The Use of Financial Derivatives in Agriculture
and an Annotated Bibliography

By
Jian Yang,
and
David J. Leatham

December 30, 1997

Jian Yang is a graduate student and David J. Leatham is a professor, both in the Department of Agricultural Economics, Texas A&M University.

Unpublished paper.
The Use of Financial Derivatives in Agriculture
and an Annotated Bibliography

Introduction

Financial derivatives are instruments whose value depends on, or derives from one or more underlying financial assets. The underlying asset includes financial securities, security indexes, reference rates, and some combination of them.

Financial derivative products are normally categorized into four basic types: financial forward, financial futures, financial options, and financial swaps. These basic instruments can be combined to create numerous more complex derivatives. Also, financial derivatives exist in two forms: exchange-listed and OTC (over-the-counter). More specifically, exchanged-listed derivative products are composed of financial futures and options while OTC derivative products include financial swaps and forwards, as well as some financial options.

Although risks associated with financial derivatives, especially with OTC products caused some concerns in their soundness, it is formally regarded, as indicated in the US General Accounting Office (GAO) report in May 1994, that (financial) derivatives serve an important function in the global financial marketplace, providing end-users with opportunities to better manage financial risks associated with their business transactions. The rapid growth and increasing complexity of derivatives reflect both the increased demand from end-users for better ways to manage their financial risks and innovative capacity of the financial services industry to respond to market demands.

Little has been published on the use of financial derivatives in agriculture. Hence, exploring the potential use of financial derivatives in the field is a good extension of Pilot Farm Program in which the USDA encourages farmers to take advantage of commodity options and
futures. Additionally, financial derivatives can help enhance the US agricultural export competitiveness.

This paper provides a review of financial derivative instruments and typical applications of them in financial and agricultural economics literature. First, the background knowledge of financial derivative markets are presented. Second, the basic analysis of each major derivative product and general application in non-agricultural sectors are reported. Third, targeting the specificity of agriculture, current and potential use of financial derivatives for farm firms and agricultural banks is discussed. Fourth, several most important policy issues affecting the use of financial derivatives are mentioned briefly, and finally, concluding remarks are made.

History and Evolution of Financial Derivatives

The development of financial derivatives is related closely to the fundamental changes in global financial markets during the past two decades.

The first exchange-traded financial derivatives emerged to deal with the adverse exchange rate fluctuation after the collapse of the Bretton Woods Agreement established in 1944. In 1971, the US Treasury abandoned the gold standard for the dollar, and actually replaced a fixed-rate exchange system with a floating-rate one. Then, one year later, foreign currency futures were introduced at the International Monetary Market, which is a division of the Chicago Mercantile Exchange (CNIE). Interest rate futures were initiated by the Chicago Board of Trade (CBOT) in 1975 with a contract based on GNMA mortgage-backed certificates, by the CME in 1976 with a T-bill futures contract (Allen and Gale, 1994). In 1982 stock indices futures were created by several exchanges. The Kansas City Board of Trade introduced a contract based on the Value Line Stock Index, the CME offered one based on the S&P 500, and the New York Futures Exchange owned one based on the New York Stock Exchange Composite Index.
The development of exchange-traded financial options followed that of financial futures. In 1973, the Chicago Board Options Exchange (CBOE) created by the CBOT began trading first standardized financial options on individual stocks. Before then, options of various kinds were traded over-the-counter (OTC) and hence there were no secondary markets. However, only until the early 1980s were financial options introduced on other instruments (Allen and Gale 1994). The first was an options contract on interest rate futures (Treasury bond futures) which was introduced by the CBOT in October 1982. Subsequently, interest rate options, including options on specific Treasury bonds, notes and bills, were also started. In December 1982 the Philadelphia Stock Exchange introduced currency options; in March 1983, the CBOE offered an option on the S&P 100 index, and stock index option trading began ever since.

The origin of the financial swap market can be traced to the late 1970s, when currency traders developed currency swaps as a technique to evade British controls on the movement of foreign exchange (Kolb, 1993). In 1981 the first interest rate swap occurred in an agreement between the World Bank and IBM.

As for financial forwards, an international currency forward market has existed for many years. On the other hand, forward rate agreement (FRA), the most common type of interest rate forward contracts, was originally introduced by banks in 1983.

**Derivative Market size**

The market size of financial derivatives is commonly measured by three metrics: open interest, notional principal of outstanding contract (measured at a period in time), and the turnover or trading activity (measured over a period of time) (CFT, 1993, and Remolona, 1993). The first metric is usually only used to measure organized exchange market size. Remolona (1993) argued that trading volume seems the more relevant measure of market size to exchange-
traded derivatives because their primary function appears to be the provision of more liquidity. In addition, he pointed out that it is hard to compare the size of exchange and OTC markets, partly because the unwinding of initial position to notional principal in OTC markets while it adds to turnover in exchange markets.

The GAO (1994) estimated that the total volume of global derivatives is $17.6 trillion in terms of notional contracts outstanding at the end of fiscal year 1992. In 1992, more than 600 million contracts were traded in organized exchange around the world. In contrast, open interest in financial derivatives reached $3.5 trillion at the end of 1991.

Financial derivative markets have grown very strongly in recent years (Remolona, 1993). In terms of underlying assets, financial derivatives based on interest rates have dominated the growth; next are those based on currency, while the last are those based on equity indexes.
<table>
<thead>
<tr>
<th>Derivative Type</th>
<th>Percentage of total financial derivatives</th>
<th>Underlying Asset</th>
<th>Percent by underlying asset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Futures</td>
<td>18%</td>
<td>Interest rate</td>
<td>96.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Currency</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equity</td>
<td>2.5</td>
</tr>
<tr>
<td>Forwards</td>
<td>42</td>
<td>Interest rate</td>
<td>27.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Currency</td>
<td>73.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equity</td>
<td>0</td>
</tr>
<tr>
<td>Options</td>
<td>13</td>
<td>Interest rate</td>
<td>89.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Currency</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equity</td>
<td>7.5</td>
</tr>
<tr>
<td>Swaps</td>
<td>27</td>
<td>Interest rate</td>
<td>62.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Currency</td>
<td>36.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equity</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Table 2. The Most Popular Financial Derivatives in the Marketplace

<table>
<thead>
<tr>
<th>Kinds of Derivatives</th>
<th>Percentage of the Surveyed Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest rate swaps</td>
<td>78.9 %</td>
</tr>
<tr>
<td>Forex forwards</td>
<td>64.2</td>
</tr>
<tr>
<td>Forex options</td>
<td>40.4</td>
</tr>
<tr>
<td>Listed interest rate futures and options</td>
<td>29.4</td>
</tr>
<tr>
<td>OTC interest rate futures and options</td>
<td>13.8</td>
</tr>
<tr>
<td>Listed forex futures and options</td>
<td>11.0</td>
</tr>
<tr>
<td>Listed equity futures and options</td>
<td>10.1</td>
</tr>
<tr>
<td>“Exotic” options, or options with limits</td>
<td>8.3</td>
</tr>
<tr>
<td>OTC equity swaps</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Table 3. The Potential Use of Financial Derivatives Being Considered

<table>
<thead>
<tr>
<th>Kinds of Derivatives</th>
<th>Percentage of the Surveyed Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest rate swaps</td>
<td>70.5 %</td>
</tr>
<tr>
<td>Forex forwards</td>
<td>46.6</td>
</tr>
<tr>
<td>Forex options</td>
<td>37.5</td>
</tr>
<tr>
<td>Listed interest rate futures and options</td>
<td>20.5</td>
</tr>
<tr>
<td>“Exotic” options, or options with limits</td>
<td>13.6</td>
</tr>
<tr>
<td>OTC interest rate futures and options</td>
<td>9.1</td>
</tr>
</tbody>
</table>


Driving Forces of the Growth of Financial Derivatives

A survey of the factors contributing to the growth of financial engineering naturally fits well to explain the rapid development of financial derivatives, the major part of financial engineering. The factors are divided into environmental factors and intrafirm factors. The environmental factors external to firm cover (1) the increased price volatility of financial products; (2) globalization of the financial markets; (3) tax asymmetries in financial commodity in different countries; (4) advances in technology and financial theory; (5) government deregulation of industry and intensified competition within the industry; (6) the decline in the cost of information and cost of transactions to encourage width and depth of arbitrage in the financial market. Intrafirm factors, which are internal to the firm, mainly include: (1) the firm’s stronger liquidity needs or the desire to reduce the transaction cost; (2) risk aversion among managers and owners; (3) the needs for reducing agency costs; (4) longing for accounting benefits helpful to improve a firm’s financial statement.

Allen and Gale (1994) observe that there are distinct motives for innovations associated
with distinct types of innovators. They add three more motives which can be classified into intrafirm factors: (5) the desire to avoid or circumvent government regulation and taxation; (6) the desire for more complete market; (7) the desire to change prices of (financial) assets that are being held.

The above explanations are mainly from the perspective of market participants. It is also instructive to analyze from the function of financial instruments. Remolona (1993) emphasizes the functions of financial derivatives as liquidity-enhancing and risk-transferring innovations. He argues that the OTC financial derivative markets tend to be less liquid than the underlying cash markets and thus OTC financial derivatives are designed to transform market risk rather than to provide liquidity. In contrast, the standardization of contract together with the clearinghouse effect offset in financial derivative exchange markets serve to limit transaction costs and thus are expected to provide liquidity in excess in the cash market. Hence, the liquidity of the underlying cash market helps judge the development of a financial derivative. If the spot market, for example, of foreign exchange market is itself so liquid that the importance of liquidity-enhancing is decreased and risk transformation functioned by a currency derivative is probably more dominant. In this case, OTC financial derivatives should have exceptional advantage in application. This may be largely accountable for the fact that currency forward is the most popular contract in terms of trading volume.

**General Application of Financial Derivative Instruments**

In general, financial derivatives are used by market participants (GAO 1994) (1) to hedge to protect against adverse changes in the values of (financial) assets or liabilities; (2) to speculate, or to assume risk in attempting to profit from anticipating changes in financial market rates and prices; and (3) to obtain more desirable financing terms. In the last case, there are two
ways working. First, market participants can work together to take advantage of differences in
the rates at which they borrow money. Second, the enhanced creditworthiness of the hedger may
be an important by-product of hedging, and thus more favorable financing terms will be
provided. It is also worthy to note that financial forwards, futures, and options are typically used
to hedge or to speculate while financial swaps are typically used to hedge or to obtain more
desirable financing. Financial swaps are seldom used to speculate because of the high cost of
swap transaction compared to those of financial derivatives.
**Financial Forward**

*Overview*

If the four basic financial derivatives, financial forward is the oldest and most straightforward. A financial forward is a contract that obligates its owner to buy a specified financial asset on a specified future date at the origination of the contract. The common forms of financial forward are currency forwards and interest rate forwards, and forward contracts have never been reported to apply to the equity market.

The currency forward market has existed for a long time. The first modern currency forward market was formed in Vienna in the second half of the 19th century (Enzig, 1968). Today it is still a major trading arena of foreign exchange. Interest rate forwards have developed rapidly in the wake of the expanded trading in interest rate contracts on the exchanges in recent years. The limited scope of forward market originates from its deficiency in liquidity, and only the underlying cash markets with a large number of participants, such as currency market, can possess the forward market form due to its mitigated or even liquidity problem.

However, financial forwards have several strengths. First, forward contracts are not traded in organized exchanges but are offered (usually by banks) on an OTC basis, thus the price is more flexible than outcry. Second, forward contracts are traded in many more locations in different time zones. On the other hand, there are two other features that should be noted. First, the credit or default risk of the contract is two-sided. The owner of the contract either receives or makes a payment, depending on the price movement of the underlying assets. Second, the value of the financial forward contract is conveyed only at the contract's maturity.

*Financial Forward Pricing*

Similarity between forward and futures contract leads most traders to treat futures price
the same as forward price. French (1983) examined several common models of futures and forward price, and tested with copper and silver. His basic conclusion is that some differences between forward and futures contract, especially futures’ daily cash settlement, may actually cause price differences between futures and forward contract. He demonstrated that the following two forward price models are roughly correct:

1. Arbitrage model

The forward price must equal the present value of the maturity spot price times the gross return from a long-term bond, i.e.

\[ f(t, T) = \exp[(T-t)R(t, T)] PV_t, T[P(T)] \]

In the equation, \( PV_t, T(.) \) denotes the present value at time \( t \) of a payment received at time \( T \). On the contrast, futures price must equal the present value of the financial product of the maturity spot price and gross return from rolling over one-day bonds. Futures price and forward price generally are not the same unless both interest rates above are nonstochastic.

2. Utility Based Model

In this model markets are assumed complete and there exist rational investors to maximize a time-additive expected utility function. The forward price is determined as follows:

\[ f(t, T) = \exp[(T-t)R(t, T)] Et[P(T)B(T)/B(t)] \] and \( B(T) = \exp[-p(T-t)]u(i,T)/P(i,T) \)

**Typical Applications of Financial Forward**

The currency forward, which is also called forward exchange, is an agreement to buy or sell a certain amount of foreign currency at a specified date in the future at a price determined today. The term usually covers one, two, three, six and twelve months. The forward market is the primary foreign exchange market that government and commercial clients use to hedge or cover foreign exchange exposure. The currency forward is used for several purposes: (1) to lock in a
certain foreign exchange rate in commercial transactions; (2) to hedge against reduction of value of assets and/or earning subject to exchange risk; (3) to arbitrage or to capitalize on interest rate in differences across countries; (4) to speculate through betting that the expected spot rate implied by the forward (exchange) rate will be different from the spot rate that will prevail at the end of the period covered in the (currency) forward contract. For this purpose, speculators may prefer currency forward because little or no capital is required on the forward market compared with other methods. Although early in 1950s currency forward contracts could be provided to cover foreign exchange risk up to four years (Einzig 1968), it should be noted that currency forward positions have been generally available in reasonable size from commercial banks through periods of up to six months. For maturities beyond six months, the volume of transactions decreases markedly. Very little has been readily translated based on open quotations beyond one year. Thus currency forward is not practical to speculate on longer-term foreign exchange exposures due to liquidity problem. As for hedging long-term currency risks through currency forward, there are two ways: long-date currency forward contracts and strips of short-date currency forward. Neither does seem to work well. The major disadvantage of the former is still poor flexibility while the latter requires high degree of accuracy in forecasting interest rates and their differentials between countries, which would be very difficult and costly.

Another innovative way can be utilized to hedge regular receivables from abroad in a time period. A series of traditional currency forward contracts at different future dates and settled at the same forward foreign exchange rate are put together to create a par forward. Particularly in the case of gradually increasing forward foreign exchange rate, it brings a cash flow advantage to the hedger, because the receivables initially are converted at a relatively higher forward rates (Anderson 1993).

Various types of arbitrage are also traditionally an important application of currency
forward. They are summarized as follows (Einzig 1968):

1. Exchange arbitrage
   (a) Arbitrage in space (bilateral or trilateral)
   (b) Arbitrage in time (spot against forward or short against long forward)

2. Interest arbitrage
   (a) Transfer of funds.
   (b) Transfer of credit availments.
   (c) Domestic use of deposits in foreign currencies

Currency forward transactions form an essential part of covered interest rate arbitrage and of certain types of exchange arbitrage. In addition, in certain types of exchange arbitrage, stock arbitrage, bullion arbitrage and commodity arbitrage, currency forwards play an accessory but none the less important part in that they safeguard arbitrageurs from loss on their operations caused by the fluctuation of the exchanges.

Currency forward speculation assumes mainly the form of 'leads and lags' arising from commercial transactions, and excessive hedging against depreciation of assets (Einzig 1968). Hence, speculative operations may take the form of buying or selling exchange forward for short or long periods, depending on the speculators' view of the proximity of the anticipated appreciation or depreciation, and depending on the discrepancy between short and long forward rates. The early methods of speculations, including a kind of purely betting on future exchange rate or buying the foreign currencies and selling the spot proceeds, are not very workable.

Forward Rate Agreements are the most common form of interest rate forward. A Forward Rate Agreement (FRA) is an agreement between two parties who wish to protect themselves from a future fluctuation in interest rates. The buyer of FRA can expect to protect himself against a future rise in the relevant interest rate and a seller of FRA can expect to protect himself against
a future fall in the relevant interest rate. The exposure to both parties only involves the interest difference between the agreed rate and actual settlement rate, but not principal amount.

Obviously, one of the major applications of FRA is to fix the borrowing cost in the future. Another is to lock in the future return for investors by selling FRAS. FRAs have several substantial advantages over other methods of hedging interest rate risk, such as interest rate future. A number of significant variations on the conventional FRA expand its scope of application, including: (1) using a "strip" or a series of FRA to lock in the interest rate over a series of interest rate reset dates; (2) using a combination of FRAs and foreign exchange forward contracts to create a synthetic FRA in a foreign currency; (3) Forward Spread Agreements (FSA) designed to allow parties to lock in spreads or differentials between two currencies. Similar to currency forwards, FRAs in a standard market practice are confined to full monthly periods such as one, three, or six months of interest period.

Financial Futures

Overview

Financial futures may be defined as such futures contracts based on financial instruments that obligate the holder to buy or sell a specific amount or value of an underlying asset, reference rate, or index at a specified price on a specified future date. The common types of financial futures are interest rate futures, foreign currency futures, and stock index futures.

The basic form of futures is considered identical to that of forward contract. However, in fact, there are some substantial differences between them. First, forward contract is made upon the agreement of two parties, thus credit or default risk severely restricts the opportunity of business. On the contrary, futures contract are traded through an exchange and credit or default risk that has almost been reduced to zero. Two of the most effective devices are "marked-to-
market” and requirement of “margin.” Second, forward contract is so customized as to have difficulty of finding trading partners if the number of participants in the market is not too many; futures contract, with standardized terms, eases the difficulty in matching the basic need of participants. Third, it is difficult for forward contract to be fulfilled without actually completing delivery, while futures contract can be sold off at any time on an exchange. It implies much more liquidity of future contract compared to forward contract.

Financial Futures Pricing

Understanding financial futures pricing is a key to successful performance in the market. The most common model in pricing financial futures is the Cost-of-Carry model which rests on the idea of arbitrage. Below is cited the related formulas (Robert W. Kolb 1993).

1. The Cost-of-Carry model in perfect markets

The futures price must equal the spot price plus the cost of carrying the spot financial commodity forward to the delivery date of futures contract. Expressing it mathematically, we have the following equation:

\[
F_0,t = S_0(1+C)
\]

where \( F_0,t \) = the futures price at \( t = 0 \) for delivery at time = \( t \)

\( S_0 \) = the spot price at \( t = 0 \)

\( C \) = the cost of carry, expressed as a fraction of the spot price

Otherwise, there is an opportunity for Cash-and-Carry or Reverse Cash-and-Carry Arbitrage.

2. The Cost-of-Carry model in imperfect market.

Market imperfection does not invalidate the basic framework shown above. To prevent arbitrage, the reasonable financial futures prices within a bound are quantified below:
\[ S_0(1-T)(1+C) \leq F_{0,t} \leq S_0(1+T)(1+C) \]

where \( T \) is transaction cost. Robert W. Kolb (1993) applied above rules to the cases of interest rate futures and stock index futures.

**Typical Application of Financial Futures**

Interest rate futures include short-term, intermediate-term, and long-term interest rate futures, which are particularly of significance for hedging purpose. The representative short-term interest rate futures are Treasury bins, certificate of deposit (CD), and Eurodollar futures contracts. Treasury notes and GNMA futures are intermediate-term while Treasury bonds futures are almost the only long-term futures. Intermediate-term futures usually are not the best choice in the longer-time hedging. GNMA is associated with greater administrative problems and especially relative difficulty of secondary trading. It is also argued that the hedger often could do at least equally better by using Treasury bonds futures in the place of Treasury notes futures, due to its uncertainty of cheapest delivery and market liquidity.

Interest rate futures can be used in the following representative ways (Anderson 1993):

1. Selling interest rate futures contract for the borrower to fix the future cost of funding, or more generally for the institution to hedge against increasing interest rates. The short interest rate hedge generates a profit when interest rates increase above the market's expectation of future rate. The problem here is that the timing of interest rate futures does not necessarily fit the time schedule of the borrowing program.
2. Buying interest rate futures for institutions to hedge against falling interest rate and lock in the return on future loans or investments. The risk of unmatched timing still exists.
3. Selling interest rate futures to hedge investment in long-term securities. The applicability of this kind of hedging heavily depends on an unexpected favorable movement in the interest rate level against the initial outlook.
4. Preventing the underwriter of
new issues from loss. (5) Buying (or selling) short-term interest rate futures to lengthen (or shorten) the effective maturity of short-term investment assets. Similarly, selling (or buying) interest rate futures can lengthen (or shorten) the liabilities. (6) Speculating to gain intramarket spreads, intermarket spread and intercurrency spread. Intramarket spread involves different maturities in the underlying instruments. Intercurrency spread assumes a stable foreign exchange rate development and a strong convergence between the interest rate levels of the two currencies. (7) Immunizing portfolio using interest futures.

The currency futures market is similar to the currency forward market in many ways. Currency futures can offer some hedging opportunities. But currency futures are much less popular hedging tools compared to currency forwards, due to their several differences (Bishop and Dixon 1992). First, there is no flexibility in the currency futures market in amounts and delivery dates. In the case of frequent fluctuation of exchange rates, even a small proportion of unmatched positions implies possibly much loss. Second, currency futures are also only available on a few major currencies and are more difficult to use for cross-rate deals. Third, the cash margin requirement tied with possibly daily change in exchange spot rates and their future prices are a significant burden for many corporations. In contrast, currency forwards include all currencies that can be traded and can be dealt at any time of a day, whereas currency can not. More importantly, Currency forward markets have more liquidity (which seems unique an exception to the rule that exchange-traded derivatives are more liquid than OTC derivatives), and large transaction can be completed more quickly and at one price. For this reason, most participants tend to rely on forward contracts. In fact, currency futures markets are more suitable to speculate and speculators are the largest users of the futures market.

Stock index futures contract is an standard agreement between the clearing corporation of the futures exchange and the sellers and buyers of the contract to deliver or take delivery of
funds equal to the value of an underlying market index (times a set multiple) at the end of a specified period. The stock index futures are intended to hedge the systematic financial risk or overall market risk. Stock index futures can be utilized to apply in the marketplace in the following ways: (1) adjust portfolio market exposure and enhancing the market timing of the exposure through buying or selling stock index futures. It can serve the purpose of hedging or just speculating. (2) arbitrage with stock index futures to reap intramarket spreads. The opportunity arises when a particular group of stocks on which a futures contract exists is believed to lead all other stocks during major market moves (in practice, comparing the correlation coefficients between indexes over different intervals of time); (3) arbitrage between a particular index futures and its underlying index when the futures contract is believed to be out of line with the fair or theoretical price; (4) use index futures to prevent the losses of a portfolio below the floor level of return. It equivalently creates a protective put by shorting index futures to reduce beta associated with allocating a portion of portfolio to risky instruments and the remainder to riskless index futures, but it requires more frequent monitoring and updating as the market moves significantly in either direction. Inevitable basis embodied in the futures would cause a deviation of realized return from the specified floor value.

Morris (1989) pointed out that managing market risk by hedging with stock index futures prevent from the same problems associated with traditional methods of managing market risk. The major advantages include lower transaction cost and more consistency with other investment strategies, but the limitations are also emphasized. Basic risk still remains even after portfolio has been hedged. When the portfolio contains a large proportion of firm-specific risk, the basic risk will be higher and thus stock index futures are not very effective in reducing the overall risk of a relatively undiversified portfolio. In fact, the best stock index futures contract for hedging should be that whose price is most correlated with the value of the portfolio. Index futures
trading also involves new types of risks. One is marking-to-market risk, which often causes problem of immediate cash. Another is managerial risk, which is broadly defined as the risk resulting from inappropriate strategies.

**Financial Swap**

*Overview*

Financial swaps are agreements between counterparts to make periodic payments to each other for a specified period.

The basic kinds of financial swaps are currency swaps and interest rate swaps. However, there are increasingly more variations. Here we only focus on generic or plain vanilla swaps. A little later, we extend our attention to some exotic swaps.

Financial swap market is in explosive development due to its unique characteristics. Compared to exchange-traded financial futures and options, financial swaps escape many of the limitations inherent in them (Kolb 1993). First, swap agreements are more flexible to meet the specific needs of the customers. Second, swap market offers participants a privacy in trading that can not be obtained in exchange trading. Third, the swap market is virtually subject to little government regulation while the futures and options exchanges are regulated considerably by government. The CF17C has formally announced that it will not seek jurisdiction over swap market.

On the other hand, financial swaps also have their inherent drawbacks. First, it is more difficult to find a counterpart to consummate a transaction. Especially when the contract terms are unique, it would cause serious problem of prohibitive searching cost. Second, swap agreements are less easy to be altered or terminated early since this requires the agreement of both parties. This implies the liquidity problem. Third, for futures and exchange-traded options,
the performance on the contracts for all parties is effectively guaranteed by the exchanges. In contrast, financial swaps carry more credit risk (default risk).

Financial Swap Pricing

In general financial swap pricing can be viewed as consisting of three major components: forward prices, transaction costs, and credit risk inherent in the transaction (Clifford W. Smith, Jr., et al. 1986; Robert W. Kolb, 1993.)

1. Forward prices. The forward price is central to any swap agreement, whether it is in the form of forward interest rate, the forward exchange rate, or the forward price of a commodity. The forward rate embodied in a swap contract must be consistent with those contained in other corresponding financial contracts such as bonds and financial futures. If there are no ready arbitrage opportunities, the forward rates for financial swaps must be the same as the market's view of the future, which is reflected in prevailing term structure. Hence, the forward rate component is determined by competition from other credit market instruments.

2. Transaction costs. This component would be reflected in the bid-ask spread for a risk-free transaction plus any origination fees that are charged. The primary determinant of bid-ask spread is demand for liquidity or liquidity risk. Put it another way, the bid-ask spread depends on the availability of additional counterparts to offset the initial swaps. For some complicated swaps, certain fees are charged for designation.

3. Credit risk. In contrast to the preceding components, which are both independent of the counterparts, the credit risk premium is determined by appraising the creditworthiness of the swap partner. The main concern is the default risk. A swap used as a hedging tool is considered to reduce substantially the default risk and usually charged with a lower swap price. Another typical factor is any regulatory constraints on the flow of capital that influence the efficiency of
the markets. That is why the swap involved with cross-border currency flows is sometime charged higher price.

*Typical Applications of Financial Swaps*

In general financial swaps are widely used to hedge and reduce financing cost, but seldom to speculate. This is due to the high transaction cost compared to those of other financial derivatives, according to the market participants (GAO 1994). The use of financial swaps are broadly summed up in four categories (Smith et al. 1986): (1) financial arbitrage, (2) exposure management, basically applied in asset or liability management, (3) tax and regulatory arbitrage, and (4) completing markets, or put another way, filling gaps left by missing markets.

Smith et al. (1986) pointed out that the financial arbitrage appeared to be significantly less important than when swaps markets first opened. They can be applied typically in the following cases (Geanuracos and Miller 1991), most of which are reported from the major U.S. companies:

1. Lowering borrowing costs. Firms can often cut debt costs by borrowing in the market of their best comparative advantage and swapping into their preferred liability structure.

2. Hedging long-term translation exposure. For hedging long-term foreign exchange exposure, especially of five years or more, a currency swap is often the only viable method available.

3. Minimizing interest rate risk. Companies can use swaps to switch from fixed- to floating-rate debt and back again, depending on their forecasts of interest rate movement.

4. Restructuring the balance sheet. Swaps can be used to reach this goal and create both interest rate and currency hedging advantages, as well as a tax advantage.

5. Reaping tax savings. A combination of intracompany loans and currency swaps
herpes exploiting favorable tax treatment.

(6) Circumventing exchange controls.

(7) Freeing blocked funds. In countries that prohibit currency swaps, including certain Latin American and Asian countries, multinational corporations could take advantage of interest rate swaps are an increasingly important potential means in asset and liability exposure management. The uses of interest rate swaps as a debt instrument is recognized earlier than as in asset markets. Interest rate swaps can be applied typically as a liability management tool as follows: (1) Creating synthetic fixed or floating rate liabilities. It can help fix the cost of short-term debt in the former case or to be provided with lower interest cost funding over a period. (2) Unlocking the high cost of existing fixed rate liabilities. This depends on the borrower's expectation that a floating interest rate would cut down the funding cost for the relevant term. It is particularly attractive in the case that the relevant borrowing can not be repaid or refinanced or that prepayment penalties are applicable and/or the costs associate with refinancing would be significant. (3) Managing the cost of current floating rate liabilities. The cost saving results from the differences between the rates payable on the successive swaps.(4) Managing the cost of fixed rate liabilities. This enables the borrower to preserve the value of its below market fixed rate funding even in a declining rate environment.

Interest rate swaps also can play a role in managing asset or investment portfolio (Das 1989). The classic use of interest rate swaps in asset market is to create synthetic fixed or floating rate securities that best satisfy return and portfolio requirements.

Another use is to lock in unrealized profits (or minimize losses) on the capital value of fixed rate investments originating from interest rate fluctuations. Utilizing interest rate swaps rather than physical purchases and sales of securities would have yielded curve (or maturity) switches undertaken more conveniently and in more cost-effective way. This lengthening or
shortening of the term of the portfolio consistent with rate expectation would maximize the gains and/or minimize the losses resulting from yield curve changes. Also, interest rate swaps can be used to improve portfolio performance on both fixed rate and floating rate assets.

The basic use of currency swaps in managing liability includes hedging foreign currency exposures and locking in foreign currency gains or minimizing losses on foreign currency borrowings.

Currency swaps can also be utilized in asset markets in the following ways:

(1) To create synthetic foreign currency assets, in which the ‘investors pay interest rate related to one kind of currency and receive interest flows based on the other kind of currency. It may be particularly useful in attaining favorable tax treatments, through avoiding the implications of withholding tax on a transaction or alternatively creating securities synthetically where equivalent securities may not exist. (2) To lock in foreign currency gains or minimize losses on foreign currency investments.

It is worth noting that the use of financial swaps as an instrument of active asset or liability management requires the capacity to enter into and especially subsequently reverse the original transaction. The depth of the relevant markets determines the availability of desired liquidity and then the efficiency of financial swaps applied in these cases.

Moreover, according to data collected by GAO in 1994, little financial swap is reported to trade on equity markets. This is partly because that equity swap is such a new instrument as emerged in 1990 and market is not yet developed. However, recently financial swap agreement concept has begun to be used by institutional investors on exposure to equity markets. An equity-index-linked swap or a (cross) currency equity-linked swap has initiated. The appeal of the equity index-linked swap lies in that equity index returns can be earned without incurring basis risk or margin requirements, compared to the existing index futures and index options. This
implies savings in transactions and custodial costs. However, it also has a major limitation of less liquidity and credit risk, which can largely account for the present lack of the specialized market.

**Nongeneric Swaps**

A nongeneric swaps is one whose terms deviate from those that define a generic swap (Arditti, 1996). Some frequently encountered nongeneric swaps are accreting swaps, rollercoaster swap, basis swap, zero-coupon swap, forward swap, asset swap, and index amortization swaps. Accreting swaps have an increasing notional principal and often are tied to real estate finance. Rollercoaster swaps can hedge a floating rate loan in which the balance first increases and then diminishes.

**Financial Option**

**Overview**

An option is the right to buy or sell, for a limited time, a particular good at a specified price. There are two types of options, call options and put options. While the ownership of a call option gives the owner the right to buy a particular good at a certain price, with that right lasting until a particular date, Ownership of a put option gives the owner the right to sell a particular good at a specified price, with that right lasting until a particular date.

Prior to 1973, options of various kinds were traded over-the-counter. In 1973, the Chicago Board Options Exchange (CBOE) began trading options on individual stocks. Since then, the options market has experienced rapid growth, with the creation of new exchange and many different kinds of new option contracts. There exchanges trade options on goods ranging from individual stocks and bonds, to foreign currencies, to stock indexes, to options on futures contracts.
Financial Option Pricing

Option pricing is the most attractive among financial derivatives and a lot of work has been done on it. Fischer Black and Myron Scholes (1973) provide the first explicit general equilibrium solution to the option-pricing problem for simple puts and calls. It is still a basis for the later development in this field. An excellent survey (Smith, Clifford W, Jr, 1976) was conducted to examine other major pricing models to extend and modify the Black-Scholes model. Here we just focus on the pricing of two simplest forms of (financial) option, i.e., puts and calls.

1. The pricing of call option. In this case, the Black-Scholes theoretical model price is usually very close to the market price of the option (Robert W. Kolb, 1993). The formula for the Black-Scholes option pricing model is given by:

\[ C = SN(d_1) - E \exp(-RfT)N(d_2) \]

Where:

\[ d_1 = \ln(S/E) + \left( Rf + 0.5r^2 \right) T/\sqrt{rT} \]

\[ d_2 = d_1 - \sqrt{T} \]

\[ N(d_1), N(d_2) = \text{cumulative normal probability value of } d_1 \text{ and } d_2 \]

S = stock price
E = exercise price
Rf = the risk-free rate of interest
\( r = \text{instantaneous variance rate of the stock’s returns} \)
\( T = \text{time to expiration of the option} \)

In deriving the model, the following assumptions are employed:

1. The option can only be exercised at the terminal date of the contract. That is to say, it is a European option.
2. There are no penalties for short sales.
3. Transactions costs and taxes are zero.
4. The risk-free interest rate is constant.
5. The stock pays no dividends.
6. The stock price is continues.
7. The market operates continuously.

The subsequent modification of the basic Black-Scholes model shows that no single assumption seems crucial to the analysis. First, Merton (1973) has shown that if a stock pays no dividends, the Black-Scholes option pricing model may be applied directly to value American options. Second, Merton derived the solution to the European call-option-pricing problem when the underlying stocks pay dividends continuously.

2. The pricing of put options. The Black-Scholes model can also be used to price put options through the principle of put-call parity Hans Stoll (1969) as follows:

\[ S - C + P = \frac{E}{(1+R_f)^T} \]

where P is the price of the put and C price of the call.

In summary, there may be six main approaches used to value options in practice: (1) closed-form solution, (2) approximate analytic methods, (3) lattice methods, (4) Monte Carlo methods, (5) quadrature methods, and (6) finite difference methods.

Due to a variety of reasons, the multiplicative binomial and the Black-Scholes models are inappropriate for pricing interest rate options (Arditti, 1996). Two among these reasons are invalidated assumption of constant volatility of the underlying instruments and the yield tending to revert to a long-run level. The arbitrage-free, one-period interest rate tree model is proposed for the pricing purpose. Details of the model construction and operation is available in Arditti (1996).
**Typical Application of Financial Options**

Interest rate caps, collars, and floors are the most popular forms of OTC interest rate options. The holders pay negotiated up-front fee and front-end fee instead of premium to buy these OTC interest rate options. According to Eckl et al. (1990), caps are defined as call options on interest rate and floors put options on interest rate. These OTC interest options can be applied in the following ways: (1) Caps provides protection against interest rate without fixing rates. The short-term borrower with a cap will tend to achieve substantial savings without unlimited risk if rates rise only moderately. Collars function similarly to protect the interest rate risk. The chief difference is that collars limits the possibility of profit from a decline in rates below the floor. (2) Creating synthetic floating rate liability. A fixed rate borrower can create an exposure to a floating interest rate index by purchasing a floor at a level equal to the cost of its fixed rate debt. (3) Purchasing caps and floors as an alternative to price fixing mechanism such as interest rate swaps and FRAS. This basically intends to establish a maximum cost of borrowings or minimum rate of return on investments while maintaining the possibility of lower costs or higher return if favorable movements in the rate structure occurs. (4) Selling caps and floors for a floating rate borrower to lower its cost of borrowing. It can be originated from gains (particularly in stable market environments) from the premium received from option writing activities which can be speculative or written against offsetting portfolio position.

The essential difference between caps as well as collars and swaps is that the former group is asymmetric and the latter symmetric risk management instruments. In a comparison of all-in hedging alternatives, it seems a natural outcome that fixed rate provided by interest swaps is the best protection against very high interest rates in the future while caps or collars provide protection against high rate level at high costs.
Currency options, also called Foreign Exchange (FOREX) options, are divided into two categories: the traded FOREX options and the OTC FOREX options. The traded options market is only possible to buy options on a small number of currencies and only denominated in US dollar. That is why OTC market is relatively important to be a supplement and has grown during 1986-1988 at a phenomenal rate (Stapleton, 1990). However, both types of FOREX options can employ almost same strategies and serve controlling foreign exchange risks in the several typical ways.

1. Hedging contingent exposures in foreign currency. Contingent foreign exchange exposure is closely related to the future cash flows in foreign currency which is possible but not certain. In this case, currency forward or futures alone cannot work well in hedging. Disposals of foreign subsidiaries, uncertain foreign sales, and uncertain dividend remittances from abroad result in contingent or potential receivables. Two basic techniques for coping with contingent receivables are (1) buy a put option on the foreign currency or (2) sell the foreign currency forward and simultaneously buy a call option. Similarly, contingent payables in foreign exchange occur as the result of transactions such as stock tender offers, merger and acquisition tenders to foreign companies, pending foreign lawsuit, and probable foreign dividend payment. Also, there are two ways of hedging: (1) buy a call option on foreign exchange or (2) simultaneously buy a long currency forward contract and a put option.

2. Active management of foreign exchange exposure. Except the kinds of foreign exchange exposure mentioned above, hedging other kinds of currency exposure by using currency option can have the additional flexibility and the provision of complex risk-return trade-off profiles, which would not be available through other derivative instruments. The two important strategies involved are currency option straddles and spreads. 3. Currency options are used to better international portfolio management. It possibly increases the expected return of a
portfolio by accepting more risk and to reduce the risk of a portfolio by accepting lower expected return. If an international portfolio cover all of the foreign exchange positions by buying currency forwards or futures, the expected return is locked in at the cost of removing any upside potential. Currency options instead provide other trade-offs. In a case study of Merck & Co., Inc., (Lewent and Kearney 1990) which involved net asset and revenue exposure to exchange, it was concluded that currency options are preferred to currency forwards under the weak U.S. dollar scenario, since it retains the opportunity to get possibly large potential gains at a cost equal to the premium. In a word, high volatility of exchange rate fluctuation makes currency options generally superior to currency forward, and vice versa. However, the cost is rather high. According to Howcroft and Storey (1989), currency options on average cost approximately 6% a year on major traded currencies.

In sum, currency options are usually the second best alternative behind either a spot or a forward contract. If one had a strong opinion on future market direction, dealing forward would likely be preferable to an option.

An index option is also called stock index options. So far index options are based on market indexes that includes as few as 20 stocks and as many as 1700 stocks. Standard & Poor's 100 index option accounts for about 80 percent of the daily volume traded in all stock index options (Brenner 1990). Stock index options can be used in portfolio management in ways similar to the use of stock options in single stock market. But stock index options may be preferred to stock options for its broader strategies in a portfolio as a whole. They provide a risk-return profile that matches closely most diversified portfolios and they are cheaper than a portfolio of stock options. Here the application with an emphasis on the special aspects of index strategies is described, including (1) to buy index puts and protect a portfolio of stocks from declining in value below a given level, and (2) writing index call options to enhance portfolio
return when the market is believed to be rather 'stable' in the near future. In fact, it is the most popular strategy adopted by mutual funds according to a survey conducted by CBOE in 1987. (3) To produce 'synthetic' portfolios. Buying an index call or writing an index put could be a substitute to buying a large diversified portfolio at a faster speed. Diversification, especially for small investors, is essential to reduce unsystematic risks. Making short position in portfolio by using index options is much more difficult. (4) Using index options to enhance investment return by varying the allocation of funds among broad asset classes, typically between a stock market index, long term bonds and cash equivalents. It results from exploiting inefficiencies in relative prices of securities in these classes. Compared with index futures applied in similar case, using stock index options in the asset allocation guarantee that a change in the level of the market automatically alters the portfolio's exposure in the different asset classes. This will make the whole portfolio less risky and cut down the need of subsequent transaction. (5) Hedging the written options by buying comparable index options. This is the only practical way in the case of users with a negative gamma. Hedging with index futures can make the position 'delta neutral' but it does not affect the gamma, which implies that loss would be incurred even with the hedging if there is a big change in stock prices in a short time interval; (6) using index options to hedge individual stocks because it is claimed that at least 40 percent of the volatility in individual stocks is due to market volatility. In fact, index options are the only efficient hedging instrument for stocks that have no listed options and those that have illiquid options.

Traded options on debt instruments fall into two broad categories: options on actual or spot debt instruments and options on futures contracts. Interest rate options or debt options, in most cases only referred to exchange-traded ones, are often tied into an underlying futures contract. It is in fact an option on futures and we discuss later. Here we refined interest rate options to an option on physical debt instruments.
Finally, we focus on options on futures or futures options. There are some important differences between options on physicals and options on futures. First, exercising of options on futures requires an immediate cash settlement between the buyer and the seller, contrasting with exercising the other kind of options on physical assets. Second, call options on futures encourage early exercises while call options on physicals discourage the similar market behavior. These distinct features will impact the pricing of options on futures. If the futures price is higher (lower) than the spot price, the call option on futures should sell for more (less) than the call option on the physical assets. The reverse is true for put options.

Trading options on futures is a rather indirect method of tracking (financial) commodity price movement. In this sense, options traded on the physical commodity itself would be an efficient financial instrument. However, under the following two basic cases, options on futures should be preferred to on actuals (Leuthold et al. 1989). First, options traded on futures are subject to less of a liquidity constraint on exercise. While the cash market supply of any commodity is limited, the available supply deliverable against the option on a futures contract can be expanded to a unlimited extent by futures traders. Second, the capital requirements for taking a position on exercise of the option on a futures contract are typically much smaller than those required for exercise of an option on the commodity itself, which involves posting the entire cash value of the strike price. Options on futures thus allow a greater access to the hedging or speculative opportunities than options on the physical commodity itself.

Options on futures can be used combining the features of futures and options. (1) Calls on futures can be used much like a long futures position for both speculative and hedging purpose, when a price increase is expected. The key difference between them is that the loss is fixed at the initially paid premium in case of options instead of the basis risk in case of futures which implies unlimited risk in theory. But the buyer also has some flexibility in the amount of premium paid.
(2) Call options’ ability to fix a maximum price to be paid on a financial commodity is particularly attractive to an investor with an anticipated long position in an underlying financial instrument. (3) Using a put option rather than a short futures to speculate.

There are several cases of applying options on interest rate futures. Option on Treasury-bond futures can be used to control market timing based on market outlook and provide a means of enhancing investment returns with minimal risk. This is largely because that for some market participants, say, pension managers, are typically not structured to short cash bonds and thus buying put on a negative market outlook is a distinctive advantage. Options on bond futures can also be used to structure buy/write position against the cheapest-to-deliver Treasury bond. This type of strategy involves buying a cash bond and selling call options and receives income from the cash bond and premium from calls.

**Exotic Financial Options**

There are a number of different types of exotic options and their uses, particularly as hedging instruments. They are (1) barrier options, (2) Asian or average options, (3) currency-translated options, (4) packages or hybrid options which can be used to tailor specific risk profiles with an arbitrary piecewise linear payoff function, (5) forward. Arditti (1996) also discussed in greater details five types of popular exotic options, including the exchange option, the look-back option, the up-and-out put (a form of a barrier option), the Asian option, and the compound option.

**Comparison and Selection of Financial Derivatives in Hedging**

**Hedging interest rate risk.**

The choice of an interest rate swap or an interest rate futures as an hedging vehicles involves trade-offs in terms of cost, flexibility, convenience and credit risk. To assess the costs, the bid/ask spread plus commissions in the two derivative markets should be compared. Since an
interest rate futures has much shorter life and a series of futures contracts are often needed to hedge longer-term interest rate exposure, which probably cause some uncertainty on futures yields. In contrast, interest rate swaps can offer interest rate protection in one contract. But futures provide more flexibility to hedgers to adjust their positions than swaps, though consideration on managerial convenience seems in favor of swaps. Also, interest rate futures impose no additional credit risk while an ever-present risk of an interest rate swap transaction is counterpart default. Again, a major consideration on selection between FRA and an interest rate swap is that an interest rate swap can manage interest rate risk in one contract rather than by a series of FRA contracts. The drawback of interest rate swaps, futures, and FRAs is that the user cannot take advantage of favorable movements of interest rate. Interest rate options overcome this problem. An important consideration on options or futures hedging against interest rate risk is certainty of activities. When a future borrowing or lending or investment is certain to occur, hedging by using interest rate futures is recommended; if not, hedging by using interest rate options is better (Howcroft and Storey, 1989, pp91).

Hedging currency risk

Currency forward is often the best choice because of its low cost, flexibility, and enormous market liquidity. It is particularly true when exchange rate is only moderately volatile. Currency options are usually the second best alternative, behind a spot or forward. If one has a strong opinion on future foreign exchange market direction, dealing forward would likely be preferable to an option. However, it is also argued that high volatility of exchange rate fluctuation can make currency options superior to currency forward in many cases (Lewent and Kearney 1990). But the currency option is much more expensive. According to Howcroft and Storey (1989), currency options on average cost approximately 6% of the value of the currency involved a year on major traded currencies. Currency swaps have some advantages over currency
forwards in hedging long-term currency risk (Handjinicolaou, 1990). The corporation has to pay the currency at a faster rate under the long-dated forward structure than in currency swap structure. The corporation might prefer the currency swap if its investment does not generate enough cash in the beginning year or even in the earlier years. It also implies the corporation has less credit exposure by using currency swaps. The cost of the two markets should be compared. If there exists discrepancies between these two markets, it gives rise to arbitrage opportunities. So far no explicit fee is charged with currency forwards but with currency swaps. Also, market liquidity in the two markets is very important consideration. Additionally, currency swaps can allow easy hedging of complex exposures. That is partly why it is popular to banks that have more expertise.

Currency futures are generally much less popular hedging tool compared to currency forwards, due to their several differences (Bishop and Dixon 1992). First, there is no flexibility in the currency futures market in amounts and delivery dates. In the case of frequent fluctuation of exchange rates, even a small proportion of unmatched positions implies possibly much loss. Second, currency futures are also only available on a few major currencies and are more difficult to use for cross-rate deals. Third, the cash margin requirement tied with possibly daily change in exchange spot rates and their future prices is a significant burden for many corporations. In contrast, currency forwards include all currencies that can be traded and can be dealt at any time of a day, whereas currency futures can not. More importantly, Currency forward markets have more liquidity (which seems unique an exception to the rule that exchange-traded derivatives are more liquid than OTC derivatives), and large transaction can be completed more quickly and at one price. For these reasons, most participants tend to rely on forward contracts. In fact, currency futures markets are more suitable to speculate and speculator are the largest users of the futures market.
Hedging equity risk

Brooks (1989) examined strategies employing stock options, stock index options, stock index futures options, and stock index futures. He argues that when considering covered call writing or protective put buying, two of most common option hedging strategies, stock or stock index options appear to be preferable to stock index futures options for risk-averse investors. In some cases, stock index futures is more attractive than equity option, due to its lower cost.

Financial Engineering: Exotic Combinations of Financial Derivatives

One of the most important functions of financial derivatives is risk management. Some types of risk are simple to manage only with single financial derivative available in the marketplace, but others require custom solutions. It also applies for other major functions of financial derivatives. In fact, financial engineering generally refers to creation of custom solutions, especially for complex risk management, by using a combination of financial futures, options, forwards, and swaps. The most common combinations are reported as follows.

Combinations between options (Kolb, 1993). Combining options in certain way possibly create a position that has almost any desired level of risk exposure (Kolb, 1993). Straddles, strangles, bull and bear spreads, and butterfly spreads are the most common forms. Another important case is the compound option, an option on an option (Arditti, 1996). The classic use of a compound option is in tendering. For an example, when a US corporation bids for a British firm in sterling, it faces two uncertainty in acceptance of the bid and in the future dollar cost of sterling. Buying a European call on another European call can mitigate the associated financial risk.

Combination between forwards. A swap contract is normally the result of the combination because it is in essence nothing but a series of forward contracts strung together
Combination between swaps. A forward contract can be synthesized by two swap contracts with different life.

Combinations between options and swaps. There are two outcomes. One is options on swaps while the other is option swaps. Options on swaps refer to an option either to enter into or to provide the swap at a known price over a specified period. In essence, options on swaps combine the features of interest rate options with swap transaction. Options on swaps can further be classified into three classes: (1) swaption, (2) callable and putable swaps, and (3) contingent swaps. Swaption can provide the user to limit its downside risk in switching from fixed to floating interest rates or vice versa, without limiting potential benefits associated with unforeseen favorable interest rate movements. The holder of the callable (putable) swap enjoys the additional flexibility of the call (put) provision but pays an up-front premium or an adjustment built into the swap rate. The contingent swap structure may generate significant savings compared to a standard swap. Option swaps refers to transactions involving the purchase or sale of options on financial instruments and commodities. The structures essentially entail the securitization of options embedded in securities issues. There are also three basic option swaps, which are interest rate option swaps, foreign exchange or currency option swaps, and stock index option swaps.

Combinations between forward and swap. A forward swap is in effect a forward contract on a swap and can be constructed as a package of swaps (Smith et al. 1989). It usually aims to cope with a firm's exposure to interest rate at a known date in the future though it is currently unaffected by interest rate movements. Das (1989) defined it as an interest rate swap which commences at a specified time in the future, and pointed out that forward swaps are usually utilized on the market (1) to lock in fixed rates commencing at a specified time in the future, (2)
to extend existing swaps or fixed liabilities to suit a changing asset or liability profile, (3) to generate fixed rate funds at the current lower interest rate with the call option. Brown and Smith (1990) discussed how to use forward (interest) swap to manage callable debt. Showers (1992) focused on another kind forward swap that was termed forward currency swaps.

Combination between options and futures. The product is options on futures which is already actively traded on exchanges. As we mentioned, options on futures generally provide an increased market liquidity than options on underlying cash instruments.

Combinations between options and forwards. The major consequence of this kind of integration is forward options or options on forwards, and options on forward rate agreement is originally common form (Smith et al. 1989). It also can be applied in currency contract by market-making banks (Howcroft and Storey, 1989.)

Using Financial Derivatives in Agriculture

One of the most important functions of financial derivatives is risk management; it is already widely recognized by most market participants. Recent publicity of losses in derivative
transactions casts some doubt on the soundness of using derivatives. However, many have realized that properly managed derivatives are a key to keeping the US financial system competitive, and losses mostly result from speculation and other factors not directly related to derivatives.

This part provides a review of the use of financial derivatives as a risk management tool in agriculture, focusing on interest rate derivatives by several major lenders and the discussion to financing agriculture. First, major potential user groups and risks involved in agriculture are briefly discussed. Second, general benefits of using financial derivatives are presented. Third, individual use of financial derivatives by major agricultural lenders is examined in the following order: commercial banks, thrift institutions, and life insurance companies. Finally, implications for financing agriculture by using derivatives are discussed in more depth.

**Major Users and Business Risks in Agriculture**

There are two basic categories of potential users of financial derivatives in agriculture: agricultural production units and financial intermediaries in agriculture.

Agricultural production units refer to farmers and farm firms, and the former with relatively small operations traditionally covers large proportion. Both of them are facing the following financial characteristics (Barry et al. 1995): (1) Agriculture in the United States is still a capital-intensive industry with large proportion (70-80%) of investments in farm real estate. The dominance of real estate among the other farm sector's assets obviously shows the sensitivity of asset structure in agricultural production to interest rate movements. In fact, real estate debts usually comprise about 55 percent of the sector's debt obligation. (2) Since 1970s, the farm production has heavily relied on borrowing funds largely with variable rates (the ratio of interest expense to total production expense has been steadily above 10 percent), and thus was added with rate-sensitive debts. The general relative decline in the net farm income also
contributes to it. Moreover, a more complex risk environment emerged in the 1980s, lower exchange rates for foreign currencies in 1970s vigorously helped to increase US agricultural exports and farm income while a reversal of the pattern in 1980s caused lower exports and declining farm income. It reflects the farm sector's growing sensitivity to forces in the international markets and foreign currency risk.

Financial intermediaries in agriculture in the United States refer to commercial banks, Farm Credit System (FCS), life insurance companies, trade credit especially by agribusiness &ms, individuals and sellers financing, and Farmers Home Administration (FmHA) Commodity Credit Corporation (CCC) and some other governmental lending institution (Barry et al. 1995).

For farm real estate loans normally with the maturity more than 10 years and less than 40 years, FCS (34.3%), commercial banks (22%), life insurance companies (13%), FMHA (10.3%), are listed as major institutions of financing with decreasing contribution, according to the data in 1990. In contrast, in 1990, commercial banks (46.3%), individual lenders (including trade credit and individual and sellers financing) (18.3%), FmHA (15%), FCS (14.9%), and CCC (6.2%) are the most important sources for intermediate or short-term non-real estate farm debts.

Obviously, two major kinds of risks involved in the United States agriculture are interest rate risks and foreign currency risks. The major forms of foreign currency risk are the following (Lewent and Kearney 1990; Bishop and Dixon 1992):

1. Transaction exposure. It refers to a change in the expected result of transactions arising from business transactions that are planned, are currently in progress, or have already been completed. Examples include a signed, but not shipped, sale contract; a foreign-currency-denominated receivable or payable; and a collected, but not converted to local currency receivable.

2. Translation exposure, also called accounting exposure. It concerns gains or losses occurring in the translation of foreign currency assets and liabilities to local currency and affects the
financial statement.

(3) Economic exposure, also called "future revenue' exposure. It is defined as a change in the dollar value of future earning power and cash flow as a result of currency adjustment.

(4) Competitive exposure. It refers to a change of a company's competitive position due to currency movement. One of best example is the adverse effect of strong dollar on the competitive position of much of U.S. pharmaceutical industry in the early 1980s.

Interest rate risk may be of great importance to financial intermediaries while foreign currency risks may not. In contrast, both foreign currency risks and interest rate risks may be important to agricultural production units. Both types of risk can be properly managed by the use of financial derivatives. However, we only focus in this paper on use of interest rate derivatives by major financial intermediaries in agriculture.

Benefits of Using Financial Derivatives

Sangha (1995) summarized the general benefits of using financial derivatives as follows.

1. A prudent use of financial derivatives can provide a new mechanism to manage or reduce various business risks at low transaction cost.
2. The innovative use of financial derivatives can greatly help end-users cut their financing cost.
3. Financial derivatives can provide more access to financial markets, especially to unfamiliar ones at lower costs. Put another way, they can create more complete markets to investors.
4. Financial derivative instruments play an important role in asset management due to their lower transaction costs relative to the spot market instruments.
5. The users of financial derivatives can expect to be offered opportunities on taking advantage of asymmetries in tax and regulatory requirements across different countries, markets or securities.
Financial derivatives can be used to speculate and make profits by assuming certain risks, probably with suitable degree.

Derivatives as a hedging tool in asset/liability management are very attractive and asset/liability management is of greatest interest to financial intermediaries in agriculture, including commercial banks, thrift institutions, and life insurance companies. Compared to traditional portfolio adjustment methods, hedging by using financial derivatives has particular strengths, including high speed, lower transaction costs, and no increased credit risk in management of (interest rate) risks (Morris and Merfeld, 1988). We will survey the typical use of financial derivatives by these institutions.

Use of Financial Derivatives by Commercial Banks

Commercial banks were the earliest and are also the most sophisticated users of financial derivatives. They are not only end-users, but also dealers of derivatives. During the past few years, the use of derivatives in the U.S. banking industry has grown rapidly (Edwards and Eller, 1995). From 1990 to the end of the first quarter of 1995, total assets of those US banks involved in derivatives grew almost 35%, from $2.3 trillion to $3.1 trillion. During the same period, the notional amounts of derivative contracts at US banks almost tripled, rising from $6.8 trillion to almost $18 trillion.

However, the number of banks involved in derivatives is still relatively small about 600 as of March 31, 1995. A primary reason for the low participation rate seems to be the large amount of intellectual and reputational capital required to develop and maintain a comprehensive and knowledgeable derivatives trading function (Gunther and Siems, 1995). Typically, only the large institutions can gather the necessary resources to produce extensive derivative trading operations. The available data confirms that the largest banks account for most of the activity:
The top fifteen banks hold more than 95 percent of derivative contracts (as measured by notional amounts) of the US banking industry. Many argue that the positive association between bank capital and derivative activities is comforting from a regulatory perspective (Gunther and Siems, 1995).

Gunther and Siems (1995) explored the determining factors motivating banks’ derivative usage. Potential effectiveness in hedging risks is claimed to be one of the strongest motivations for using derivatives. Hedging devices vary depending on users’ balance sheet structure. Banks offer a wider array of financial services than any other type of financial institutions. The majority of assets are loans (70.4% in 1990). Most short-term loans and term loans have a variable rate, but some term loans have a fixed-rate. Long-term security holdings are significant (total proportion of all kinds of security holding is 17.9% in 1990). Interest-bearing deposits, the largest form of liabilities for commercial banks (78.2% in 1990), primarily consists of time and saving deposits. Demand deposits are another important source of liabilities (14.4% in 1990).

Traditionally, depository institutions have had longer average maturities on the asset side than on the liability side, and a rise in the interest rate would harm banks. Today, it is very difficult to specify a maturity structure generally applied to banks since they have diversified assets and liabilities, partly attributable to recent deregulation. Commercial banks still suffer funding gaps, though it may be negative or positive. Banks must manage the interest rate risk arising from the negative or positive gap or duration position in their assets and/or liabilities.

Many commercial banks actively use financial futures to manage their asset and liability price risks. Banks with a portfolio of fixed-rate assets may wish to hedge prices of these assets against a rising interest rate. Equally important, hedging against a rising interest rate by lenders can help lower default risk if increases in market rates are not reflected in the rate paid by the borrower. Two ways available are to fix the cost of financing or to prevent the portfolio from
further price erosion. Since a bank cannot always easily identify the exact source of funds used
to finance a portfolio, it often may choose to hedge the asset itself. Consequently, the bank can
sell an appropriate amount of underlying interest rate futures (usually long-term). The bank thus
effectively unlocks the return on a fixed asset, matching the unlocked cost of liabilities that
finance the asset. In another case, when a bank is concerned that liability costs may rise faster
than asset returns, it may choose to protect its interest spread. In hedging a bank’s interest spread
it could be easier to lock in the cost of funding than to hedge particular assets. Short position in
Eurodollar and T-bill futures contracts can be used since they more closely coincide with the
nature of a bank’s liabilities. The increase in cost of loanable funds would be offset by gains in
futures contracts.

Some commercial banks may be more concerned about falling rates. Many commercial
banks usually make nice profits as rates rise, because the rates of return on many of their assets
(prime rate commercial loans) can be adjusted daily but the cost of liabilities does not change
until the liability matures. Quite understandably, the rates at which the liabilities roll over often
does not fall as fast as the prime rate on a large portion of the bank’s assets. To deal with the
threat of falling rates, a bank can buy futures contracts, matching the maturity of the existing
portfolio of CDs or other variable rate liabilities. Another use of financial futures is in pre-
refunding existing assets when rates are expected to fall Essentially, the bank can purchase
futures to lock in the future reinvestment rate. If interest rates move lower between the time the
hedge is secured and reinvestment, the hedger’s profit in the futures market helps reduce the cost
of investments.

Listed interest rate options should be very attractive to banks as a hedging tool because of
the contingent nature of many of their assets and liabilities. The two basic options are puts and
calls. A call option gives the owner the right to buy a particular good at a certain price, with that
right lasting until a specified date. A put option gives the owner the right to sell a particular good at a certain price, with that right lasting until a specified date.

The first use of interest rate options in bank asset management involves reducing the risk of a portfolio expansion through the sale of calls or, less frequently, the purchase of puts (against rising rates). For instance, when interest rates payable to depositors increase, the best choice available to banks is to extend out on a positively sloped yield curve (i.e., to invest on longer-term securities and earn a higher positive maturity premium) rather than downgrading the quality of their portfolio (i.e., investing on lower-rated securities typically with higher coupon yield and higher default risk). In that case, the only way available to reduce market risk (i.e., of further rising rates) and not to reduce current yield is to sell the call against position. Interest rate futures are sharply discounted relative to cash instruments in the case of a positively sloped yield curve and thus unacceptable. But the sale of call will bring additional premium income (completely or partially) to offset the depreciation of the portfolio. This proves effective during a period of time when premium levels are rather high with regard to the volatility actually experienced. In situations where banks only want to run the least possible loss in the hedged asset position, buying put is generally preferable to either selling call or futures. The put hedge can flexibly lock in the floor price of the asset portfolio, and even prevent your portfolio from any direct price erosion at the expense of a premium.

Another good application is the hedging of prime rate loan. Though banks usually have a large portion of their balance sheets already in a natural hedge, it still could squeeze bank profits in the short run since earnings on these assets may not be adjusted as quickly as the rising cost of funds. Buying T-bill puts will provide protection against rising rates, and will prove better than other types of hedging methods when the prime rate adjustment in falling rate markets become sticky with regard to the rates on short-term securities. Also note that interest rate swaps
generally would be better than interest rate options for hedging maturity mismatch of banks' assets and liabilities if the mismatch can be expected to last for a longer time. However, due to the high transaction cost and lack of liquidity of swaps during fluctuating markets, interest rate option strategies may be preferable if the assets must be hedged quickly or if the assets are expected to be sold after a relatively short holding period.

Interest rate options can also play a unique role in hedging asset risks of a contingent nature. One of the best examples is to hedge loan commitments (Leatham and Baker, 1984). Lenders frequently approve loans, such as mortgages, and allow a period of time for the applicant to accept or reject the loan. In other word, approval of a loan may implicitly be writing and giving to the potential borrower a put option for, say, 30 to 45 days. A lender could purchase a put option to hedge this risk.

The use of interest rate options on the liability side of bank management is for the most part quite similar to the application on the asset side, except they tend to be on the opposite direction and tend to be more oriented toward the short-term securities. Obviously, banks can use interest rate options or futures to hedge floating-rate liabilities and issuance of short-term CDs. In the former case, banks are forced to use the T-bill options or Eurodollar options since there are no listed options on CDs. As in asset hedging, in the situations where the basis (between futures and cash) is expected to move adversely (that is, the basis is strengthening for long hedging and weakening for short hedging), interest rate options hedge may be a good substitute for interest rate futures or cash hedge. Hedging the issuance of longer-term debt by interest rate options can at times be of particular benefit. When rates are generally expected to fall banks are in a position to purchase calls and extend maturity of their liabilities. The institution can benefit from it whether the expected decline in rates materialize or not. Finally, gap risk, where exposure results from assets repricing before liabilities, can be hedged through the purchase of a call. This will

46
allow greater profitability in the event of sharply rising rates, which may fit the overall risk structure of some banks better than the futures hedge which effectively locks in a rate.

Among OTC derivatives, commercial banks most often use interest rate swap. Commercial banks enter into interest rate swaps for a variety of purposes. Interest rate swap can help them reduce funding cost by benefiting from quality spread, which arises due to differences in interest rate spreads between fixed-and floating-rate credit markets. Typically, the quality spread between borrowers with higher credit ratings and smaller borrowers with lower credit ratings in fixed-rate market than the floating-rate market (Sangha, 1995). Whether they are fixed rate or floating rate payers in the swap, both counterparties can share the quality spread differential and have a lower borrowing cost if the market inefficiencies do continue to exist. However, more importantly, commercial banks can utilize interest rate swaps to manage their interest rate risk. Buying or selling swaps can serve to adjust the duration of banks' portfolio to that of their liabilities. Commercial banks can also provide more credit by using interest rate swap, partly because of greater access to some previously unexploited credit sources, and partly because of provision for better service to customers. Many customers prefer to minimize their rate risk by taking fixed-rate loans. But in the past, banks have found it difficult to extend fixed rate loans outright because their fixed rate funding costs have been high, sometimes as high as those faced by some of their customers. The direct funding sources of lower cost for banks are often from money market. Thus, banks can enter into interest rate swaps agreeing to pay a fixed-rate while receiving a rate based on a floating rate index. Doing so, banks protect them from the later increase in interest rate and make offering of fixed-rate loans feasible: banks pay their debtors the received floating rate (of which a rise is concerned) from swaps and eventually actually pay a fixed-rate and meanwhile expect to receive the other fixed-rate from their loan borrowers. Commercial banks can also provide a floating rate loan, together with a swap, to the
borrower. It is creating an equivalent of a fixed-rate loan to the borrower. But, by unbundling the components (the floating rate loan and the swap), banks can price each more efficiently.

It is worthy of noting that the use of financial swaps as an active hedging instrument of asset or liability management requires the capacity to enter into swap position and subsequently reverse the original transaction. The depth of the relevant markets determine the availability of desired liquidity and the efficiency of financial swaps applied in these cases. However, banks most likely will hedge using an interest rate swap if its gap involves either an intermediate or a long-term planning horizon.

Use of Financial Derivatives by Thrift Institutions

Nonbank thrift institutions have a much narrower scope of business and have been highly exposed to interest rate risk Savings and loans (S&L) are a large percentage of the thrift industry. The S&L’s portfolio primarily consists of long-term fixed-rate mortgage funded by short-term liabilities. The correlation coefficient between the S&L industry’s ROA and the 10-year Treasury note rate over the 1977-86 period is -0.75 (and it is statistically significant at the 2 percentage level) (Morris and Merfeld, 1988). The interest rate risk of a typical S&L is heavily dependent on the interest rate risk of its asset portfolio because the market value of liabilities is not very sensitive to changes in interest rates.

Morris and Merfeld (1988) argue that the effect of interest rate movements on the market value of mortgages can be separated into two components: a fixed-income effect and a prepayment effect. The fixed-income effect is the effect of changes in interest rate on the value of a fixed-rate mortgage holding the length of the payment stream – that is prepayments – constants. The fixed-income effect causes the market value of a mortgage to move in the opposite direction of a change in interest rate. The payment effect, an additional effect on
mortgage value caused by changes in interest rate change, modifies the fixed-income effect such that mortgages rise in value less than other fixed-income securities when interest rates fall and mortgages fall in value more than other fixed-income securities when interest rates rise. S&L's lose when interest rates go up and gain when interest rate rates go down because their costs of funds rise and fall with rate changes but the receipts from fixed-rate mortgage remain constant.

Interest rate swaps may be particularly useful for hedging the interest rate risk of S&L's, in terms of S&L's investment horizons. Swaps essentially allow S&L's to change a variable-rate cost of funds into a fixed-rate cost of funds. To do so, an S&L can enter a swap by becoming the fixed-rate payer and floating-rate receiver. The swap receipts can be used to pay the S&L's variable cost of funds. Thus, interest rate changes would not affect the cost of funds. However, swaps are a good hedge for the fixed-income component of interest rate risk but not for the prepayment component. Thus, swaps are a good hedging instrument for S&L's against small changes in interest rates. But for large changes in interest rates, the prepayment component is large, too. S&L's cannot exclusively rely on swaps to hedge against interest rate risk.

To hedge interest rate risk, S&L's can also use a variety of financial futures trading on different exchanges by taking a short position, selling financial futures. Most hedging by S&L's is done using Treasury bonds or Eurodollar futures. Like interest rate swaps, financial futures are a particularly inexpensive means of hedging. However, since the maturities of financial futures range from three months to two and a half year, swaps are often thought to be better than financial futures for hedging fixed-rate mortgages against variability in interest rates. Short positions in financial futures only provide S&L's with an effective hedge against the fixed-income component of interest rate risk. Still, like swaps, short positions in financial futures cannot hedge accurately against of the prepayment risk. Marshall (1990) argued that the more unpredictable the prepayment rate, the greater the advantage of futures hedging over swap
hedging.

As an alternative, options can be used effectively to hedge against large interest rate risk and to protect S&L's from prepayment risk. Usually, interest rate options on futures rather than interest rate options on cash instruments are in practice. The latter has a far less liquid market. Mortgage lenders can offset the prepayment effect by buying call options to protect from falling interest rates; they can offset the prepayment effect by buying put options when interest rate rates rise, particularly above the mortgage coupon rate. In sum, it is possible to construct a n3ix of options and futures or swaps that practically manage an S&L's interest rate risk.

According to a recent Federal Home Loan Bank Board study, less than 10% of the thrift industry was actively involved in the futures and options at the end of 1986. But the information would be incomplete if we do not allow for the falling interest rates at that time as the most significant deterrent to institutions entering the futures and options markets. Furthermore, the data during 1984-1986 reveals that options tended to be more popular than futures to thrift institutions.

Use of Financial Derivatives by Life Insurance Companies

Life insurers invest the bulk of their funds in long-term securities such as bonds, stocks, and mortgages. But, due to the high predictability of their cash inflows (a major part of which are premiums from policyholders) and outflows, they have less uncertainty in managing their balance sheet than commercial banks and thrifts. Because of legal requirement and tradition, life insurance companies generally pursue income certainty and safety of principal, which have to rely on forecasting interest rate. Life insurers are exposed to interest rate risk particularly rising from their asset management. Thus, employment of financial derivatives in their asset management is the focus of life insurers.
Some typical uses of financial futures by life insurers are illustrated by Powers and Castelino (1991). Insurance companies can use the futures market to hedge the depreciation of their assets since they usually hold a huge amount of fixed income securities. They can also use the futures market to increase the liquidity of their portfolio. A unique problem of life insurance companies is that any losses taken by life insurers in their fixed income portfolios must be charged against accumulated surplus and that lowers the amount of insurance a company can write. Financial futures can be used to help solve this problem. When rates begin to increase, a life insurer could sell futures contracts short against its existing portfolio. The decrease in value of existing portfolio can be offset by the gains from futures market when rates are higher. In this type of hedging, it is not necessary to identify futures contracts to be used for each particular cash position. Instead, only categorization of securities into major groups should be conducted.

A closer look at the use of financial derivatives by life insurers in the real world is based on a valuable survey conducted in 1987 (Figlewski, 1989).
Table 1. Financial Derivatives in Use by Life Insurers (Percent of the group using the contract)

<table>
<thead>
<tr>
<th>Derivatives</th>
<th>Larger Firms</th>
<th>Smaller Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Futures</td>
<td>80%</td>
<td>25%</td>
</tr>
<tr>
<td>Financial Options</td>
<td>60%</td>
<td>12%</td>
</tr>
<tr>
<td>Financial Swaps</td>
<td>67%</td>
<td>25%</td>
</tr>
<tr>
<td>Financial Forwards</td>
<td>20%</td>
<td>19%</td>
</tr>
</tbody>
</table>


Table 2. Most Frequently Used Contract by Life Insurers (percent of the group using the contract)

<table>
<thead>
<tr>
<th>Instruments</th>
<th>Larger Firms</th>
<th>Smaller Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Using Now</td>
<td>Likely In Future</td>
</tr>
<tr>
<td>Money market futures</td>
<td>27%</td>
<td>33%</td>
</tr>
<tr>
<td>(T-bill, Eurodollar, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Currency futures</td>
<td>33%</td>
<td>13%</td>
</tr>
<tr>
<td>Fixed-income futures</td>
<td>80%</td>
<td>13%</td>
</tr>
<tr>
<td>(T-bond, T-note, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock index futures</td>
<td>40%</td>
<td>47%</td>
</tr>
<tr>
<td>Stock options</td>
<td>27%</td>
<td>27%</td>
</tr>
<tr>
<td>Money Market options</td>
<td>7%</td>
<td>3%</td>
</tr>
<tr>
<td>Fixed-income options</td>
<td>47%</td>
<td>40%</td>
</tr>
<tr>
<td>Currency options</td>
<td>13%</td>
<td>27%</td>
</tr>
<tr>
<td>Stock index options</td>
<td>13%</td>
<td>53%</td>
</tr>
</tbody>
</table>

Tables 1 and 2 show that financial futures are substantially more widely used than options. Financial swaps are also common. This is largely because of the less contingent nature of life insurers’ assets and liabilities. The most popular futures contracts are those based on fixed-income instruments and stock indexes, and the most popular options contracts are fixed-income options and stock options. In contrast, life insurers less frequently use money market futures and money market options to hedge short-term interest rate risk since their funding sources are relatively insensitive to the risk.

Many strategies can be employed by life insurers, and the following are some of the most popular. Anticipatory hedging by buying bond futures to lock in a yield in anticipation of a later purchase of actual bonds is one of the most common hedging strategies of life insurers. Another is immunization, using futures to adjust the duration of a bond portfolio. As a short futures position is added to the bond portfolio, the short position is added with a negative weighting into portfolio duration calculation and thus it can serve to lower the weighted average portfolio duration to the desired number (Leuthold, et al. 1989). To immunize a portfolio, it is necessary to adjust the portfolio so that its duration is equal to the holding period or investment horizon. Short hedging of current security position and hedging commitment period risk are also common. Writing covered calls and buying calls are two most common options strategies for life insurance companies. An option is covered when the writer owns enough of the underlying cash instruments to meet the requirements of the contract if it is exercised. A writer can also be covered by owning another call of the same class that a lower strike price. As a covered call writer, a life insures is not required to pay any initial margin costs and aim to earn premium at the expense of giving up the right to any increase in the value of the underlying assets beyond the strike price. Buying calls, and buying puts which is another common option strategy for life insurers, help limit the loss of their portfolios and attain great leverage. Also, as we expected,
speculation by uncovered long or short position or arbitrage to enhance returns are almost never employed in financial futures or option transactions.

**Implications of Financing Agriculture by Using Derivatives**

As pointed out previously, there are two basic categories of potential users of financial derivatives in agriculture: agricultural production units and financial intermediaries in agriculture. However, only the latter is the focus here.

There are various kinds of risks involved with agriculture lenders in the United States. The most significant one, as applied to most financial institutions, is interest rate risk.

Financial deregulation, changing monetary policy, and rapidly fluctuating inflation rates have made market interest rates highly variable. It effects both agricultural borrowers and lenders (Ladue and Leatham 1984). For the agricultural lenders, most commercial banks and FCS have used floating or variable rates, particularly on longer-term farm loan. Life insurance companies generally have not adopted floating rates. In recent years, they typically offer loans with shorter maturities and a provision for interest rate adjustment every 5 years (Barry et al. 1995). The FmHA does not use variable rates. In sum, the major sources of credit to agriculture involve risks associated with floating-rate versus fixed-rate and short-term versus long-term loans.

From the perspectives of agricultural borrowers, they have the same kinds of interest rate risks as lenders but in the reverse directions. Conventional fixed-rate agricultural loans with no prepayment penalties protect agricultural borrowers from upward movements of interest rates and allow them to take advantage of downturns, but things have been changing. During 1980-81, bearing of interest rate risks by agricultural borrowers inflicted losses on their fixed-rate borrowing. Agricultural borrowers can manage these risks by themselves, but may be better off to transfer the risks to agricultural lenders.
Interest rate risk seriously affects the availability of agricultural credit. Based on data on non-real estate agricultural lending by commercial banks in Texas, Betubiza and Leatham (1993) showed that banks have reduced their agricultural loan portfolios in response to increased use of interest sensitive deposits after deregulation since 1980; some banks even stopped making agricultural loans. Quite logically, it can be expected that the new opportunities for agricultural lenders to manage interest rate risk provided by prudent use of financial derivative may help overturn the unsatisfactory trend.

To manage interest rate risks, large agricultural lenders such as some large commercial banks, life insurance companies, and Farm Credit Banks (FCBS) are the primary users of financial derivatives, particularly interest rate derivatives. Ways of using financial derivatives by these two major agricultural lenders, commercial banks and life insurance companies are discussed as above. However, smaller commercial banks are inactive in participating in the financial derivative markets, and the agricultural banks are mostly smaller banks. Thus, there is much potential left to further finance agriculture by employing derivative instruments.

Now let's turn to specialized farm lending institutions. FCS is the most important among specialized farm lending institutions. In general FCS is still a modest participant in financial derivative markets (FCA work group report, 1995). Most Farm Credit Banks (FCBS) use only interest rate swaps, which constitute 98 percent of off-balance sheet uses of derivatives. The total outstanding notional amount reached $13.0 billion as of December 31, 1994, with a credit risk exposure of $60 million. Swaps are used to lower funding costs or for interest rate management in the FCS. Two typical uses of derivatives by FCS are illustrated in greater details (Pederson and Maginnis, 1985). In one example, a St. Paul FCS bank, wanted to shorten the effective maturity of FCS bond portfolio by replacing fixed-rate interest payments with a floating-rate commitment repriced at 6-month intervals. The FCS bank entered a swap and became the
floating-rate payer in the swap with the reset based on the Farm Credit bond coupon rate. Later, due to the decline of interest rates and reduced cost of 6-month FCS bonds, the FCS bank received net interest payments in each period and also improved its debt structure. Another study showed that the Treasury bill futures can be used by the Bank for Cooperatives to hedge against unanticipated increase in its 6-months ahead borrowing costs (Severn, 1985).

In sum, using derivatives is beneficial to agriculture because (1) agricultural lenders can lower their funding cost and thus very probably reduce the interest expense of agricultural production units; (2) agricultural lenders can have greater access to more capital market and thus provide more credit sources to agriculture; (3) agricultural lenders can have more flexible ways to manage interest risks and thus provide loans with more favorable terms (such as lower minimum amount of a loan) to serve agricultural production; (4) agricultural lenders can also reduce or transfer the risks inherent in agricultural production in other indirect ways. Agricultural lenders, for example, can act as brokers or counterparts for agribusinesses in OTC derivative transactions, particularly in interest rate swaps (Covey, 1996). In this case, assumption of a counterpart's role is easier than as a broker. Farmers holding fixed-rate or variable rate loans can protect themselves against unfavorable interest rate movements by entering an appropriate OTC interest rate derivative contract.

Finally, when financial derivatives are applied to finance agriculture, some disadvantages of certain instruments may be deteriorated. Since agricultural banks with smaller asset are the biggest farm lenders, the higher cost may often cause financial options unfeasible to agricultural banks and thus to finance agriculture to some extent. Financial options were found to be prohibitively expensive to hedge interest rates (Leatham and Baker, 1988). In contrast, inexpensive means of hedging, like swaps and futures, are more attractive.

In conclusion, proper use of financial derivatives is beneficial to lenders and further to
customers they serve. This is extremely important to prevent American agriculture from financial distress, which happened before. Some successful strategies in employing financial derivatives by major lenders reported in the paper can help financial intermediaries better use the new financial instruments.
Policy Issues Affecting the Application of Financial Derivatives

Associated with the application of financial derivatives are several policy issues that cannot be ignored, including legal, tax, accounting issues, and of course regulation. We shall discuss regulation first as follows, given the increasing importance of this topic. In particular, it is worth noting that the problem of regulation, in addition to regulatory issues in the general sense, is also extended to include internal control.

Regulatory Issues

Financial derivatives activity has grown rapidly and expanded the financial linkage between the institutions that use them and the markets in which they trade. No matter what differing views regulators and market participants may have, it is agreed that financial derivatives are heavily affecting the operation of financial system.

From 1974 to present, the major responsibility of regulating financial derivatives is split between The Commodity Futures Trading Commission (CFTC) and the Securities and Exchange Commission (SEC). However, banks and their affiliates, one group of largest derivative market participants, as well as thrifts are also subject to overall oversight of four federal bank regulators, which are OCC, Federal Reserve, FDIC and the Office of Thrift Supervision, and/or state-level banking authorities. Insurance companies are specifically monitored by insurance regulators, usually state insurance departments.

For exchange-trade derivatives, the Johnson-Shad Accord basically coordinates the jurisdictions of both. Specifically, the jurisdiction of the SEC covers options on securities, certificate of deposit, foreign currency if traded on a national securities exchange, exempted securities and stock groups or indexes. The CFTC’s jurisdiction extends to futures contracts and options on futures contracts on exempted securities (except municipal securities), certificate of deposit and broad-based groups of indexes of securities, as well as options on foreign currency
not traded on a national securities exchange.

Recently financial derivatives' built-in risks are more expressly addressed by publicity when they are used to transfer or reduce the risks in other financial activities. These risks include credit risk, market risk, legal risk and operational risk. The 1994 GAO report identifies more or less weakness of market participants in the United States, especially those on OTC market, in terms of eliminating all these four kinds of risks. On the other hand, financial institutions and their affiliates are not subject to enough examination, capital and reporting requirements. Since 1980s, the rapid development of OTC financial derivatives created more controversy on financial derivative regulation. In 1993 CFTC and in 1994 GAO separately conducted a study on regulation on OTC derivative market. The conclusions of both are similar: financial derivatives are of help to the United States' financial system and although excessive regulation may hinder the continues development of derivative financial market, strengthening current supervision is needed because significant gaps and weaknesses exist in the regulation of many major OTC dealers and this implies systemic risks. Thus, it calls for not only self-management of financial derivative dealers and end-users, but effective governmental regulation.

Disclosure and reporting of derivatives activities has been recognized one of the most critical regulatory issues. Disclosure of financial derivatives could be improved in three major areas: disclosure of volume and activity of financial instruments, assessment of risk incurred and disclosure of accounting principles used (OECD, 1991).

Internal control

Board et al (1997) made a summary of derivatives regulation, in which the role of internal control is especially emphasized. After the collapse of Barrings in 1995, a lesson drawn is that there is no alternative to the establishment of effective and stringent internal risk control
systems. In Barings, there was no separation of trade and settlement, which allowed Leeson’s activities to be concealed. In addition, there was no formal, and independent, risk management division which monitored Leeson’s activities. The failure makes clear that stringent internal investigations are the principal mechanisms by which the management can inform themselves of the efficacy of their control procedures. These reports should be regularly commissioned and their recommendations must be acted upon.

In fact, positions in derivatives change from minute to minute, so annual or even quarterly reporting is unlikely to be useful for monitoring positions. One of the main managerial challenges is to track derivatives positions for control and capital adequacy purposes. However, in practice, this can only be done internally by banks. Consequently there is a need for supervisors to move from rule-based regulation (e.g. detailed capital adequacy rules) to self-regulation (e.g. reliance on internal risk control systems). This raises the questions of how the official regulators may best test and monitor internal risk control systems. Another challenge is to obtain useful information: for OTC markets on counterparties (credit risk) and total net positions (market risk); for exchanges on total positions (preferably consolidated at headquarters and known by home supervisors).

One main conclusion reached by author is to emphasize the pre-eminence of the need continuously to improve and monitor the performance of internal risk control systems. The power of the internal auditor to check internal control procedures should be enhanced -- the challenge is to do this without reducing the incentive for firms to engage actively in such self-examination. However, even in the aftermath of Barings, the authors do not believe that external or internal auditors should be brought into the regulatory process. They point out a need for reinforcing the role of the Bank of England's derivatives team for checking on internal risk control systems.
Merton Miller (1997) emphasized that no serious danger of a derivatives-induced financial collapse really exists, and for further comfort it may offer to those worried about the dangers from unregulated derivatives, he said that derivatives already are very extensively regulated. He argued against the GAO complaint that SEC has no special or specific requirements for their derivative operations by pointing out two points. First, derivatives business relies heavily on credit quality, no body will deal swaps with you if you can not convince them that you have adequate capital or substantial collateral. Moreover, for further reassurance to the particularly credit-sensitive sector of the market, some of the big brokerage firms have even split parts of their derivatives business off into subsidiaries, with dedicated capital of their own. And far from suggesting any looming capital inadequacy, the ratings of the subs, in fact, are actually higher than that of banks that do most of the derivatives business. Second, those banks, which account for about 70% of the derivatives business, are themselves heavily regulated. The derivatives activities of every bank dealer are regulated by at least one, and sometimes by as many as three separate regulators.

Legal Issues

Legal issues on financial derivatives are essentially related to legal risks associated with financial derivative contracts. In this sense, they include the following three major aspects (GAO 1994). The primary issue is legal enforceability of derivative contracts. In other words, financial loss possibly results from an action by a court or by a regulatory or legislative body that invalidates a derivative contract or prior derivatives transactions. The terms of a derivative contract, for example, may violate a law. Until recently, legal status of swaps in the United States is undetermined because the related law can be applied broadly enough to regard them as illegal off-exchange futures contracts. Another major legal issue is whether a party to a derivative
contract may be deemed to have lacked the authority to have entered into the contract. Some largest derivatives' losses have occurred to date in the United Kingdom due to a legal decision of this kind. A local government council was judged to lack the legal authority to enter swaps and other derivative contracts. The treatment of certain material contract provision in case of a valid contract can also cause legal uncertainty, that is, a court or regulatory body may choose not to enforce a provision of the contract even when a contract is valid. Many derivative market participants are concerned about the enforceability of netting agreements in the United States since the law does not address cross-product netting. In other countries, there exists more uncertainty in this respect.

Additionally, legal protection of derivative products and related services in favor of innovators are another important legal issue. Some experts (Peter K Trzyna 1992) discuss several major ways of protection. A copyright can be used to protect derivative products. Its advantages go as follows: (1) it is inexpensive; (2) it is quickly obtained; (3) litigation is highly efficient; and (4) injunctive relief is relatively easy to obtain. However, it also has a big disadvantage that the protection is rather limited in scope, for instance, ideas are unprotected. A patent can also be utilized to indirectly protect the computerized aspects of the financial derivative product. The advantages include broad protection for 17 years and potent remedies. Again, there are some disadvantages: (1) it is more expensive; (2) only patentable subject matters that are new and unobvious are protected; (3) it is unenforceable until it is issued; and (4) it is potentially expensive to enforce. Unfair competition law is also available to protect a derivative product on security itself. Misappropriation litigation has been successful in protecting stock market indexes. The following are advantages of protections against misappropriation: (1) it exists immediately; (2) it does not involve registration expense; (3) it lasts indefinitely. There are some disadvantages, including that: (1) it might not exist in a given state or at all; (2) litigation is
inefficient; (3) monetary damage and other costs are not likely to be awarded; and (4) it does not protect independent creation or the copying of subject matter that is not unique. The last recommended way of protection is to use a trademark or service mark to protect a derivative on security. A trademark can be used to limit the extent to which a competitor's financial product can be associated with the creator's product. There are several forms of trademark protection, such as common law protection, state protection of a mark, and federal trademark registration. Each form above has its advantages and disadvantages. But of all of the forms of trademark protection, federal registration is considered preferable as it offers significant presumptive rights at a nominal cost. Trademark/service mark protection has the advantages as follows: (1) it may vest immediately upon use upon issuance; (2) it protects against a likelihood of confusion among distinctive symbols used in association with goods and services; and (3) it ends to involve efficient litigation with reasonable remedies. The primary disadvantage is its inability to protect against similar financial product and services marketed under a distinctly different mark.

**Tax Issues**

Tax treatment on financial derivative products severely affects the economic cost and benefits obtained from the current financial products. An investor may incur unexpected tax liabilities that are not consistent with the net economic consequences of a transaction. Moreover, minimizing undesirable tax risks or taking advantage of desirable tax characteristics can direct the development of new derivative products.

1. Classifications of products for income tax purpose (Conlon 1994). The US federal income law does not provide a uniform set of tax rule on financial derivatives, rather, it depends on the result of categorizing a financial product. Current tax law may classify financial derivative products into the following six categories: (1) debt, (2) stock, (3) "pass-through" equity, (4)
options or forward contracts, (5) "mark-to-market" contracts, and (6) "notional principal contracts." As for many other innovative derivatives, they can be classified differently and thus have very different federal income tax consequences to investors. Besides, a more complicated derivative product may be broken into several various parts for tax purposes. It is also important to note that the state law classification of a financial derivative or an entity that issues a financial derivative does not necessarily determine its federal income tax classification.

2. Types of taxpayers. The diversified income tax rules apply to various kinds of entities, such as pension and profit-sharing plan, mutual funds, insurance companies, and so on. These different special rules will modify or even change the normal tax treatment on a specific derivative product. Also, how an acquired derivative is characterized may result in an entity's failure to be qualified for the special tax rule.

3. Source of income and expense. The transactions of financial derivatives in global market may cause the source of income and expense. It is very important to tax consideration. First of all, U.S.-source income that is paid to a non-U.S. investor may place a burden of up to 30% withholding tax. In addition, it is also important for U.S. investors to have the favorable treatment in their foreign income from derivative deal.

4. Property of underlying assets. Derivatives on municipal markets possibly can offer tax-exempt benefit. Investors who desire short-term tax-exempt may invest interest rate swaps, caps and floors on municipal bonds. But there are also some complexities to guarantee the benefit.

**Accounting Issues**

The accounting issues are closely tied with tax consideration. It is often mentioned together with disclosure and reporting requirement as a regulatory issue. The major accounting issues for financial derivatives in global context includes the following ones (OECD, 1991):
1. The relevance of fundamental accounting principles. Due to the lack of standards, enterprises refer to and apply various fundamental accounting principles to financial derivatives, including substance over form principle, the "going concern" principle, the accruals or matching principle, the consistency concept, the prudence concept. But there may be apparent conflicts between these principles when applied to certain derivative products. For instance, in relation to the use of the mark to market approach, say, when it is applied to financial futures, there could be opposition between the prudence and substance over form concepts depending on the interpretation given to these concepts.

2. Recognition of off-balance-sheet transaction. Defining what should be recognized and unrecognized as liabilities in the balance sheet has been a major controversial topic, and it is essential even for some financial instruments already appearing on the balance sheet if their contingencies are not fully disclosed. The particular difficulty in recognition of financial futures, options, swaps and forwards, comes from the fact that normally only transactions for which at least one of the parties to the contract has fulfilled its obligations are accounted for the balance sheet. But the typical feature of financial derivatives is that they have not been fulfilled by either contracting party. Current conceptual framework for accounting and reporting only provides limited guidance with respect to recognition criteria.

3. Measurement of value. There are many methods for measuring financial derivatives. Between countries and even within the same country, practices for different derivative products are rarely identical. In the United States, investors encounter the following valuation rules which are not always consistently applied (OECD, 1991): (1) market value: for trading portfolios, speculative futures contracts, they are carried at market value with unrealized gains and losses included in income; (2) Equity method: for equity securities with sufficient ownership to exercise significant influence. (3) Lower of portfolio cost or market. (4) net realizable
(settlement) value: for short-term receivables and payables. (5) present value discounted at historical rates: for long-term receivables and payables, including bonds. (6) amortized historical cost: investments in debt securities classified as held-to-maturity are generally carried at amortized cost, such as hedged futures contracts. In general the measurement of derivatives by varied agencies depends mainly on the purpose and designation of their use on a particular transaction.

4. Revenue recognition. The accounting issues related to valuation inevitably involve timing and recognition of gains and losses in the income statement. The concept of "realized gains" raises a difficult problem of interpretation. At present, recognition is treated differently depending on whether financial derivative transactions are for hedging trading, investing or financing purpose.

A more in-depth understanding can be obtained by examining the reported accounting treatment of financial futures and options. For financial futures, generally speaking, unrealized gains and losses resulting from changes in futures contract quotation should be recognized currently in the income statement, or in another word, to employ "mark to market" method. But some futures transaction can be provided with hedging accounting treatment, in which the related asset or liability is or will be measured at cost, amortized cost, or the lower of cost or market. A futures contract to be qualified as a hedge of existing assets or liabilities for accounting purpose should meet three conditions and meet five conditions to be a hedge of an anticipated purchase or sale of financial instrument. Gains and losses from short hedge should be deferred to the extent that the futures contracts have been as hedges. Gains and losses from a long anticipatory hedge of an asset or a short anticipatory hedge of a liability would be amortized to income over the holding period of the asset. In the case of financial options, certain guidelines are set forth. First, if puts are purchased to hedge an existing asset carried at cost, premium paid would be deferred,
the gain resulting from offsetting the put would be amortized over the remaining life of the asset, but any gain or loss on hedged position that exceeds the offsetting looser gains should be recognized currently. Second, if puts are purchased to hedge anticipated rollover of deposits or acquisition of a new funding source, any premium paid would be deferred. Third, if call options are purchased to hedge the anticipated purchase of an asset any premium paid would be deferred. Fourth, short put options and naked call options against uncovered securities should be accounted for on a market-value basis. Finally, covered calls would be applied with market-value method though not specifically addressed.

Concluding remarks

The past two decades have witnessed a phenomenal growth of financial derivatives. As instruments whose value derives from one or more underlying financial asset, financial derivatives generally fall into four basic types: financial forward, financial futures, financial options and financial swaps, in the form of either exchange listed derivatives or OTC derivatives.

While typical uses of different types of derivatives vary, in general, they are used (1) to hedge against adverse changes in the values of financial assets or liabilities; (2) to speculate, or to assume risk in attempting to profit from anticipating changes in financial markets rates and prices; (3) to obtain more desirable financing terms. Despite some publicized misuse associated with financial derivatives, they are used to shift, decrease, not increase, risk. Actually, hedging is the most important function of financial derivatives. With financial derivatives at its core, financial engineering has developed to provide custom instruments in finance.

Agricultural production units and financial intermediaries in agriculture are the two groups of financial derivatives users in agriculture. The former group refers to farmers and farm firms, while the latter includes commercial banks, thrift institutions, life insurance companies,
and other institutions. Two major kinds of risks involved in the United States agriculture are interest rate risks and foreign currency risks. Interest rate risk is of great importance to financial intermediaries while foreign currency risks may not. In contrast, both interest rate risk and foreign currency risks are important to agricultural production units. On the whole, the use of derivatives benefits the agriculture through lowering funding cost, providing greater access to more capital markets, more flexible ways to manage interest risks and transferring risks inherent in agricultural production in other indirect ways.

There are important policy issues associated with the use of financial derivatives, most significant of them are the issues of regulation. In the United States, the major responsibility of regulating financial is split between the Commodity Futures Trading Commission and the Securities and Exchange Commission while groups of financial derivatives users are also subject to oversight of other regulatory agencies. Due to the nature of derivatives trading, it is difficult for outsiders to monitor trading position to an adequate extent, as a result of this, internal control has taken on greater importance. Regulation aside, legal, tax and accounting issues are three other policy issues of concern to financial derivative users and regulators.

**Literature Cited**


Miller,Merton (1997) Merton Miller on derivatives, John Wiley & Sons,Inc.


