	39.18	2.62	-.88
Strategy VIII	104	58	55	40.70	3.30	.64
Twelve Weeks:						
Strategy I	0	0	0	40.06	4.22	0
Strategy II	312	117	37	38.99	2.62	-1.07
Strategy VIII	109	66	60	40.98	3.54	.92
Fourteen Weeks:						
Strategy I	0	0	0	40.06	4.69	0
Strategy II	312	114	36	38.80	2.62	-1.26
Strategy VIII	106	64	60	41.15	3.94	1.09



## 5.0

## HEDGING AND THE HOG CYCLE

As indicated in section 3.3, previous studies of livestock futures have suggested that they tend to over estimate cash prices during downward trends in prices and under estimate cash prices during upward trends. This would suggest, in turn, that hedging during the downward part of the hog cycle is more beneficial than during the upward part.

It would appear that this suggestion is correct. In Figure 5.1, the relative returns from an unhedged position or from a hedged position are presented from 1969 through 1974 in comparison to weekly Toronto cash prices. Like Figure 4.2, the upper graph in 5.1 shows the relative gain from the unhedged or hedged position. If a point falls above the "zero" line greater returns are realized from not hedging. If a point falls below the "zero" line, greater returns are realized from hedging.

It can be seen from Figure 5.1 that during the cyclical downturns in prices which began in early 1970 and late 1973, hedging was clearly profitable most of the time. However, during periods when the cash price was rising, hedging was rarely profitable.

The years 1970 and 1973-74 are the only times during the six years analyzed here that the hog cycle was clearly in a downward phase. The downturn of 1973-74 represents a period when hedging was particularly profitable. The reader may recall that in the second half of 1973 when prices were high, (just after the U.S. price freeze on pork was lifted) newspapers carried stories to the effect that large stocks of frozen pork were being built up by packers and "speculators", and "experts" were forecasting substantial cutbacks in pork production in early 1974 because of high feed grain prices. In the end, the forecasts were wrong and "speculators" lost money on their stocks as production increased and pork prices fell drastically.

During this period, futures traders apparently believed the experts and substantially over estimated future cash prices. Producers who hedged during this period could have reaped substantial benefit.

The foregoing clearly points to a knowledge of the hog cycle as an indicator of when to hedge. To determine the potential gains from hedging during the downward part of the cycle, strategies III through XII were adjusted to trigger hedges during the price declines of 1969 and 1973-74 as well as when the Toronto-Chicago price difference indicated a hedge should be undertaken. The results are presented in Tables 5.1 and 5.2.

The information in Table 5.1 shows that with the adjustment for the stage of the hog cycle, strategies III through XII each resulted in a greater number of hedges and a greater number of profitable hedges than when no adjustment was made (see Table 4.4). Furthermore, each of these strategies resulted in a larger gain in average return per cwt. and greater protection against price risk as measured by the deviation from expected price.

The information in Table 5.2 shows that strategies III through XII each resulted in substantially increased net returns relative to selling in

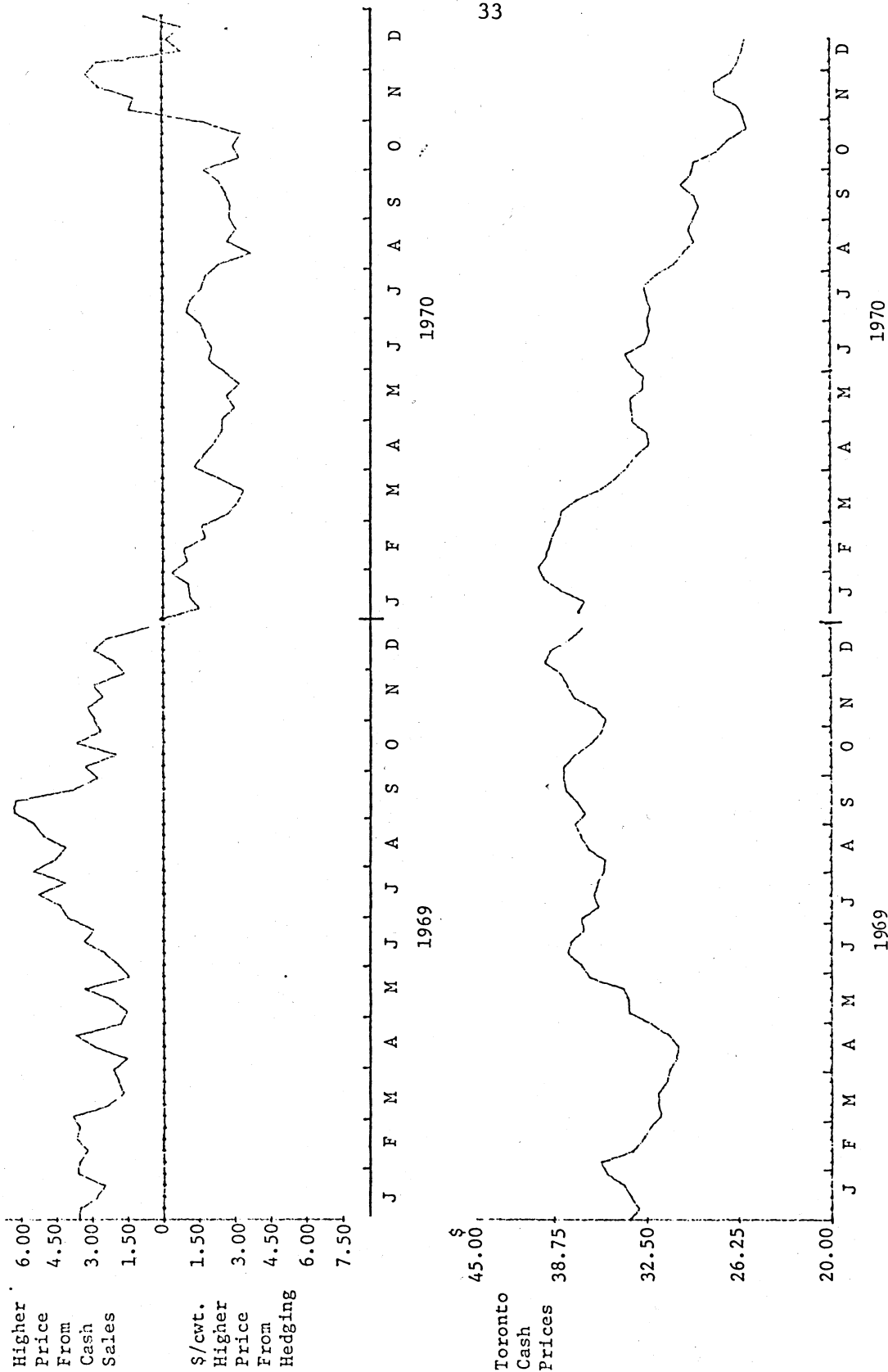
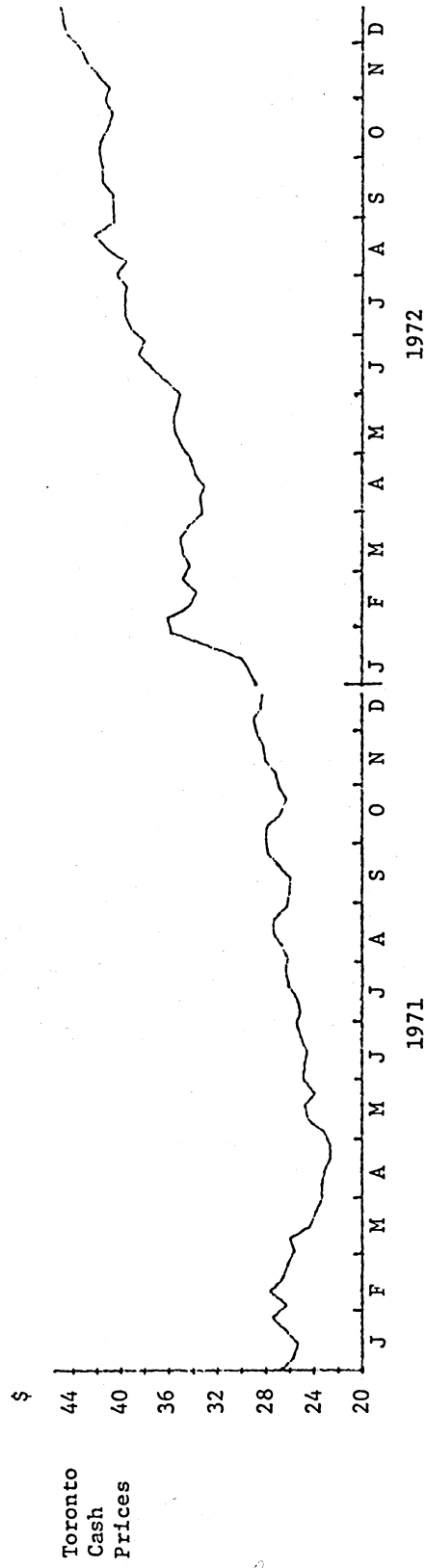
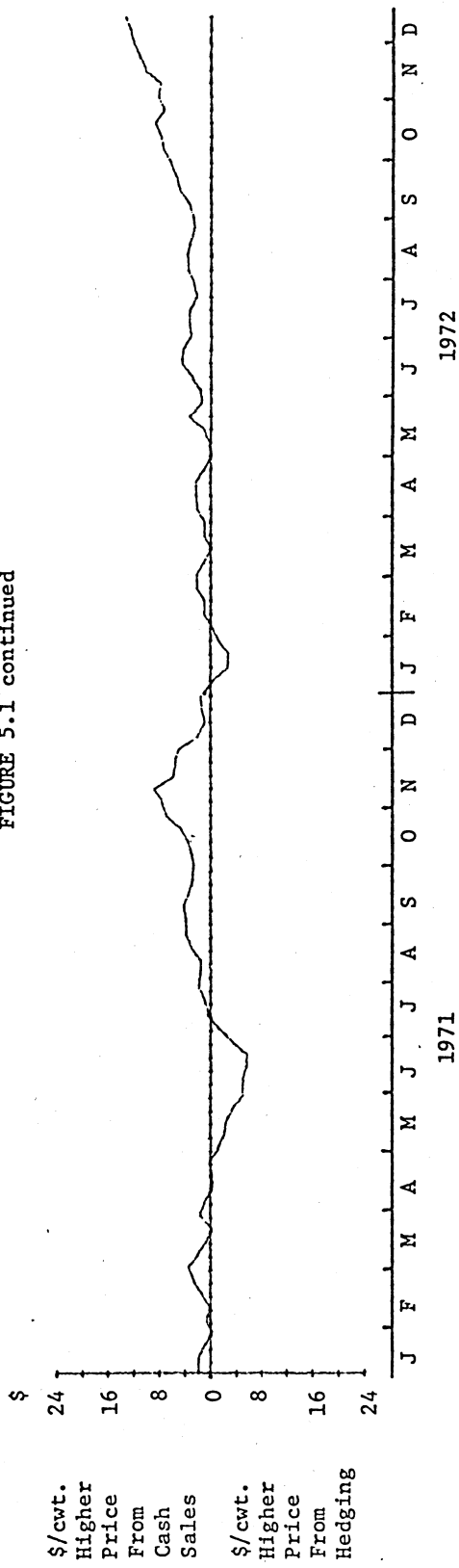


FIGURE 5.1: Relative Outcomes of Hedged versus Unhedged Positions and the Hog Cycle, 1969-1974

cont'd.

FIGURE 5.1 continued



cont'd.

FIGURE 5.1 continued

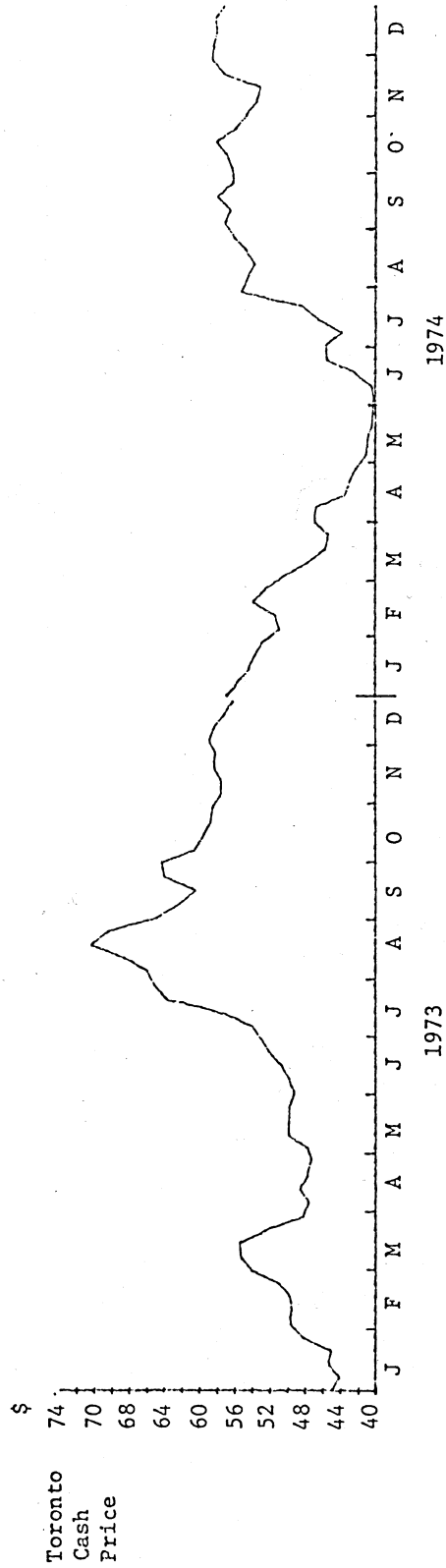
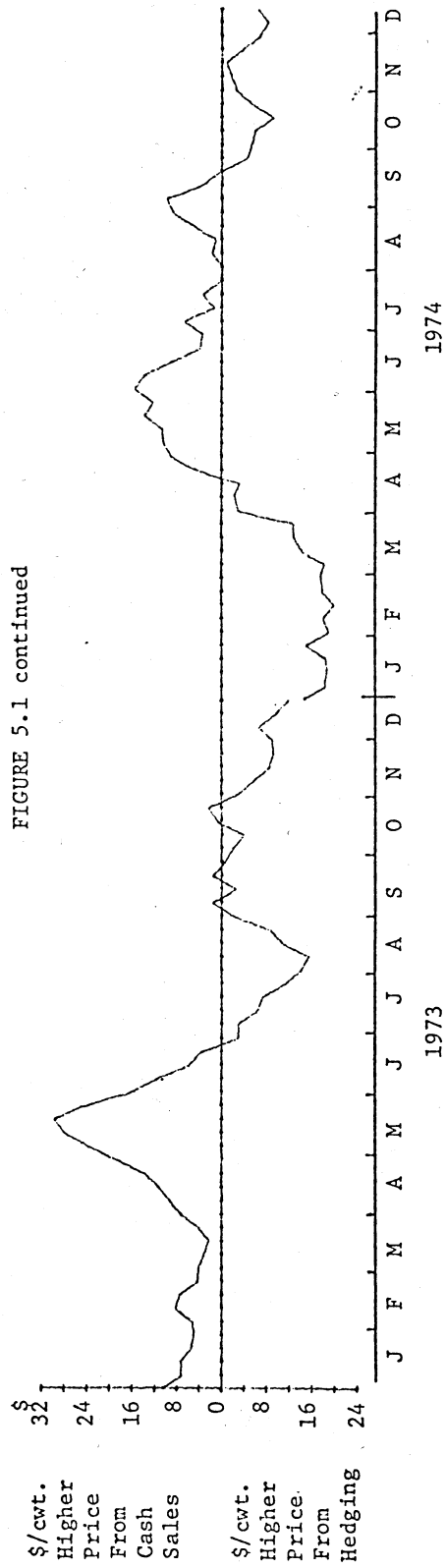


TABLE 5.1: Outcomes of Hedging Strategies Adjusted for Hog Cycle, 1969-1974

Strategy		Number of Hedges	Number of Profitable Hedges	Percentage of Hedge With Profit	Average Return	Deviation From Expected Price
Strategy I	(No Hedge)	0	-	-	\$40.06	\$4.22
Strategy II	(Full Hedge)	312	117	37%	38.99	2.62
Strategy III	(\$ +.50 basis)	203	113	55	40.71	3.09
Strategy IV	(\$ .00 basis)	191	110	57	40.82	3.10
Strategy V	(\$- .50 basis)	186	109	59	40.89	3.12
Strategy VI	(\$-1.00 basis)	173	107	61	41.03	3.26
Strategy VII	(\$-1.50 basis)	165	105	63	41.11	3.25
Strategy VIII	(\$-2.00 basis)	149	99	66	41.21	3.37
Strategy IX	(\$-2.50 basis)	137	99	72	41.32	3.44
Strategy X	(\$-3.00 basis)	124	93	75	41.36	3.66
Strategy XI	(\$-3.50 basis)	112	87	77	41.40	3.70
Strategy XII	(\$-4.00 basis)	101	84	83	41.40	3.74

TABLE 5.2: Net Returns and Total Cost of Hedging for Twelve Strategies Adjusted for Hog Cycle, 1969-74

Strategy		Gross Gain in Price per cwt. From Pure Cash Strategy	Cost of Hedging per cwt (1969-74)	Net Return From Hedging per cwt	Net Return From Hedging Over 312 Weeks
Strategy I	(No Hedge)	0	0	0	0
Strategy II	(Full Hedge)	\$-1.07	\$.25	\$-1.32	\$-101,930.40
Strategy III	(\$ +.50 basis)	.65	.16	.49	37,837.80
Strategy IV	(\$ .00 basis)	.76	.15	.51	39,382.20
Strategy V	(\$ -.50 basis)	.83	.15	.68	52,509.60
Strategy VI	(\$-1.00 basis)	.97	.14	.83	64,092.60
Strategy VII	(\$-1.50 basis)	1.05	.13	.92	71,042.40
Strategy VIII	(\$-2.00 basis)	1.15	.12	1.03	79,536.60
Strategy IX	(\$-2.50 basis)	1.26	.11	1.15	88,803.00
Strategy X	(\$-3.00 basis)	1.30	.10	1.20	92,664.00
Strategy XI	(\$-3.50 basis)	1.34	.09	1.25	96,525.00
Strategy XII	(\$-4.00 basis)	1.36	.08	1.28	98,841.60

the cash market. The greatest return over the six year period (\$98,841.60) resulted from strategy XII.

One might question the validity of the analysis presented in this section since the adjustment for the stage in the hog cycle was made after the fact. That is, since the analysis was carried out in 1975 it was relatively easy to look back and determine exactly when market prices began to decline. The question arises as to whether market price declines can be predicted in the future so that the time to initiate a hedge can be determined.

Quite clearly, it is not possible to forecast the exact time at which prices will begin to turn downward. While the hog cycle has been relatively consistent over time, its price peaks have been reached at intervals of from 30 to 45 months. The cyclical peaks depend to a certain extent on the time taken by producers to adjust to changes in hog prices. But they also depend on changes in feed grain prices and changes in supplies and prices of substitutes, such as beef. Given the number of factors which affect the price of pork, prediction of precisely when a turning point will occur is very difficult. However, knowledge of market conditions can help the producer in making hedging decisions. Such knowledge, gained from careful review of market outlook information available from a number of sources, when used in conjunction with the analysis presented here can provide the pork producer with opportunities to reduce price risk by hedging in live hog futures.

## 6.0

## SOME ADDITIONAL CONSIDERATIONS

There are a number of factors which should be kept in mind by the producer who considers using the futures market. These are outlined below.

6.1 Size of the Contract

As has been pointed out, a futures contract represents approximately 150 hogs. Since many Ontario producers have relatively small operations, the contract size may be a limitation. It should be borne in mind that if a producer has only 100 hogs and sells a futures contract, he is speculating in futures to the extent of 50 hogs. Given the size constraint, one possible means by which producers can hedge is to sell contracts jointly - i.e. two or more producers can open an account jointly to carry out futures transactions. It is often wise when one is beginning to hedge to keep the futures position relatively small compared to the number of hogs. For example, if three producers, each with 100 hogs consider hedging jointly, it is probably wise to sell only one futures contract. This allows the producers to gain experience with the futures market, allows them to learn about the psychological impact of meeting margin requirements and minimizes the costs of making errors.

The same applies to larger producers. If a producer plans to market say 300-500 hogs in a particular period, he may be wise to sell only one contract - at least until he gains experience with the market.

6.2 Trading In and Out

The speculative nature of hedging often induces producers to deviate from a hedging strategy. Deviations can take several forms. If a futures position turns favourable, there is a temptation to remove the hedge and take partial profits. If the position turns unfavourable, there is a temptation to remove the hedge and reduce losses in the hope of subsequently selling futures at a higher price. Trading in and out of futures while hogs are on feed goes against the basic objective of hedging which is to lock in a price. Furthermore, trading in and out can increase the cost of hedging because commissions can mount rapidly. Often the only person who gains from trading in and out is the broker!

Finally, trading in and out is not hedging. It is speculating in futures and the reader should be aware of the fact that the vast majority of futures market speculators lose money.

The suggestion to hedge fewer hogs than will be marketed is important when the possibility of an increase in futures price is considered. If a producer plans to market 300 hogs but has sold only one contract and the futures price increases, there are a number of implications. First, the producer must deposit margin for only one contract instead of two. Second, he is still assuring a price on the hogs hedged. Third, he provides himself the opportunity to make a speculative gain on the unhedged hogs if the cash price is also increasing.

6.3 Hedging Means Selling Futures

A hedge is only a hedge if futures are sold. If futures are

purchased, the producer is speculating in hogs and speculating in futures. The essence of hedging is to reduce price risk, not to increase it.

#### 6.4 Selling the Appropriate Futures Contract

The futures contract which is sold should correspond as closely as possible with the date on which hogs will be marketed. If hogs are to be marketed in February and a July futures contract is sold, the producer runs the risk of not receiving protection against a price decline. In most years, considerably different factors affect the price of hogs in July than in February. It is conceivable that the February price could decline while July is increasing.

A closely related point is that the producer should avoid transactions near the end of trading in a contract. The last day of trading for a given contract is approximately the 20th of the month - i.e. December contracts are traded until about the 20th of December. The producer should not be trading later than the 5th. Beyond this date, there is the possibility that hogs will have to be delivered against the contract (to Chicago!). If hogs are to be marketed late in a month for which there is a contract (say December), then the hedge should be placed in the next contract (February in this case).

#### 6.5 Hedging and the Games Nations Play

We have pointed out that, while the Toronto basis is quite variable, it normally is variable only within a range - U.S. price plus or minus transport and tariff charges. The reason that transport and tariff charges provide the extremes within which the Toronto price can vary, is that there is free trade in pork between Canada and the U.S. However, if trade is impeded, then the limits within which Canadian prices can vary around the U.S. are removed. If trade were not allowed and Canadian production decreased, Canadian prices could go much higher than those in the U.S. because imports would not place a ceiling on our prices. Similarly, an increase in production could send Canadian prices down relative to the U.S. because Canada would not have a market for her surplus.

Historically, Canadian production has been more variable than U.S. production, mainly because of relatively violent swings into and out of pork in Western Canada. This means that if trade with the U.S. were impeded by government action, there would probably be more variation in Canadian prices or, at least, there would be different variation. In such a situation, the Chicago futures market would be useless as a hedging medium for Canadian producers. In recent years, there has been a tendency for the two federal governments to impede trade. In early 1974, Canada limited imports of beef from the U.S. In late 1974, the U.S. imposed export restrictions on Canadian pork and beef. Such actions can cause a significant change in the Toronto basis. These changes can mean that a producer who is hedging can be seriously affected. If further impediments to trade occur, Ontario producers should be quite wary of using futures.

#### 6.6 Hedging on a Positive Basis

At several points in this report, the potential danger of initiating



a hedge when Toronto exceeds the futures price has been discussed. The danger cannot be over emphasized. The analysis shows that there is considerable risk of an adverse basis change in these circumstances except, possibly, during the downward part of the hog price cycle.

#### 6.7 Hedging Takes Time and Effort

There is always a danger in a report like this one that the process of hedging sounds oversimplified or that the results will be taken too literally. We have attempted to point out in this report that hedging is not a simple undertaking and that it can be psychologically demanding because of the possibility of meeting margin requirements.

It should also be noted that, while the analysis presented here concludes that hedging selectively can be a very useful marketing tool, this conclusion should be interpreted with care for at least two reasons. First, the data refer to the recent past. While there is no obvious reason to expect price relationships to give different results in the future, the future is unpredictable, and different results may be obtained. Second, the data used to analyze basis relationships included only Thursday closing prices. While it would appear that changes in basis occur systematically, we have pointed out that futures prices, and therefore basis, can change dramatically even within a day. Hence, it is important that basis be carefully analyzed by a producer who intends to follow a selective hedging strategy.

The above discussion leads to the conclusion that hedging is not a mechanical procedure. Much time and effort is required to develop a hedging strategy, to monitor and analyze basis, and to obtain and interpret market information. The necessity for this effort cannot be minimized. Successful management of marketing decisions requires the same degree of effort as successful management of the swine herd.

## 7.0

## SUMMARY AND CONCLUSIONS

This report has described the mechanics of trading in live hog futures, described the economic characteristics of live hog futures and developed and analyzed hedging strategies over a 312 week period from 1969 through 1974. The strategies analyzed include a pure cash strategy, a complete hedging strategy and ten selective strategies in which hedging decisions were triggered only when the difference between Toronto cash and futures prices was within certain limits at the beginning of successive twelve week periods. Twelve week hedging periods were adopted since twelve weeks represents the approximate length of time necessary to raise a weanling pig (50 lbs.) to market weight.

The major conclusions are as follows. First, all strategies which included hedging in the futures market afforded a producer the opportunity to reduce the risk of a price decline. Hedging as a matter of course (i.e. hedging one contract each week) provided the greatest protection against price risk, but resulted in lower average market prices over the 312 weeks. However, the remaining ten selective strategies resulted in both lower price variation and higher average returns than the pure cash strategy. Each of the selective strategies were found to be superior to either the pure cash or the full hedging strategies.

Second, average returns increased over the selective strategies depending on the price difference between Toronto cash and the futures price. Strategies which triggered hedges when the Toronto cash price was substantially below the futures price provided the greatest increase in returns. However, these strategies also provided less protection against price risk.

Third, all ten of the selective strategies resulted in significant returns net of the cost of hedging.

Fourth, it was concluded that the Ontario producer should not hedge when Toronto price is substantially above the futures price. If hedges are initiated in this circumstance, the producer risks losses on both his hogs and his futures position.

Fifth, the potential gains from hedging are greatest when hedging is undertaken during a downturn in the hog (price) cycle. During the downward price periods of 1969 and 1973-74, hedging provided higher average returns and more protection against price risk than over the six year period as a whole.

Sixth, hedges of relatively long duration appear to provide more potential gain than hedges of short duration. When strategies were compared for hedges lasting 6, 8, 10, 12 and 14 weeks, a selective hedging strategy resulted in greater gains when the hedge was held for 14 weeks than for shorter periods. The selective hedging strategy resulted in larger relative gains over a pure cash or pure hedging strategy as the duration of the hedge was lengthened. This implies that significant gains are available to a producer who follows prices closely and adopts a flexible hedging strategy triggered by the Toronto basis.

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