THE USE OF FUTURES MARKETS BY LESS DEVELOPED COUNTRIES
FOR COMMODITY EXPORTING

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Selected Developing Countries that Depend Highly on Commodity Export Earnings and the Commodity Share of Total Country Exports, Cocoa, Coffee, Sugar, and Cotton, Average 1978-1980

<table>
<thead>
<tr>
<th>Country</th>
<th>Cocoa</th>
<th>Coffee</th>
<th>Sugar</th>
<th>Cotton</th>
<th>Total</th>
</tr>
</thead>
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<tr>
<td><strong>America</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>2.6%</td>
<td>13.2%</td>
<td>4.2%</td>
<td>.1%</td>
<td>19.9%</td>
</tr>
<tr>
<td>Colombia</td>
<td>----</td>
<td>62.2</td>
<td>2.3</td>
<td>1.9</td>
<td>66.4</td>
</tr>
<tr>
<td>Costa Rica</td>
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<td>32.0</td>
<td>2.6</td>
<td>.4</td>
<td>36.1</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>8.5</td>
<td>14.5</td>
<td>6.4</td>
<td>----</td>
<td>49.4</td>
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<tr>
<td>Ecuador</td>
<td>2.1</td>
<td>11.4</td>
<td>1.1</td>
<td>.1</td>
<td>14.7</td>
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<tr>
<td>El Salvador</td>
<td>----</td>
<td>64.4</td>
<td>2.3</td>
<td>9.9</td>
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<td>4.1</td>
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<td>----</td>
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<td>1.5</td>
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<td>1.1</td>
<td>28.3</td>
<td>2.2</td>
<td>1.9</td>
<td>32.5</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>----</td>
<td>31.5</td>
<td>4.0</td>
<td>18.5</td>
<td>54.0</td>
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<tr>
<td>Paraguay</td>
<td>----</td>
<td>.8</td>
<td>.4</td>
<td>34.7</td>
<td>35.9</td>
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<tr>
<td><strong>Africa</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Benin</td>
<td>26.2</td>
<td>8.2</td>
<td>----</td>
<td>17.8</td>
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<tr>
<td>Burundi</td>
<td>----</td>
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<td>----</td>
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<td>Cameroon</td>
<td>17.8</td>
<td>25.1</td>
<td>----</td>
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<tr>
<td>Central African Republic</td>
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<tr>
<td>Chad</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>71.7</td>
<td>71.7</td>
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<tr>
<td>Egypt</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>17.2</td>
<td>17.2</td>
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<tr>
<td>Equatorial Guinea</td>
<td>34.2</td>
<td>45.4</td>
<td>----</td>
<td>----</td>
<td>80.6</td>
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<tr>
<td>Ethiopia</td>
<td>----</td>
<td>70.7</td>
<td>----</td>
<td>.2</td>
<td>70.9</td>
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<tr>
<td>Ghana</td>
<td>69.5</td>
<td>.3</td>
<td>----</td>
<td>----</td>
<td>69.8</td>
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<tr>
<td>Ivory Coast</td>
<td>25.1</td>
<td>25.1</td>
<td>.2</td>
<td>1.9</td>
<td>53.3</td>
</tr>
<tr>
<td>Kenya</td>
<td>----</td>
<td>27.1</td>
<td>.9</td>
<td>.4</td>
<td>28.5</td>
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<tr>
<td>Madagascar</td>
<td>1.0</td>
<td>41.1</td>
<td>2.3</td>
<td>.1</td>
<td>44.5</td>
</tr>
<tr>
<td>Mali</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>46.7</td>
<td>46.7</td>
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<tr>
<td>Mauritius</td>
<td>----</td>
<td>----</td>
<td>66.2</td>
<td>----</td>
<td>66.2</td>
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<tr>
<td>Reunion</td>
<td>----</td>
<td>----</td>
<td>72.8</td>
<td>----</td>
<td>72.8</td>
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<tr>
<td>Rwanda</td>
<td>----</td>
<td>52.7</td>
<td>----</td>
<td>----</td>
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<tr>
<td>Sudan</td>
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<td>----</td>
<td>52.1</td>
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<tr>
<td>Swaziland</td>
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<td>----</td>
<td>44.6</td>
<td>1.4</td>
<td>46.0</td>
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<tr>
<td>Tanzania</td>
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<td>30.5</td>
<td>1.3</td>
<td>13.4</td>
<td>45.8</td>
</tr>
<tr>
<td>Uganda</td>
<td>.1</td>
<td>89.4</td>
<td>----</td>
<td>2.8</td>
<td>92.3</td>
</tr>
<tr>
<td>Upper Volta</td>
<td>----</td>
<td>----</td>
<td>4.2</td>
<td>33.5</td>
<td>37.7</td>
</tr>
</tbody>
</table>

| Other                     |       |        |       |        |        |
| Yemen, Arab Rep.          | ----  | 5.4    | ----  | 28.0   | 33.4   |
| Fiji                      | .2    | ----   | 54.2  | ----   | 54.4   |
| Papua New Guin            | 10.1  | 18.7   | ----  | ----   | 28.8   |
| Turkey                    | ----  | ----   | ----  | 12.1   | 12.1   |

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Price Instability*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocoa (ICCO Daily Price)</td>
<td>40.07</td>
</tr>
<tr>
<td>Coffee (Guatemalan)</td>
<td>31.95</td>
</tr>
<tr>
<td>Sugar (ISC World Price)</td>
<td>58.07</td>
</tr>
<tr>
<td>Cotton (Egyptian, c.i.f. Liverpool)</td>
<td>17.21</td>
</tr>
<tr>
<td>Corn (US, f.o.b. Gulf ports)</td>
<td>18.31</td>
</tr>
<tr>
<td>Wheat (US, f.o.b. Atlantic ports)</td>
<td>21.32</td>
</tr>
</tbody>
</table>

*Coefficient of variation expressed as a percentage

I. INTRODUCTION

Many developing countries rely heavily on primary commodity exports as a major source of national income and some are dependent on the exports of a single commodity for a large portion of their foreign exchange earnings. Thus, the level and stability of revenues derived from exports of primary commodities are matters of concern to these countries. In Table 1 examples of developing countries are provided that depend largely on earnings from export of a few commodities. The commodity share of total country exports is also shown for cocoa, coffee, sugar, and cotton.

Most international markets for primary commodities are characterized by prices that vary greatly within and between marketing years. See Table 2 for a cross-commodity comparison of commodity price instability. Price variability taken together with production variability imposes revenue variability and uncertainty on producing countries.

Producing countries, often in concert with consuming countries, have adopted a number of programs and policies attempting to moderate revenue or price instability, or raise absolute commodity price levels. These attempts have met with limited success. Buffer stocks, buffer funds, and export and import quotas are among the conventional mechanisms used to moderate instability. Frequently commodity programs involve a combination of several policies in an effort to both raise and stabilize export revenues. These programs, which fall under the heading of international commodity agreements, require the cooperation of a majority of the countries that produce and consume a particular commodity. For example, coffee, cocoa, and sugar are marketed under international commodity agreements.

Exporting countries may also insulate internal prices from world prices to achieve any one of a number of goals. Trade and marketing policies can be
designed to raise, stabilize, or tax producer incomes or lower consumer costs. Major importing countries often adopt similar policies to protect the income of domestic producers. The cotton and sugar markets are largely influenced by internal pricing and trade policies of major importing and exporting countries.

Finally, the often competing interests of developed and developing countries, as well as producers and consumers, exert pressure on any program designed to influence price and trade behavior. Conflicts of interest arise over the level at which to stabilize prices and the degree of protection to be afforded producer incomes in different countries. The net effects of a program established to improve or stabilize the incomes of certain commodity producers may be disastrous to those same producers or competing producers.

The following is a short list of some attempts by producing countries, acting in cooperation with consuming countries, to stabilize or raise commodity prices.

1) International Cocoa Agreement. Cocoa producing countries responded to the high cocoa prices of the late 1970's by expanding cocoa production. Cocoa prices have since fallen by over 50% in nominal value. In August of 1981 the International Cocoa Agreement (ICCA) was provisionally implemented. Its intent is to maintain cocoa prices within a specified band through the use of a Buffer Stock Fund (BSF). The BSF has been unsuccessful in its attempts to support cocoa prices. Two factors have led to this failure: (1) the world's largest exporter (the Ivory Coast) and importer (the United States) are not members of the agreement, and (2) target prices have been set too high for the BSF to maintain in light of increased world cocoa production and limited BSF funds.

2) International Coffee Organization. Coffee prices also rose dramatically in the late 1970's prompting expansion of coffee production in many
producing countries. Increased production along with declining per capita demand for coffee has put strong downward pressure on coffee prices. The October 1, 1980 imposition of export quotas on producing countries by the International Coffee Organization (ICO) has partially stemmed a dramatic decline in coffee prices. Maintaining coffee prices above a level that would equate total coffee supplies with coffee demand has come at a heavy cost to coffee producers. The USDA estimates that carryover stocks at the beginning of the 1982/83 season will represent 45 to 50 percent of world consumption requirements. These stocks, most of which are held in producing countries, are expensive to store and can not be sold (except to non-ICO members) unless world demand increases or the ICO lifts export quotas.

3) International Sugar Agreement. International trade in sugar is far more complex than the trade in coffee and cocoa. Sugar differs from coffee and cocoa because the production of sugar is not concentrated in developing countries. The pricing and trade policies of major importing countries that also produce large quantities of sugar have a profound impact on the export movements and revenues of all sugar exporting countries. In particular, the protectionist policies of the United States and the European Community affect the variability of prices in the world sugar market.

The International Sugar Agreement (ISA) was founded to stabilize prices at a level "remunerative and just to producers and equitable to consumers." Most of the major sugar exporters and importers are members of the ISA except the European Community. The ISA operates to maintain prices within a specified band through quotas on exports, restrictions of imports from non-member countries, and the release or accumulation of stocks. The ISA has been unsuccessful in its efforts to hold prices within its targeted range during periods of both rising and falling world sugar prices. Currently world sugar prices
are far below the minimum target price. The ineffectiveness of the ISA is due to two factors: (1) The supply and demand for ISA sugar are both inelastic. The ISA export quotas are non-restrictive during periods of low demand. Prices must fall below targeted levels to clear market supplies. When demand for ISA sugar is high the ISA stocks and exporter supplies are inadequate in holding down world price. (2) The ISA cannot finance accumulating or carrying adequate stocks to stabilize prices.

Would the use of Futures Markets Stabilize or Improve the Earnings of Commodity Exporters?

The use of futures markets by developing country exporters of primary commodities has been suggested as a means by which exporters can stabilize or increase export revenues. Futures markets exist for many of the commodities exported by developing countries. The most active futures markets are located in New York and London although smaller less liquid futures markets can be found around the world. Table 3 lists the major futures markets for cocoa, coffee, sugar, and cotton and the location of these markets.

Trading in futures may be viewed as either an alternative or a complement to the conventional mechanisms for stabilizing or improving export revenues such as international commodity agreements. As will be discussed later, futures markets are sources of price and stock information and vehicles for price-risk transferance. Futures markets also afford exporters flexibility with regard to pricing and marketing decisions. Carrying commodity stocks through and over marketing years can be facilitated with futures market use. Finally, futures markets may provide exporters with a means to support commodity prices, either directly through futures trading or indirectly through a

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1 There are futures markets for all of UNCTAD's "core" commodities except hard fibers, jute, and tea.
Table 3

Major Futures Markets for Cocoa, Coffee, Sugar, and Cotton

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Futures Markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocoa</td>
<td>London Cocoa Terminal Market; New York: Coffee, Sugar, and Cocoa Exchange</td>
</tr>
<tr>
<td>Coffee</td>
<td>Coffee Terminal Market Association of London; New York: Coffee, Sugar, and Cocoa Exchange</td>
</tr>
<tr>
<td>Cotton</td>
<td>New York Cotton Exchange</td>
</tr>
</tbody>
</table>
better understanding of inter-temporal price relationships and stock availability.

With all these potential benefits it would seem as though developing countries should be regular and active users of and participants in futures markets. However, there is scant evidence of developing country participation in futures markets. Powers and Tosini (1977) report that large foreign trader participation in U.S. futures markets is very small (usually less than 10% of open interest), except for futures trading in coffee. Powers and Tosini examined only positions "reportable" to the CFTC, i.e., those positions greater than 25 contracts. On average 16.1% of the long open interest in coffee emanated from Latin American accounts between June of 1976 and February of 1977.

Why do developing countries not participate in futures markets? Is it because they do not understand the benefits futures markets provide? Or, is it because they are constrained from participating because of inadequate financial requirements? Or, perhaps, is it because futures markets are biased in favor of developed country producers and consumers, or just perceived as so? This report will address these questions as well as discuss considerations pertaining to the efficacy of futures market use by developing country exporters.

The Economic Opportunities Futures Markets Provide to Developing Country Exporters.

The exhaustive literature on the economic role of futures markets portrays futures markets as serving many purposes. Some writers naively view futures markets as pure price insurance markets. Other writers see futures markets as an efficient source of information regarding prices, stocks, and

1 Powers and Tosini examined only positions "reportable" to the CFTC, i.e., those positions greater than 25 contracts.
expectations. Still others perceive futures markets as primarily a commercial tool used by commodity traders for making profits as well as for facilitating cash market transactions. Of course these perceptions of the economic role of futures markets overlap. Nonetheless, they provide a framework for considering how developing countries can use futures markets in commodity exporting.

1. Pure Price Insurance: Forward Pricing of Exports

Exporters may use futures markets to voluntarily "lock-in" a price for their exports well in advance of any actual sales. They may sell any number of futures contracts at a market price they consider favorable. Because futures prices eventually converge to the price of the "cash" commodity, an exporter can receive a net return on the eventual sale of the commodity approximately equal to the price at which the futures contracts were sold.

For example, in January, a Colombian exporter may find the $1.25 per pound price of July coffee (coffee to be delivered in July) quoted on the Coffee, Sugar, and Cocoa Exchange, to be a favorable price. The exporter sells a number of July futures contracts equal to the amount the exporter wishes to sell at $1.25/lb. If the exporter then sells his coffee in New York in July on the cash market, he will receive $1.25/lb. for his coffee regardless of movements in cash market prices. This is due to the fact that cash and futures market prices converge in the delivery month. Any futures market gains or losses offset equivalent cash price movements. If the cash and futures prices do not converge the exporter can make delivery on his futures contracts and still receive $1.25/lb. for his coffee.

If the exporter sells July coffee futures at $1.25 but decides to sell his actual stocks of coffee on the cash market before July or at a location other than New York, the exporter may receive a net return for his coffee
somewhat greater or less than $1.25/lb. In such cases the exporter faces "basis risk." For instance, if the exporter sells his coffee on the cash market in March, the price at which the coffee futures are bought back (the price at which the exporter closes his short futures position) may be different than the price the exporter receives on the cash market. The difference between the July futures price in March and the March price of cash coffee is the March-July basis. July coffee futures may be selling for $1.40 in March while cash market coffee prices may be $1.50. In this case the exporter makes a $1.35/lb. net return on his coffee sale ($1.50 cash market price less $.15 futures market loss). If the cash and futures prices in March were reversed the exporter would receive a $1.15/lb. net return.

Similarly, the price of coffee sold at another location, say, at a Colombian port, will not usually be the same as the price of coffee in New York. The difference between coffee prices at New York and the Colombian port is the Colombian "spot basis," or the local Colombian basis. This basis is less than or equal to the cost of transporting coffee between Colombia and New York. If the Colombian exporter sells July coffee futures and later sells his cash coffee at a Colombian port, his net return will be lower than if he had sold his cash coffee in New York by the amount of the local basis. Thus, the exporter "locks-in" a return for his exports equal to the futures price minus the local basis only to the extent that his basis remains constant.

Finally, the Colombian coffee exporter may decide to sell his coffee on the cash market after July. He may still use futures trading to obtain a price for his coffee close to $1.25/lb.\(^1\) How close the price the exporter eventually receives is to $1.25/lb. depends on the relationship of futures prices across delivery months. The exporter can simply "roll-over" his futures contract to another delivery month, moving the risk of price volatility into the future. This "roll-over" strategy helps to insulate the exporter from unexpected price changes in the cash market.

\(^1\) How close the price the exporter eventually receives is to $1.25/lb. depends on the relationship of futures prices across delivery months.
position in July. That is, come July, the exporter closes out his July futures position while simultaneously opening a short position in September coffee futures. Likewise, if he still has not sold his cash coffee by September, he closes out his September position and opens a short December position. Rolling-over his position does not guarantee him $1.25/lb., but it may net the exporter a price closer to $1.25/lb. than had he not used futures markets. Rolling-over coffee positions from July to December may result as follows (these prices are of course fictitious):

Sell July futures in January at 1.25  
Buy back July futures in July at 1.50  
$ .25 futures loss

Sell September futures in July at 1.40  
Buy back September futures in September at 1.30  
$.10 futures gain

Sell December futures in September at 1.20  
Buy back December futures in December at 1.15  
$.05 futures gain

Sell cash coffee in December at 1.15

Net return to exporter from establishing initial futures position in January: $1.05/lb.

Net return to exporter if no futures trading: $1.15/lb.

Note that these prices could have been chosen such that futures trading would result in a greater net return than no futures trading.

The exporter in this example receives less than $1.25/lb because coffee futures prices are higher for nearby delivery months than for distant delivery months. That is, in July the price of the July future is above the price of the September future and in September the price of the September future is above the price of the December future. When futures prices are in such a relationship the futures market is said to be inverted. Coffee futures prices are usually inverted. If on the other hand the distant futures prices were greater than nearby prices, the market would be called a "carrying charge"
market. As will be discussed later, the difference between futures prices for differing maturities is an important piece of market information. Suffice it here to say that any futures trader must understand the significance of the differences between futures prices for differing maturities. A failure to understand this significance will result in inefficient and costly futures trading.

An exporter that uses futures markets to forward price exports in any of the manners described above may do so to stabilize export revenues or to help plan export marketings. It is easy to see how the forward pricing of exports would help an exporter plan export marketings. An exporter can decide to sell fractions of his commodity over intervals denominated by contract months. He will know in advance the prices he can receive for his exports and can plan the timing of cash market sales accordingly. The opportunity futures markets provide by allowing for forward pricing in a liquid market may be of substantial worth to a developing country where the timing of export revenues is vital to foreign exchange management.

Whether forward pricing of exports would stabilize export revenues is another matter. Export revenues will be stabilized if the variance of prices received through forward pricing in a futures markets is less than the variance of prices received through only cash market transactions for any given quantity of exports. Futures prices may or may not vary more than cash prices. However, because futures prices move in line with cash market prices across marketing years, forward pricing in a futures markets can not substantially decrease year-to-year variance in export earnings. Furthermore, futures trading alone will not moderate variance in export earnings attributable to production variability. In fact, forward pricing may be more risky than simple cash market sales if the quantity of the commodity available for later export is uncertain. An exporter considering selling his anticipated export
sales on futures markets prior to harvest faces the possibility that there will be a shortfall in production. If the exporter sells forward an amount greater than available export supplies and prices subsequently rise he will not be able to offset futures market losses with cash market gains. Production uncertainties thus introduce a potential source of greater variability in export earnings that would arise from forward pricing anticipated exports. A later section of this report will address this problem in greater depth.

2. Futures Markets as a Source of Market Information

Exporters need not trade futures contracts to benefit from futures markets. Futures markets can be used as a valuable source of market information. An understanding of the relationship between futures prices taken together with careful monitoring of futures and cash market prices should result in more efficient export marketing.

The relationship between futures prices for differing maturities signifies a market determined price of commodity storage. Holbrook Working (1949) developed the theory of the price of storage. Eck (1982) provides an explanation of the theory and its implications for today's international commodity markets. What follows is a brief statement of the theory and suggestions as to how exporters can use information contained in futures prices to improve export performance.

The difference in price between futures contracts specifying different delivery months, a price spread, is a signal of the availability of commodity stocks to the market. Large price spreads represent an abundance of stocks; small or negative price spreads represent a tightness in stocks. When stocks are abundant futures markets provide an incentive to store a commodity for later release. The incentive is the return the market offers for carrying stocks between contract months, the difference in futures prices across those months. Typically returns to storage, carrying charges, are greatest between
contract months immediately following harvest and smallest between those months immediately preceding harvest. However, small or negative carrying charges will occur whenever stocks available to the market are tight. Likewise, when stocks are plentiful, positive carrying charges can be found between all contract months.

Full carrying charges include the physical cost of storing a commodity and the interest return for holding an asset across contract months. The difference in futures prices across contract months can not exceed full carrying charges because any such profitable storage opportunities will be quickly eliminated through storage arbitrage. For example, if in December cash sugar is selling at 11¢ and March sugar futures are at 15¢/lb., while full carrying charges per pound between December and March are 2¢/lb., an arbitrageur can simply buy cash sugar in December and simultaneously sell March futures. He will secure an return for storage of 4¢/lb. between December and March while storing sugar only costs him 2¢/lb. Arbitrage will quickly reduce the market return to storage to 2¢/lb. or less. Full carrying charges alone are a strong enough incentive to remove surplus stocks from the market and place them in storage.

When price spreads between futures contracts are less than full carrying charges the market determined return for storage does not cover full storage costs. In signalling a tightness in stocks, the market is prompting the release of stocks from storage. Price spreads between contract months immediately preceding harvest are usually small or negative because stocks will by then be drawn down and new supplies are expected after harvest. The market will not usually provide a full return for storage immediately before harvest.

While there is an upward limit on futures price spreads, there is really no limit on the extent futures prices can display negative price spreads.
When price spreads are negative a futures market is said to be inverted. Large inversions occur when current supplies are very small relative to current demand.

The relationship between stocks and price spreads is fairly regular for most storable commodities. It is most often depicted by a diagram showing the relationship between end-of-year stocks and the price difference between the old and new crop future in the old crop future's delivery month. A typical relationship estimates what Working termed a "supply of storage curve." Figure 1 shows the supply of storage curve for cocoa using world stocks of cocoa in September and real cocoa price spreads between December and September futures in September for both New York and London futures.

The exporter that understands the significance of futures price spreads can use this information to his benefit in the timing of export sales. Just by examining futures price relationships an exporter can gain an awareness of current market conditions and implicit expectations of future market conditions.

Furthermore, understanding the information contained in futures price spreads will lead to more judicious use of futures markets. Exporters may hold commodities in storage by hedging stocks on futures markets without fear of adverse price movements. Futures prices will signal the exporter when to store and when to sell. For instance, if a cocoa producer with large post-harvest inventories in December faces a cash price of 65¢ per pound in New York while March futures are selling for 67¢ per pound, the producer can hedge his inventories by selling March futures and earn 2¢ per pound storing cocoa. If the producer does not sell his cocoa on the cash market in March he may "roll-over" his hedge in March into May futures. However, rolling-over will only be prudent if the market will pay the producer to store cocoa from March to May. That is, the price spread between the March and May futures in March
Real Spread-Cocoa (Circled numbers refer to Sept. date) 1964-1981
Dec.-Sept.

Estimated World Cocoa Ending Stocks - September

Real Spread = \( \frac{P_D - P_S - P_S(r_{3m})}{P_S} \)

Where:
- \( P_D \) = December futures price in September
- \( P_S \) = September futures price in September
- \( r_{3m} \) = Prima rate converted to three month yield

Spreads taken on last day of trading of NY contract for both NY and London
- * - New York
- * - London

must cover the producer's cost of storage between those months. If the March-May price spread does not cover storage costs the exporter should not roll-over his March futures position. He should instead sell his cocoa on the cash market.

A final note should be made here regarding the informational value of commodity futures prices. Aside from indicating the market determined return for storage as determined by current supply and demand conditions, futures prices contain no more information than does today's cash price. Futures prices for differing maturities are not forecasts of future prices any more than is today's price. When new information reaches a futures market both futures prices across contract months and cash prices react simultaneously. Changes in futures price spreads in response to new information reflect changes in the demand for the storage or release of stocks. Futures prices are in some instances unbiased predictors of subsequent cash market prices. However, the predictive power of futures prices is only a by-product of their role in allocating stocks over time.

3. Futures Markets as a Commercial Tool

Futures markets offer a wide range of pricing and marketing opportunities to the sophisticated merchant. Trading in futures allows for flexibility in the forward contracting and pricing of cash market transactions. Rather than sell a commodity for a fixed cash price an exporter may choose to price sales using futures prices. Contracts made with reference to futures prices are called "basis priced contracts." The parties to a basis priced contract agree to two separate components in pricing the export sale. One component is the choice of the futures contract that will later determine the absolute price of the export sale. The other component is the basis, or the amount over or under the relevant future's price the exporter will earn for making the sale. Included in the basis are transportation costs between the futures market and
the delivery location and any premiums or discounts for differences between the quality of the commodity exported and the quality of the commodity specified in the futures contract. Basis priced contracts allow the exporter (as well as the importer) to fix one dimension of an export sale in advance, but maintain flexibility, and a certain amount of risk, in the other dimension. Forward contracts fix both dimensions, cash market sales, by definition, fix neither.

Peck (1982) provides a number of examples of basis priced contracts and compares their performance to other pricing strategies. The following is just one example of a basis priced contract.

In October a Ghanian cocoa exporter contracts with an importer for delivery of cocoa in Accra in May at 5¢ per pound under the New York May futures price. The basis, 5¢, represents in large part the cost of transporting cocoa between Accra and New York. The exporter soon thereafter sells May futures equal to the amount of his sale. Likewise the importer will buy an equivalent amount of futures while also booking transportation to his destination for cocoa in May. The price at which the exporter and importer sell and buy May futures need not be the same. Herein lies the pricing flexibility and risk. The final clearing of futures positions may occur in a number of ways. The way in which it does occur is specified in the contract. The importer's purchase of futures may be done for the exporter's account thereby fixing both the exporter's and importer's net returns/costs. Or, in May, the exporter and importer may exchange futures positions for cash. The price of the May futures then determines the exporter's and importer's net returns/costs. If, for instance, the exporter sells May cocoa in October at 69¢ per pound and later effectively offsets his position at 65¢ per pound his net price for cocoa is 65¢ plus 4¢ futures profit less 5¢ basis, or 64¢ per pound.
Finally, futures markets also provide exporters with a means to affect the absolute level of commodity prices. Rather than use futures markets individually for conventional pricing and stock-carrying purposes, exporters may attempt to support cash market prices by trading futures collectively. Their strategy would be to purchase futures contracts in a great enough amount to create upward pressure on futures and cash market prices. If required to sustain upward pressure on prices, exporters could stand for delivery on their long positions. Taking long positions in futures markets could thus be a temporary substitute for taking long cash market positions—i.e. holding buffer stocks.

The benefits to such a program rest in the leveraging power afforded by futures markets. Exporters need not immediately restrict exports. Nor would they have to store stocks in their own countries. Instead they would only have to put up enough margin money to take and hold onto their futures positions. Their futures trading should be profitable if they can force prices upwards.

However, using futures markets as a vehicle to support cash prices is a risky undertaking. Failure in supporting prices would be very costly. Also, there remains the question of what to do with stocks acquired by standing for delivery. Unless these stocks can be effectively removed from the market, any increases in prices achieved through futures trading will be short lived. Moreover, exporters considering price manipulation through futures trading run the risk of regulatory action of the part of the futures exchange or the Commodity Futures Trading Commission (CFTC). Attempts to manipulate prices are often met with limitations on the trading of futures contracts or the total suspension of futures trading in a particular contract. Futures markets are much more closely regulated than cash markets in this respect. It is not uncommon or illegal for governments to support or stabilize commodity prices.
through direct cash market intervention. Similar activities on the part of individuals are illegal in futures markets. It is unclear whether regulators of futures markets should or can effectively regulate the futures market activities of foreign governments. For example, the large long futures positions taken by Central American coffee producers in 1977 were alleged by the CFTC to be manipulative; trading was suspended in December futures. This episode has stirred the debate over the proper regulation of international futures trading.1

II. FACTORS TO CONSIDER BEFORE USING FUTURES MARKETS FOR COMMODITY EXPORTING

The basic mechanics of futures trading are quite simple. Through a broker, orders are placed to buy or sell a certain number of futures contracts. These orders are executed in an organized commodity exchange by licensed traders. All transactions are made through the exchange which acts as a clearinghouse. Only a small percentage of a contract's value is required as a margin to establish a futures position. As the price of a futures contract changes each trader's account is credited or debited by the full value of the price change. If over time there are too many debits, a trader must place additional funds in the margin account or else the futures position is closed. Finally, the trader closes out the position by buying (selling) futures if the original transaction was a sale (purchase) of futures. Less frequently, a trader may close the position by taking or making delivery of the commodity specified in the futures contract.

This brief description of futures trading might indicate deceptively that successful futures trading is a straightforward enterprise and, that success only requires buying cheap and selling dear. However, there are many potential pitfalls along this route. Long-term successful use of futures markets for attaining any one of several possible commodity marketing goals is achieved only with a high level of expertise. This section will be devoted to a discussion of factors which influence the success of futures trading and hedging strategies. Specific attention will be paid to factors that most directly influence the efficiency and success of LDC use of futures markets for commodity exporting.

Price vs. Production and Revenue Protection

As discussed in the introduction, futures markets can be used to forward price exports. This practice is referred to as anticipatory hedging. If the
exporters local basis is known and constant, forward pricing in a futures markets fixes (or establishes) the price eventually to be received for the cash commodity before harvest or even before planting. However, futures trading does not guarantee that quantities hedged before harvest will equal the quantity available for sale later on the cash market. Yields are stochastic; producers face production uncertainties. Prior, to harvest producers can only form expectations of what their yields will be. Therefore it is unlikely that producers would be able to hedge the exact amount of their harvests because in some years they would hedge too much and in other years too little. Unless producers maintain large storage facilities to regulate the flow of stocks onto the market over good and bad years, producers face sizable risks in forward pricing an expected crop on futures markets.

Producers also have no guarantee that they will obtain the "best price" for their exports or that they will stabilize export earnings by forward pricing anticipated exports. Earnings may actually be destabilized by anticipatory hedging. If an exporter sells forward a crop before news of the size of next year's harvest reaches the market place, the futures price at which the crop was sold will be significantly different from the harvest time, cash market price. The futures price may be significantly greater or less than the cash market price. Futures prices at any moment in time only reflect current market information; new information will change futures prices accordingly. Because in aggregate price and quantity supplied of a commodity are negatively correlated, news of a small harvest will raise prices while news of a large harvest will, in general, lower prices. The exporter that forward prices his crop before harvest may reap an implicit price gain if the aggregate harvest is larger than expected and prices subsequently fall. But, likewise he may incur both implicit and explicit futures losses if the harvest is smaller than
trader must be able to meet margin calls immediately.

Traders from foreign countries may have greater difficulty than domestic traders in maintaining a futures position. Futures contracts are purchased or sold in the currency of the country where the futures market is located. Margins are also established in domestic currencies or interest bearing government securities. Therefore, foreign traders must have ready access to foreign exchange to meet margin calls as well as to establish a futures position. This may be a problem for traders from countries where foreign exchange availability is limited or requires bureaucratic approval. Government sponsored trading agencies may have more success in procuring foreign exchange than private firms.

Foreign traders also face risks from exchange rate movements. The value of their currency may change against the value of the currency in which futures contracts are denominated. Foreign traders may profit or lose from exchange rate movements. For example, if the foreign currency devalues in the course of holding a short futures position, the foreign trader will incur a loss even if there is no change in the price of the futures contract; a long position in the same situation would result in a profit. In effect the foreign trader is speculating on the value of the foreign currency relative to the value of the domestic currency when holding futures contracts. The foreign trader may reduce his exchange rate risk by concurrently hedging in foreign exchange markets. This may prevent losses stemming from exchange rate changes but will require added liquidity on the part of the foreign trader.

Who Trades Futures Contracts?

Individuals rarely take positions in futures markets except as speculators. Instead, hedgers are usually large commercial firms whose major enterprises are merchandising the commodities they hedge on futures markets. These large firms successfully use futures markets because of their financial
liquidity and their expertise in the commodity markets in which they do busi-
ness. Government sponsored trading agencies may also successfully use futures
markets provided they are well funded and develop a staff with futures market
expertise.

Individual producers typically are too small to hedge efficiently on futures markets. Besides financial constraints, they are restricted in their
ability to hedge by the large size of futures contracts, which is often
greater than the size of their crop. Individual producers may also not be
able to keep abreast of market news or maintain communication ties with a
broker at a rate necessary to open or close out a position at appropriate
moments.

However, if individual producers can forward contract a portion of their
crop with a larger agent, such as a commercial merchandising firm or a govern-
ment trading agency, they can establish a price for their crop in advance of
harvest. Forward contracting reduces price uncertainty and has the advantage
of not requiring margin deposits. But, as a pricing strategy, forward con-
tracting is not as flexible as futures trading: forward contracts are not
easily reversed nor are they generally traded.

Thus, local marketing infrastructure strongly influences the success of
LDC use of futures markets. Government marketing agencies must take hedging
responsibility if local merchandising firms are not able to trade futures
contracts because of inadequate financial leverage or foreign exchange limita-
tions. Individual producers can not be expected to hedge their produce on
futures markets. Their interests can best be served if they can forward
contract with merchandising firms or a government marketing agency.

Exporting Objectives and Trading Strategies

As discussed in the introduction, futures markets can be used for many
purposes. A country's exporting objectives largely determine whether futures
markets are used for 1) forward pricing to regulate marketings or to reduce price risk, 2) stock-carrying, 3) pricing flexibility, or 4) price manipulation. When independent commercial firms manage a country's exports, they usually hedge in futures markets for conventional stock-carrying and pricing flexibility. Exports from developing countries however are not usually managed by independent commercial firms. Instead they are typically controlled by a government marketing agency or commercial firms whose pricing and marketing practices are largely influenced by government policies. As such, developing country exporters may be constrained in their use of futures markets by government political and financial pressures. Their futures trading strategies may reflect exporting objectives such as international price manipulation, export promotion, foreign exchange acquisition, and certainty in future export revenues. Hence, LDC futures trading strategies may differ greatly from traditional hedging strategies.

There is evidence to suggest that exporting countries have attempted to use futures markets to support prices, most notably coffee prices, above market clearing levels. By taking large long positions exporters may try to force market prices upward. This strategy is essentially speculation. The exporter, or group of exporters, gambles that its willingness to buy contracts will exceed the willingness of other traders to sell. To maintain upward pressure on price the exporters must hold onto their positions and not release a large amount of stocks onto the market. If reversing their long positions would result in an undesirable price decline, the exporters must be willing to stand for delivery.

Exporters considering price manipulation through futures trading must have adequate financial reserves to purchase and hold a large number of futures contracts. More importantly, they must be able to endure the prospect
of losing their high risk gamble. Furthermore, successfully raising market prices may only come at the heavy cost of acquiring and holding huge quantities of stocks. Finally, prolonged price manipulation will lead to the eventual demise of a futures contract either because of regulatory action or because both speculative and hedging interests desert the market.

Futures markets may also be used as a vehicle for direct commodity marketing. In the most extreme form, exporters can sell futures contracts with the intent to deliver the specified commodity to an official delivery point upon contract expiration. This option may appear attractive because it eliminates the need to find and contract with buyers. The exporter can choose well in advance when to market a given quantity of its commodity. Because price is also established, uncertainty with regard to future revenues is reduced. However, in practice the delivery option is usually impractical and rarely exercised. Delivery points are commonly in consuming regions. To make delivery an exporter would have to arrange transportation for its commodity to an official delivery point and these costs from the exporter's location may prohibit delivery. Moreover, heavy use of the delivery mechanism is likely to depress the price of a futures contract, thereby making the contract less attractive to prospective traders. Finally, the grade of the commodity specified in the futures contract may differ from the grade produced by the exporter considering delivery. While standard premiums and discounts are usually allowed for alternate grades, such compensations may understate premiums and overstate discounts actually paid on the cash market.

Of course an exporter need not exercise the delivery option to use futures markets for forward pricing a given quantity of exports. The exporter can, as previously described, hedge intended future cash market sales. The hedging strategies of a developing country in forward pricing will be influenced by its attitudes toward risk. Developing country exporters are
characteristically averse to short run income variability. Their foreign exchange holdings may be insufficient for even temporary unplanned foreign exchange outlays. Thus, developing countries may not take futures positions that could result in large margin calls. Or, they may close out futures positions after large margin calls even if those positions guarantee a long-run gain. While the expected returns to futures trading may be positive, the possibility of negative returns, even only in the short run, may preclude the successful use of futures markets by LDC's in markets with high variability in futures prices.

On the other hand, high cash market price variability may make developing country exporters more likely to automatically forward price intended sales on futures markets. They may be unwilling to risk receiving lower prices even given a high probability that cash prices will rise in the future. A futures position would be a form of insurance, guaranteeing a known level of future export revenues. Exporters may be willing to forego probable greater revenues in exchange for reduced uncertainty.

Basis Risk

Hedgers encounter "basis risk" if their cash market transactions are separated by space, time, and form from their futures market transactions. For example, consider a cotton exporter that hedges inventories on a foreign futures market. The grade of cotton held by the exporter differs from that called for in the futures contract. The cotton is to be sold later at a local port. If the price of cotton at the exporter's location does not move with the price of cash cotton at the futures market location or delivery points, i.e. the "spot basis" at the exporter's location is variable, the exporter's hedge may prove worthless. On the other hand, variability in the spot basis may prove to the exporter's advantage. Either way, basis variability imposes
some uncertainty on the hedger. Risk averse hedgers prefer "close hedges," that is, hedges with low basis risk.

In the example above, the closeness of the exporter's hedge depends on both the degree of integration across markets for different grades of cotton and the constancy of transfer costs between the exporter's location and the futures market delivery points. If there is instability in the price spread between the exporter's grade of cotton and the grade called for in the futures contract, the markets for the two grades are not well integrated. The futures grade may rise or fall in price relative to the price of the exporter's grade. If transfer costs such as ocean freight rates vary, then the spot price at the futures market delivery points will also vary relative to the spot price at the exporter's location. If cotton prices at the exporter's location do not usually move with cash cotton prices at futures market delivery points, the exporter's local market and the cotton futures market are essentially two separate, distinct markets. A hedge by the cotton exporter may be riskier than no hedge at all.

The cotton exporter will hedge his inventories if he anticipates a close hedge. When cash prices change at futures market delivery points he expects that local prices will usually change in the same direction, i.e. he expects that his local spot basis will remain constant. If the difference between the two prices increases, that is, the basis widens, the exporter's hedge results in a loss, although perhaps not as large of a loss if no hedge had been placed at all. Conversely, if the basis narrows, the local price rises relative to the price at the futures market delivery points, the hedge is profitable. The astute futures trader faced with basis risk may thus profit if hedges are lifted after the basis moves favorably. However, because basis risk may as easily result in a loss, basis risk is generally undesirable to the risk averse hedger.
Basis risk may confront the trader in many forms. The greater the separation between the futures market and the cash market in which the commodity is purchased or sold, the greater the basis risk. As such, basis risk is more significant to the foreign hedger than to a trader hedging in a domestic futures market. Transportation rates are likely to be variable; transportation availability may be limited. A foreign hedger also faces basis risk when cash market transactions are denominated in one currency and futures market transactions are denominated in another. Even if the local basis remains constant in one currency, a change in exchange rates will alter the basis with respect to the foreign location. Finally, government market intervention, at either the foreign or domestic location, can affect the foreign hedger's local basis. If price movements are constrained by government policy at either market location by trade policy insulating one market from the other, the basis will be distorted and the probability of effective hedging is reduced.

The Behavior of Futures Prices

Prospective futures traders are concerned with the behavior of futures prices. One major concern is whether futures prices are unbiased predictors of cash market prices. A bias in futures prices would imply that certain traders, usually speculators, would consistently profit from futures trading; others, usually hedgers, would consistently lose. Another concern is whether futures market prices are more or less variable than cash market prices. If futures prices are more variable than cash market prices, hedging may be perceived as too risky.

Many economists have studied the behavior of future prices. No attempt will be made here to present a complete theory of futures price behavior. What follows will address only briefly the effects on futures price behavior of: 1) contract specifications, 2) the regulation of futures trading, and 3)
government trade and price policies.

1. Contract Specification

The design of a futures contract substantially influences the extent to which the contract is traded. Well designed contracts attract trade by a broad spectrum of hedgers and speculators. Poorly designed contracts may attract an insufficient number of traders to insure that futures prices are unbiased predictors of cash prices, or that futures prices vary no more than, or along with, cash market prices. The principal features of a futures contract that determine its use are the specifications of delivery locations and delivery grades.

The delivery locations specified in a futures contract are not intended primarily for receiving delivery. While the delivery mechanism insures that cash and futures prices converge upon contract expiration, heavy use of the delivery mechanism is generally considered undesirable. Futures markets have attracted traders in part because positions are easily reversed; physical transactions are few. Most traders would be inconvenienced by taking or making delivery on a futures contract. Their cash market transactions are often intended for markets remote from futures market delivery points. Yet, some writers argue that too few delivery locations are allowed in futures contracts, and, that the locations that are specified favor consumers at the expense of producers. They contend that because most delivery points are located in consuming regions, exercising the delivery option is more difficult for producers than for consumers. They also argue that futures prices may reflect market conditions only at consumer-oriented delivery points; prices in producing regions need not move with futures prices. Thus, futures markets are used more often by traders that face little basis risk, that is, those that transact in cash markets that are well integrated with futures market delivery points.
The availability of numerous delivery points may improve the accessibility of futures markets to LDC exporters as well as force futures market prices to reflect international supply and demand conditions. However, adding alternate delivery points may diminish the standardization of a futures contract by diffusing the specificity of its market. Allowing premiums or discounts for delivery at alternate locations based on standard transportation differentials may cause an overflow of deliveries when transportation availability is low and rates are high. Unless these premiums or discounts are constantly adjusted for market conditions, futures price variability may rise and a price bias may become apparent upon contract expiration. Long traders may not wish to find themselves owners of a commodity in a foreign warehouse. They may close out their position at a loss rather than stand for delivery. The contract may then become unattractive to both speculators and long hedgers who have no intention of taking delivery.

The Sugar No. 11 contract, or the World Sugar contract, traded on the Coffee, Sugar, and Cocoa Exchange, allows for delivery at any point of shipping origin. No specific delivery points are specified in the World Sugar futures contract. Shorts that intend to deliver need only inform the Exchange which growth of sugar they intend to deliver and the location of the delivery port at which they will deliver. The price they eventually receive for their sugar is that established on the last day of trading of the delivery month plus or minus any premiums or discounts for the grade delivered. The Exchange compiles delivery information from all shorts that intend to deliver and, issues a "Multiple Delivery Notice" to all longs that will receive delivery. The Multiple Delivery Notice lists for each growth of sugar by each deliverer the number of contracts and the port from which delivery will occur. The longs that will receive delivery can then exchange among themselves with or
without additional compensation, any of the contracts listed on the Multiple Delivery Notice. Deliverers are responsible for loading sugar onto the ships that are the receiver’s responsibility to provide.

The World Sugar contract is unique among major futures contracts in allowing delivery at the origin of choice to the shipper—at no added expense to the shipper. Longs that stand for delivery may find themselves receiving sugar at remote locations. While they may trade delivery locations among themselves, obtaining a favorable delivery location may come only at an extra cost. Of note is that, as a percentage of maximum open contracts, deliveries on the World Sugar contract are high (usually 10-15%) relative to other major futures contracts. This may be because interest in the World Sugar contract is slow relative to normal delivery numbers, or because the design of the contract promotes deliveries. Either way, the design of the World Sugar contract can not be said to favor consumers at the expense of producers. It may in fact discourage trading or cause price biases near contract expiration when longs close out positions as the threat of delivery approaches.

Like delivery location, the specification of delivery grade affects the performance of a futures contract. Allowing a variety of grades for delivery may be to the benefit of certain producers, but it may also affect the behavior of futures prices adversely. There are a number of examples in the history of futures trading where the choice of specification of delivery grades has been the cause of a bias in futures prices or the demise of a futures contract. If the grade called for in the futures contract does not match the grade of the commodity of interest to most hedgers, hedgers may not trade the futures contract. Again, standard premiums and discounts are usually quoted for the delivery of alternate grades. These compensations need not, however, match market determined differentials. Furthermore, hedgers may be reluctant to take delivery of an alternate grade, even if compensated at a
market determined rate.

Often separate futures contracts exist for different grades of a commodity. Those contracts that best suit hedging needs survive and attract a large number of speculators as well as hedgers. Although conceivably futures markets could be established for every grade (and every delivery point) of a commodity, large numbers of futures contracts do not exist for a single commodity. Too many distinct contracts would result in a "thinness" in a good number of the futures markets. Thin markets, or markets with a small number of buyers and sellers, and small, infrequent transactions, are noted for biased prices and price variability. Thin futures markets are generally less attractive to hedgers than other more heavily traded markets, unless they offer some special feature to a discrete number of hedgers that can sustain a steady trade. Thus, most commodities can only sustain a small number of futures contracts. When more than one contract is available to a hedger, the hedger usually chooses to hedge in the market whose contract specifications best match the cash commodity to be hedged unless that market is perceived as too thin or too risky.

2. The Regulation of Futures Trading

Futures trading is regulated both by the commodity exchanges where trading takes place and by governments and government agencies. Exchanges set margin requirements and price movement limits. They may also suspend trade of a futures contract. Governments or government agencies vary from country to country in the degree to which they regulate futures trading. They may prohibit their residents from trading on foreign futures markets, prohibit traders from foreign countries or speculators from trading on domestic futures markets, or, more commonly, monitor futures trading to prevent market manipulation. The Commodity Futures Trading Commission (CFTC) regulates futures

The regulation of futures trading, while usually intended to insure the integrity of futures markets, may impose added risk on the futures trader. Most often regulators act to protect traders from situations that would otherwise result in unexpected large financial losses (by setting margin requirements and price movement limits) or price distortions (by keeping track of open contracts, setting position limits, or suspending trading). However, there may be instances where the actions of regulators disrupt orderly futures trading because of inconsistencies in regulation or because regulators mistake an orderly market for a manipulated or distorted market. The possibility that such regulatory action will occur makes futures trading risky. For example, a trader may have to close out a futures position at an undesirable time after margin requirements have been raised or because trading has been suspended. Of course those traders attempting to manipulate prices face the risk that regulatory action will thwart their attempts and lead to heavy financial losses. Because of these risks, traders may avoid trading in those markets where they perceive the possibility is high that overzealous regulators will intervene.

3. Government Trade and Price Policies

Government policy has a far reaching impact on the use of futures markets and the behavior of futures prices. Certain policies reduce both futures market use and price variability. Other policies encourage futures market use and price variability. Still others may decrease futures market use but increase price variability. The policies that lead to these events include any policy that affects cash market price behavior.

Commodity price stabilization programs that by definition reduce cash market price variability may also reduce futures price variability. Futures
futures will reflect stabilized cash market prices if futures market delivery
contracts are insulated from other markets where cash prices are not stabilized.
Lower transaction costs traders who can take advantage of stabilized prices will not
encounter adverse price movements, they have little need to hedge. Traders
may still face cash market price risk gain little by hedging in effectively
stabilized futures markets. Similarly, speculators lose incentives to take
futures positions. Futures market use thus rapidly declines.

On the other hand, unpredictable or erratic government market interven-
tions such as trade embargoes, short run price interventions, and currency
devaluations may increase price variability, as prices adjust to a new equili-
trum, as well as increase futures market use. Traders who anticipate or have
experienced government intervention which significantly affects market prices,
are more likely to hedge to protect themselves from adverse price movements.
Speculators who thrive on price variability and anticipating market
surprises may be more apt to take futures positions. Thus, futures market
activity increases with market shocks.

Trade regulation in major import and export markets may reduce the scope
of futures market use but increase futures as well as cash price variability.
Imports policies that remove large quantities of a commodity from the market
environment, for instance those that legislate prices or those that restrict
imports through quotas or tariffs, impose inelasticity on the supply of the
commodity available to the market. Cash markets become thinner and prices
become more variable. Futures markets for commodities whose trade is highly
regulated may even be characterized by prices more variable than cash market
prices. Squeezes may be more feasible as limited amounts of the commodity
become available for delivery. While hedging may be warranted by high cash price
variability, greater futures price variability may discourage hedging.
III. **EMPIRICAL CHARACTERISTICS OF FUTURES MARKETS**

The final section of this report will examine certain empirical characteristics of the cocoa and cotton futures markets. The purpose of these examinations is to identify features of these markets that are relevant to the potential futures trader. First, institutional characteristics of the New York cotton and cocoa markets will be examined, such as contract specifications, open interest and composition of trade. Some comparisons of the London and New York cocoa markets will also be made here. Then, the behavior of futures prices will be analyzed with respect to the theory of the supply of storage, the unbiasedness of futures prices, and the variability of futures prices.

Cotton and cocoa are chosen for empirical investigation because they approximate the extremes of LDC export commodities in terms of international market structure. The export side of the cotton trade (like the sugar trade) is comprised of developed as well as less developed countries. The largest cotton exporters are the United States and the USSR, followed by less-developed countries such as Pakistan, Turkey, Egypt, Sudan, Mexico, and El Salvador. Only a fraction of world cotton production enters international trade. Cocoa on the other hand is exported only by less developed countries such as Ghana, the Ivory Coast, Nigeria, Cameroon, and Brazil. Almost all of world cocoa production flows from developing to developed countries. Futures markets performance for commodities exported primarily by less developed countries such as cocoa and coffee may differ from the performance of futures markets for commodities such as cotton and sugar whose export trade is shared by both developed and developing countries and whose international trade is only a fraction of world production.
Institutional characteristics

Cocoa

Cocoa is traded in New York on the Coffee, Sugar, and Cocoa Exchange and in London by members of the Cocoa Terminal Market Association through the International Commodity Clearinghouse, Ltd. The New York and London cocoa futures contracts are similar. Their delivery months and contract sizes (since December 1980) are identical. The major differences between the two contracts are that 1) the New York contract is traded in dollars, the London contract in pounds sterling, 2) the New York contract calls for ex-dock U.S. delivery while the London contract calls for c.i.f. European delivery, and 3) the New York contract calls for lower grade cocoa than the London contract. Table 4 lists the contract specifications for the New York cocoa contract.

Prior to the Commodities Futures Trading Act of 1974, cocoa (as well as coffee and sugar) futures trading was not regulated by the U.S. government. It has only been since July of 1978 that the CFTC has collected trading data on the "newly regulated commodities." The CFTC trading data on all regulated commodities, published on a monthly basis, is a good source of information regarding open interest, trade volumes, deliveries, and commitments of traders—speculators vs. hedgers. Better data on all of the above except commitments of traders is published annually in the Coffee, Sugar, and Cocoa Exchange's Statistical Annual. Unfortunately, this publication has only been available since 1980.

Trading volume and open interest in cocoa at any point in time is concentrated in contracts expiring within nine months. An exception to this is the December contract, representing the first new crop contract, which may attract significant amount of trading up to a year before expiration. Between July 1978 and December 1980, there was no discernable seasonal pattern of total open interest. In general, open interest and trading volume is correlated
Table 4

Contract Specifications for the
New York Cocoa Contract

<table>
<thead>
<tr>
<th>Contract unit:</th>
<th>10 Metric Tons.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price Quotation:</td>
<td>Dollars per metric ton.</td>
</tr>
<tr>
<td>Minimum Price Fluctuation:</td>
<td>$1.00 per metric ton or $10 per contract.</td>
</tr>
<tr>
<td>Maximum Daily Price Fluctuation:</td>
<td>$88.00 above or below the previous day's settlement price. Limits are expandable to $132.00. Limits removed from the spot month on and after the first Notice Day.</td>
</tr>
<tr>
<td>Trading Hours:</td>
<td>9:30 AM to 3:00 PM (Eastern Time).</td>
</tr>
<tr>
<td>Delivery:</td>
<td>From licensed warehouses in the Port of New York District, Delaware River Port District or Hampton Roads.</td>
</tr>
<tr>
<td>Customary Delivery Months:</td>
<td>March, May, July, September, December.</td>
</tr>
<tr>
<td>Deliverable Growths:</td>
<td>The growth of any country of clime, including new or yet unknown growths. Growths are divided into three classifications: Group A deliverable at a premium of $160.00 per ton (including Ghana, Nigeria, Ivory Coast, among others). Group B deliverable at a premium of $80.00 per ton (including Bahai, Central America, Venezuela, among others). Group C deliverable at par (including Sanchez, Haiti, Malaysia, and all others). Deliveries are discounted for subnormal size beans</td>
</tr>
<tr>
<td>Grades:</td>
<td>Established by Exchange licensed graders in accordance with specified tolerance for defects, bean count, and other standards.</td>
</tr>
<tr>
<td>Position limits:</td>
<td>None.</td>
</tr>
<tr>
<td>CFTC Large Trader Reporting level:</td>
<td>25 contracts or more.</td>
</tr>
<tr>
<td>First Notice Day:</td>
<td>Ten full business days prior to the first business day of the delivery month.</td>
</tr>
</tbody>
</table>
Table 4 (cont'd)

Last Notice and Last Trading Day:

Ten full business days prior to the last business day of the delivery month. Trading in the current month ceases at noon (Eastern Time) on the last notice and last trading day. Notices may not be issued nor warehouse certificates delivered on Exchange half-days.

with price variability, or price uncertainty. As a percentage of world production, open interest in cocoa is high relative to other commodities\(^1\) U.S. traders holding 25 cocoa futures contracts or more must report their positions to the CFTC as either speculative or hedging. However, foreign cocoa traders are not subject to this requirement. (Foreign traders need not report positions in several other commodities—including sugar and coffee.) Reporting hedgers represent a large share of the open interest in cocoa. Table 5 shows the percent of open interest accounted for by long and short hedging in cocoa between July 1978 and December 1980. For this short sample time period there appears to be no seasonal pattern in long and short hedging. Neither long or short hedging dominates cocoa futures trading, which is not surprising given that the United States is a major cocoa importer and processor, and that processors hedge cocoa products in cocoa bean futures.

Futures trading practices for cocoa differ between New York and London. Both are "open outcry" markets; that is, bid and offer prices are verbally announced to all traders. However, in London only one price is traded at a time by one seller and one buyer. Prices move only when sellers offer more for sale at a price than is purchased (prices move down), or when buyers want to purchase more at a price than is offered (prices move up). Steady price increases (decreases) are likely to occur when there is an abundance of buyers over sellers (sellers over buyers). In New York there is no such tradition in cocoa (while there is in sugar) of trading one price at a time between one seller and one buyer. Numerous transactions may take place in the cocoa "pit" at any point in time. Whether the different trading practices in New York and London actually cause different shortrun price behavior is uncertain.

Table 5


<table>
<thead>
<tr>
<th></th>
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<td>28.6</td>
<td>50.9</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>47.2</td>
<td>36.9</td>
<td>52.4</td>
<td></td>
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<tr>
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<td>36.7</td>
<td>55.6</td>
<td>45.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>37.3</td>
<td>34.9</td>
<td>41.9</td>
<td>36.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>May</td>
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<td>46.5</td>
<td>38.2</td>
<td>33.3</td>
<td></td>
<td></td>
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<tr>
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<td>48.4</td>
<td>42.5</td>
<td>41.3</td>
<td></td>
<td></td>
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<tr>
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<td>62.9</td>
<td>35.9</td>
<td>37.0</td>
<td>45.0</td>
<td>40.0</td>
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<tr>
<td>Aug</td>
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<td>31.0</td>
<td>40.2</td>
<td>36.1</td>
<td>38.1</td>
</tr>
<tr>
<td>Sep</td>
<td>30.9</td>
<td>54.5</td>
<td>30.6</td>
<td>54.1</td>
<td>23.7</td>
<td>45.2</td>
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<td>57.1</td>
<td>45.6</td>
<td>34.0</td>
<td>23.8</td>
<td>41.3</td>
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<tr>
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<td>35.2</td>
<td>58.1</td>
<td>46.3</td>
<td>42.1</td>
<td>34.8</td>
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<td>Dec</td>
<td>41.8</td>
<td>49.1</td>
<td>51.6</td>
<td>47.3</td>
<td>34.2</td>
<td>56.7</td>
</tr>
</tbody>
</table>

Illiquidity in either market, on the buying or selling side, will result in abrupt price movements when large buy or sell orders are placed. London cocoa prices will more likely stay constant for longer periods of time than will New York cocoa prices if the London market is sufficiently liquid.

The price spreads between the London and New York cocoa markets are well arbitrag ed. The markets are open simultaneously for over two hours each day during the afternoon in London and morning in New York. Thus, prices between the two markets can be closely watched both within and between sessions in all months before contract expiration. As the delivery month approaches for any contract, the price differences between New York and London futures may change quickly, however, if there are different shortrun shortages or surpluses of cocoa stocks at New York and London delivery points. At such times, arbitrage between New York and London is less perfect and spreading riskier. The New York-London cocoa price spread may also vary across contract months if interest rates differ between the U.S. and the U.K., or if the dollar-pound exchange rate is expected to change. Such variability in price spreads is usually a sign of efficient pricing rather than insufficient arbitrage.¹

Cotton

The primary cotton futures market is at the New York Cotton Exchange, though smaller forward and futures markets for cotton exist in Hong Kong, the U.K., and India. A description of the No. 2 cotton contract, traded on the New York Cotton Exchange, since 1967, is presented in Table 6. The most salient feature of the No. 2 cotton futures contract is its specification that only U.S.-grown cotton may be delivered. As such, foreign cotton traders are somewhat limited in their use of the New York cotton market because they cannot deliver foreign-grown cotton. However, the New York cotton futures

| **Table 6**  
| Contract Specifications for the  
<table>
<thead>
<tr>
<th>No. 2 Cotton Contract</th>
</tr>
</thead>
</table>
| **Trading Unit:**  
| 50,000 pounds |
| **Price Quotation:**  
| Cents per pound |
| **Minimum Price Fluctuation:**  
| .01¢ per pound or $5.00 per contract. |
| **Maximum Daily Price Fluctuation:**  
| 2¢ above or below the previous day's closing price. No limits during the delivery month after the first notice day. |
| **Trading Hours:**  
| 10:30 AM to 3:00 PM (Eastern Time). |
| **Delivery:**  
| From Galveston, Houston, New Orleans, Memphis, Mobile, Charleston and Greenville, S.C. |
| **Customary Delivery Months:**  
| March, May, July, October, December. |
| **Deliverable Growths:**  
| Strict low middling 1-1/16 inch U.S. grown white cotton. |
| **Position limits:**  
| 300 contracts in any one future or all futures combined. |
| **CFTC Large Trader Reporting level:**  
| 50 contracts or more (5,000 480 pound bales). |

Source: Various industry sources.
market may still be used effectively for hedging by foreign traders as long as cotton prices in New York are highly correlated with cotton prices at terminal locations outside of the United States. Kofi (undated) as well as Monke and Petzel (1982) have shown that prices at terminal markets are well integrated across space and grade of cotton.

Cotton futures trading has been regulated by the U.S. government for many years by the CFTC, and before that, by the Commodity Exchange Authority (CEA). All traders, foreign or domestic, holding 50 cotton contracts or more must report their positions as speculative or hedging to the CFTC. Statistics on total monthly open interest compiled by the CFTC between 1978 and 1980 indicate no strong seasonal pattern in total open interest. The December contract is the most heavily traded cotton contract, although October is technically the first new crop future. Table 7 shows the percent of open interest accounted for by long and short hedging in cotton between 1978 and 1980. Like cocoa, a large share of open interest is accounted for by hedging. Unlike cocoa, reportable short hedging always accounted for a greater share of open interest than does long hedging in this period. This suggests that the cotton futures market is more widely used by cotton sellers, such as exporters, rather than by purchasers of cotton. Since the U.S. is a major cotton exporter, this result is not surprising.

The Behavior of Futures Prices

Supply of Storage

The theory of the supply of storage as developed by Working (1949) was presented briefly in the introduction to this report. Cocoa and cotton futures prices are examined with respect to end of year stocks to determine if the theory of the supply of storage explains the difference in futures prices for different maturities. Price spreads between old and new crop futures, adjusted for inflation and interest rate differences, are plotted against end-
Table 7


<table>
<thead>
<tr>
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<th>1978</th>
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<td>Long</td>
<td>Short</td>
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<td>Short</td>
<td>Long</td>
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<td>66.7</td>
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</tr>
<tr>
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<td>70.0</td>
<td>29.4</td>
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<tr>
<td>Aug</td>
<td>32.4</td>
<td>73.5</td>
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<tr>
<td>Sep</td>
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<td>70.6</td>
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<td>62.9</td>
<td>24.5</td>
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<td>35.1</td>
<td>78.4</td>
<td>33.3</td>
<td>57.1</td>
<td>24.4</td>
</tr>
<tr>
<td>Nov</td>
<td>35.1</td>
<td>67.6</td>
<td>30.0</td>
<td>67.5</td>
<td>20.0</td>
</tr>
<tr>
<td>Dec</td>
<td>37.8</td>
<td>67.6</td>
<td>20.5</td>
<td>70.5</td>
<td>23.7</td>
</tr>
</tbody>
</table>

of-year stocks. If their relationship approximates that shown in Figure 2 then there is strong evidence that futures price spreads reflect the supply of stocks available to the market. Positive price spreads should signal an abundance of stocks; negative price spreads should signal a shortage.

Figures 3 and 5 show the relationship between real cotton futures price spreads and three different end of year stocks numbers: U.S. ending stocks, U.S. plus foreign-non-communist ending stocks, and world ending stocks. Three sets of stock numbers are studied to investigate whether the price relationships on the New York Cotton Exchange reflect world cotton stocks or stocks within in the United States. For each comparison, both October-July and December-July real cotton spreads are plotted against end-of-year stocks to see if the October contract or the more heavily traded December contract performs as the new crop future. The true new crop future will display a larger inversion in years of short supply because the opportunity cost of storage into the new crop year is greater.

A visual inspection of the three cotton graphs leaves no doubt that cotton futures price spreads are indicative of U.S. cotton stock availability rather than foreign-non-communist or world stock availability. The weakest relationship is between cotton futures price spreads and end-of-year world stocks. This result suggests either that the U.S. cotton futures market does not reflect world market conditions, or that the rest of the world's stock holders do not respond to future's market signals to store or release stocks.

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1 "Real spreads" compensate for inflationary effects and interest rate effects on futures prices. They are derived from the following formula: 
\[ \frac{[P(\text{new crop}) - P(\text{old crop}) - P(\text{old crop}) \times \text{prime interest rate}]}{P(\text{old crop})} \]. The prime rate is adjusted to the number of months between old and new crop futures.

2 Real cotton spreads are computed from futures prices (settling prices) observed on the last trading day of the July futures, 1968-1981.
Real Cotton Spreads (Numbers are crop years) 1967-1980

US Ending Stocks
July 31 in million
480 lb. bales

* = Dec. - July
* = Oct. - July

Real Spread =
\[ \frac{P_{0,0} - P_{J} - P_{J}(r_{3m,5m})}{P_{J}} \]

Source: Journal of Commerce and Cotton and Wool Situation, USD.
Real Cotton Spreads 1967-1980

Figure 4

US and FNC Ending Stocks - July 31, in million 480 lb. bales
- Dec. - July
* - Oct. - July

Real Spread = \( P_{0,10} - P_{J} - P_{J}(r_{3m,5m}) \)
\[
\frac{P_{0,10} - P_{J}}{P_{J}}
\]

Source: Journal of Commerce and Cotton and Wool Situation, USDA
World Ending Stocks - July 31, in million 480 lb. bales

- - Dec. - July
* - Oct. - July

Real Spread = \( P_{0,D} - P_{J} - P_{J} \frac{r_{3m}}{5m} \)

Source: Journal of Commerce and Cotton and Wool Situation, USD
The price spread for the 1971/72 crop year appears to be an outlier from the supply of storage curve. The real spread more than covers full carrying charges. It is not an artifact of limit price moves; real spreads of greater than 7% prevailed throughout July of 1971. Yet, end-of-year stocks were very low in 1971. What plausible explanation is there for this anomalous spread? The answer may be that because of anticipated high cotton export demand in 1971/72 and inadequate cotton supplies, the market was paying an abnormally high return to storing cotton into the 1971/72 crop year. Privately held cotton stocks were unusually large in August of 1971, suggesting that the market responded favorably to the high return to storage. Note that the 1971 spread was extremely negative, suggesting a severe shortage of cotton stocks available to meet market demands.

Finally, the cotton futures price spreads reveal that the December cotton contract in practice represents the first new crop future. Spreads during shortage years are more negative for the December future than for the October future indicating that new crop supplies of cotton will not be available until December. While cotton may be harvested by October, the time required for ginning cotton probably accounts for this delay.

Figure 6 shows the relationship between real cocoa futures price spreads at both the New York and London futures market and estimated end-of-year world cocoa stocks. London prices have been converted to U.S. dollars before determining the real spread between the old (September) and new (December) crop futures. End-of-year stock figures are estimated from "Apparent Stock Change" statistics published by the USDA. Hence, the zero point of Figure 6 is only a reference point.

1 Real cocoa spreads are computed from futures prices (settling prices in New York and closing old prices in London) observed on the last trading of the September future in New York, 1964-1981.
Real Spread-Cocoa (Circled numbers refer to Sept. date) 1964-1981
Dec.-Sept.

Figure 6

Real Spread = \( \frac{(P_D - P_S - P_S \cdot r_{fm})}{P_S} \)

Estimated World Cocoa Ending Stocks - September

Spreads taken on last day of trading of NY contract for both NY and London
- - New York
- - London

Both New York and London cocoa spreads are consistent with a supply of storage. However, they do not closely match each other in years of stock shortages. These discrepancies are probably due to different amounts of cocoa stocks in New York and London during shortage years. The supply of storage curve is extremely steep and sensitive at low stock ranges.

In contrast to cotton futures price spreads, cocoa futures price spreads appear to represent world stock availability, at least in surplus years. This contrast may be attributable to the fact that most cocoa stocks are held in importing countries (Northern Europe, the United States, and Japan), while cotton stocks are dispersed throughout the world. Cocoa stocks are located in market-based economies; cocoa stockholders are likely to hedge on futures markets or at least pay attention to futures price signals. Cotton stockholders outside of the U.S. may not be so inclined.

Bias and Variability in Futures Prices

Futures prices are tested for unbiasedness because a persistent bias would imply that one side of a market can usually profit by taking a futures position while the other side will incur a loss. For instance, if there is a downward bias in futures prices, that is prices have a tendency to rise as the delivery month approaches, on average buyers (longs) profit and sellers (shorts) lose. A bias may be characteristic of a thin or inactive market.\(^1\) Prospective hedgers should be wary of biased prices because the net price they receive through hedging may on average be lower, or possibly higher, than the price they would have received without hedging.

A second issue of concern to potential hedgers is the effect of futures positions on the variability of revenues. The variance of futures prices is compared to the variance of spot prices to investigate whether the variability

---

of returns from hedging is greater or less than the variability of returns without hedging. In general, people are risk averse. When given a choice between two enterprises, both with the same expected return, they usually chose the enterprise with lower variance in returns. Developing country exporters are particularly averse to variability in export revenues. As such, their futures trading strategies should take into account any differences in year to year variability in futures prices as compared to cash market prices. The rewards to hedging are enhanced if the variability of futures prices is less than the variability of cash prices. Of course, if there is a relationship between the mean and variance of returns such that lower variability only comes at a cost of lower expected returns, then the rewards to hedging are diminished. Still, risk averse traders may be willing to trade some returns for lower variance.

The most commonly used technique for testing for bias in futures prices is to regress cash prices on futures prices. For example, cash cotton prices in December are regressed on December contract futures prices quoted some months before December. Separate regressions are run for each month before December. If futures prices are unbiased predictors of cash prices, each regression will yield an intercept not significantly different from zero and a slope not significantly different from one. The explanatory power of these regressions will decrease the further the predictor month is from the delivery month. (for instance, a regression of cash prices in December on December contract futures prices in November will yield a higher $R^2$ than a similar regression using December contract prices in January). Nonetheless, unbiasedness will still require that the intercept and slope do not differ significantly from zero and one for all months before contract expiration.

The problem implicit in this technique is that while each regression may not yield statistically significant results that would suggest a bias in
futures prices, a clear bias in futures prices may still be overlooked. For instance, a bias may become obvious if futures prices for a particular contract month are examined as a series. Similarly, if examined as a series rather than individually, bias found in only one previous month may be regarded as a statistical artifact if bias is not also found in the series as a whole.

Cotton and cocoa futures prices will be tested for bias using both the regression technique and a test for a trend in a series of means of futures prices. For both techniques, futures prices are deflated using the U.S. producer price index for prices received for farm products (Federal Reserve Bulletin statistic). Prices are deflated to remove the effect of inflation which would promote a spurious correlation between futures prices and cash prices over time. The December contract is used to test for bias in both cotton and cocoa futures prices. The closing or settling price for the last day of trading in December is taken as the cash price for both cotton and cocoa prices. Prices for the December contract are taken on the same day (or close to it if a weekend or holiday) for each month of trading prior to December. There are 14 years of observations, 1967-1981, for the New York cotton contract, 22 years of observations, 1960-1981, for the New York cocoa contract, and 10 years of observations, 1972-1981, for the London cocoa contract. There are a total of fifteen months of futures prices, December through the previous October, for each year for both cotton and New York cocoa, while there are only ten months, December through the previous December, for London cocoa. There was trading in all three contracts in many years during months before the earliest months used in this analysis. However, to keep the sample size constant for each contract, only those months are examined in which trading took place in all years.

A distribution-free method was used to test for a trend in futures prices
over the life of a contract. Means of deflated futures prices for all months considered are tested for a time trend using Kendall's Tau Statistic. The formula for Kendall's Tau is:

\[ T = \frac{4p}{n(n-1)} - 1 \]

where \( p \) is the number of inversions in a series and \( n \) is the number of observations in a series. Inversions occur when observations are out of sequence. For instance, in the series 3-2-1-4 there are three inversions: 3-2, 3-1, and 2-1. The expected number of inversions in an independent series is:

\[ \frac{n(n-1)}{4} \]

Hence the expected value of Tau in an independent series is zero. When \( n \) is greater than eight the variance of Tau is approximated by \( \frac{2(2n+5)}{9n(n-1)} \), and Tau is distributed as a standard normal deviate.

The variability of futures prices as compared to cash prices can also be tested in two ways. The obvious way is to test the ratio of the variance of futures prices to the variance of cash prices for each month prior to contract expiration. A simple F-test with \( n-1, n-1 \) degrees of freedom will indicate any significant differences in variances. However, like using the regression technique to test for bias in futures prices, using the ratio technique for testing differences in variances may not be very powerful for testing for a change in futures price variances over time. A Kendall test for a trend in the variance of futures prices is warranted along with F-tests comparing sets of futures price variances.

Table 8 gives the results of the regressions testing for bias in cotton and cocoa futures prices. Table 9 gives the results of the tests for a trend in the mean of futures prices using Kendall's Tau. Table 10 gives the results of the F-tests of futures vs. cash price variability. Table 11 gives the results of the Kendall tests for a trend in the variance of futures prices. The same deflated data set is used to test futures price variability as is used to test for bias in futures prices.
Table 8

Results of Regression Testing for Bias in Deflated Cotton and Cocoa Futures Prices *

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<th>Month</th>
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<th>β=1?</th>
<th>D.W.</th>
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<td></td>
<td></td>
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<td>Cotton (14 yrs. obs.)</td>
<td>New York Cocoa (22 yrs. obs.)</td>
<td>London Cocoa (10 yrs. obs.)</td>
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<td>DNR</td>
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<td>DNR</td>
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<td>.750 yes</td>
<td>DNR</td>
<td>DNR</td>
<td>1.92</td>
<td>.502 yes</td>
</tr>
<tr>
<td>Apr</td>
<td>.038</td>
<td>no</td>
<td>R</td>
<td>R</td>
<td>2.50</td>
<td>.709 yes</td>
<td>DNR</td>
<td>DNR</td>
<td>1.39</td>
<td>.590 yes</td>
</tr>
<tr>
<td>Mar</td>
<td>.055</td>
<td>no</td>
<td>R</td>
<td>R</td>
<td>2.43</td>
<td>.634 yes</td>
<td>DNR</td>
<td>DNR</td>
<td>1.79</td>
<td>.444 yes</td>
</tr>
<tr>
<td>Feb</td>
<td>.112</td>
<td>no</td>
<td>R</td>
<td>R</td>
<td>2.28</td>
<td>.553 yes</td>
<td>DNR</td>
<td>DNR</td>
<td>1.46</td>
<td>.375 no</td>
</tr>
<tr>
<td>Jan</td>
<td>.184</td>
<td>no</td>
<td>R</td>
<td>R</td>
<td>2.15</td>
<td>.496 yes</td>
<td>DNR</td>
<td>DNR</td>
<td>1.19</td>
<td>.352 no</td>
</tr>
<tr>
<td>PDec</td>
<td>.197</td>
<td>no</td>
<td>R</td>
<td>R</td>
<td>2.13</td>
<td>.450 yes</td>
<td>DNR</td>
<td>DNR</td>
<td>.954</td>
<td></td>
</tr>
<tr>
<td>PNov</td>
<td>.213</td>
<td>no</td>
<td>R</td>
<td>R</td>
<td>2.07</td>
<td>.412 yes</td>
<td>DNR</td>
<td>DNR</td>
<td>.966</td>
<td></td>
</tr>
<tr>
<td>POct</td>
<td>.203</td>
<td>no</td>
<td>R</td>
<td>R</td>
<td>1.92</td>
<td>.372 yes</td>
<td>DNR</td>
<td>DNR</td>
<td>.857</td>
<td></td>
</tr>
</tbody>
</table>

* Results pertain to a 5% significance level
(a), (b) DNR = do not reject at \( \alpha = .05 \), R = reject at \( \alpha = .05 \)
Table 9
Results of Kendall tests Testing for a Trend in the Mean of Deflated Futures Prices

<table>
<thead>
<tr>
<th></th>
<th>Cotton</th>
<th>New York Cocoa</th>
<th>London Cocoa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P = 11</td>
<td>P = 16</td>
<td>P = 3</td>
</tr>
<tr>
<td></td>
<td>N = 15</td>
<td>N = 15</td>
<td>N = 12</td>
</tr>
<tr>
<td>T</td>
<td>-.79</td>
<td>T = -.695</td>
<td>T = -.9091</td>
</tr>
<tr>
<td>Var T</td>
<td>.037037</td>
<td>Var T = .037037</td>
<td>Var T = .04882</td>
</tr>
<tr>
<td>Z</td>
<td>-4.11</td>
<td>Z = -3.611</td>
<td>Z = 4.114</td>
</tr>
<tr>
<td>evidence</td>
<td>that the mean of deflated</td>
<td>Strong evidence that</td>
<td>Strong evidence that</td>
</tr>
<tr>
<td>that</td>
<td>cotton futures prices</td>
<td>the mean of deflated</td>
<td>the mean of deflated</td>
</tr>
<tr>
<td>increases</td>
<td>increases as the delivery</td>
<td>New York cocoa prices</td>
<td>London cocoa prices</td>
</tr>
<tr>
<td>as the</td>
<td>month approaches.</td>
<td>increases as the delivery</td>
<td></td>
</tr>
<tr>
<td>delivery</td>
<td></td>
<td>month approaches.</td>
<td></td>
</tr>
<tr>
<td>month</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>approaches.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>mean of deflated cotton</td>
<td>December mean of deflated NY</td>
<td></td>
</tr>
<tr>
<td>mean of</td>
<td>prices = .291957</td>
<td>cocoa prices = .371208</td>
<td></td>
</tr>
<tr>
<td>deflated</td>
<td>Previous October mean</td>
<td>Previous October mean</td>
<td></td>
</tr>
<tr>
<td>cotton</td>
<td>mean of deflated NY cocoa</td>
<td>mean of deflated</td>
<td></td>
</tr>
<tr>
<td>prices</td>
<td>prices = .272385</td>
<td>London cocoa prices = 5.84623</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Previous January mean of</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>deflated London cocoa prices</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>= 4.67719</td>
<td></td>
</tr>
</tbody>
</table>
Table 10

Results of F-Tests Comparing Cash to
Variance December
Futures Price Variability.*  F = Variance Prior Month

<table>
<thead>
<tr>
<th>Month</th>
<th>Cotton</th>
<th>NY Cocoa</th>
<th>London Cocoa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Critical F = 2.60</td>
<td>Critical F = 2.00</td>
<td>Critical F = 3.18</td>
</tr>
<tr>
<td>d.f.</td>
<td>(13,13)</td>
<td>(21, 21)</td>
<td>(9, 9)</td>
</tr>
<tr>
<td>Nov</td>
<td>F = 1.24</td>
<td>F = .843</td>
<td>F = .834</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Oct</td>
<td>.973</td>
<td>1.04</td>
<td>.977</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Sep</td>
<td>.934</td>
<td>.995</td>
<td>.942</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Aug</td>
<td>2.32</td>
<td>1.27</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Jul</td>
<td>1.58</td>
<td>1.00</td>
<td>.841</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Jun</td>
<td>2.63</td>
<td>1.21</td>
<td>.964</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>May</td>
<td>3.83</td>
<td>1.34</td>
<td>1.07</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Apr</td>
<td>3.14</td>
<td>1.60</td>
<td>1.37</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Mar</td>
<td>2.31</td>
<td>1.17</td>
<td>.920</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Feb</td>
<td>2.18</td>
<td>1.54</td>
<td>1.32</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Jan</td>
<td>2.11</td>
<td>1.76</td>
<td>1.47</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>pDec</td>
<td>1.98</td>
<td>1.81</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>pNov</td>
<td>2.19</td>
<td>1.82</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>POct</td>
<td>2.28</td>
<td>2.09</td>
<td>yes</td>
</tr>
</tbody>
</table>

*Results pertain to a 5% significance level.
Table 11

Results of Kendall tests Testing for a Trend in the Variance of Futures Prices

<table>
<thead>
<tr>
<th></th>
<th>Cotton</th>
<th>New York Cocoa</th>
<th>London Cocoa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P = 39</td>
<td>P = 11</td>
<td>P = 20</td>
</tr>
<tr>
<td></td>
<td>N = 15</td>
<td>N = 15</td>
<td>N = 12</td>
</tr>
<tr>
<td></td>
<td>T = -.2571</td>
<td>T = -.790</td>
<td>T = -.3939</td>
</tr>
<tr>
<td></td>
<td>var T = .037037</td>
<td>var T = .037037</td>
<td>var T = .04825</td>
</tr>
<tr>
<td></td>
<td>Z = 1.336</td>
<td>Z = -4.11</td>
<td>Z = -1.7825</td>
</tr>
</tbody>
</table>

Reject independence at = .1. Weak evidence that the variance of deflated cotton futures prices increases as the delivery month approaches.

December variance of deflated cotton of deflated London prices = .00481389. Previous October variance of deflated cotton prices = .00210796.

Reject independence. Strong evidence that the variance of deflated NY cocoa prices increases as the delivery month approaches.

December variance of deflated NY cocoa prices = .0398277. Previous October variance of deflated NY cocoa prices = .0190874.

Reject independence at = .05. Evidence that the variance of deflated London cocoa prices increases as the delivery month approaches.

The most striking aspect of these results is the contrast between the results of the regressions and F-tests and the results of the Kendall Tests. The regressions and F-tests in general would support a conclusion of unbiasedness in futures prices (at least for cocoa) and a insignificant difference in the variability between futures and cash market prices. On the other hand, the Kendall tests point to a conclusion of bias in cotton and cocoa futures prices and increased variability in futures prices as the delivery month is approached. The discrepancies in these test results appear to stem from the difference between the statistical significance of pair-wise comparisons and a test of a series. The regression coefficients usually do not differ from zero and one, yet most intercept coefficients are greater than zero and most slope coefficients are less than one. The F-statistics are usually less than the critical value for statistical significance, yet most increase with time from the delivery month. This information is not given its due in pairwise comparisons, while it is in a test of a series.

The results of the regressions and F-tests taken together with the Kendall tests indicate that a downward bias does exist on average in cotton and cocoa futures prices and that the variability of futures prices increases as the delivery month approaches. However, the bias is small and not assured for any given month or any given year. Likewise, the year-to-year variability in near futures prices is not much greater than the variability in distant futures prices. It is plausible that the increase in futures price variability as December, the delivery month, approaches is due in large part to the information on the exact size of the new crop that reaches the market around harvest. This information provides a shock to the market that can not be fully incorporated in the futures prices of the months before harvest. Projections of the size of the new crop may attenuate this shock but will not eliminate it.
The various test results for cotton as compared to those for cocoa suggest that cotton cash market prices are appreciably more volatile than are cocoa cash market prices and that cotton futures prices contain less predictive power than do cocoa futures prices. This may be a reflection of the difference in the international markets for cotton and cocoa. Cotton prices may be subject to greater shocks than cocoa prices because the U.S. acts as residual supplier of cotton to the rest of the world. Demand for U.S. cotton is not steady from year to year, but instead depends on random cotton supply deficits in importing countries. The supply and demand for cocoa is far more predictable. Supply trends roughly follow the five year cycle in cocoa production. Evidence for this contrast between cotton and cocoa is borne out by the Durbin-Watson statistics from the respective regressions. The cotton regressions show negative serial correlation in the residuals: positive predictive errors follow negative predictive errors. The cocoa regressions show positive serial correlation in the residuals of regressions of cash prices on distant futures prices. This means that predictive errors are of the same sign for a sequence of years. Further insight into this contrast between the behavior of cotton and cocoa futures prices might be gained by examining the errors in projections of new crop market conditions for cotton and cocoa. Any systematic errors in these projections will have a profound impact on the behavior of futures prices.
CONCLUSIONS

Developing countries that rely heavily on the revenues from the export of a few commodities confront great variability in their export earnings. Instability in the prices received for commodity exports accounts for part of this variability. Numerous stabilization schemes such as buffer stock programs have been attempted in order to reduce price instability. At best most have met with limited success. The use of futures markets by commodity exporters has been suggested as either an alternative or a complement to conventional price stabilization programs. This paper has tried both to describe the economic opportunities futures markets provide to developing countries and to explain the factors developing countries must consider before using futures markets. Some empirical characteristics of two representative futures markets, cotton and cocoa, are also presented.

Less developed countries can use futures markets to forward price anticipated exports. Futures markets also afford flexibility in the pricing of exports. The relationship of futures prices for different maturities provides information regarding the availability of stocks to the market. Finally, exporters can earn a return to commodity storage by hedging stocks on futures markets.

The use of futures markets will not, however, completely eliminate variability in export revenues. Revenue instability is caused by variability in quantity as well as price. As long as production is variable, revenues will in general vary unless stocks are withheld in times of plenty and released in times of shortage. Futures trading may facilitate commodity storage, but it will not affect production variability.

Exporters from developing countries may face a number of constraints that reduce the desirability of futures trading. For instance, developing countries may be unable or unwilling to meet the financial requirements for
maintaining futures positions. Or, they may confront severe basis risk. Basis risk is likely to be greater for exporters from developing countries than for other hedgers because the cash markets transactions of the former are usually more widely separated in either space, time, or form from their futures market transactions.

The use of futures markets is often offered as a means by which primary commodity producers can support commodity prices. This would be achieved by taking enough long futures positions to create upward pressure on futures prices and subsequently cash market prices. While there is evidence that such a strategy may be successful in the short-run (as in the 1970's coffee market), this strategy is very risky and probably can not succeed over prolonged periods. It is risky because large financial losses may be incurred if the attempt is unsuccessful. It probably can not succeed over prolonged periods because interest in futures trading will wane in response to the artificially supported prices leading perhaps to the closure of the futures market. Also, regulators of futures markets are likely to take actions to prevent or curtail any deliberate price manipulation on the part of futures traders.

In comparing the behavior of futures prices on cocoa and cotton futures markets it was found that cocoa prices at both New York and London futures markets are responsive to world stock levels in accordance with the theory of the supply of storage. On the other hand, cotton futures prices appear to reflect U.S. cotton stock availability more closely than world stock availability. This difference in futures price behavior may be due to the structure of the international markets for cocoa and cotton. Most of the cocoa produced is exported to developed countries under relatively competitive market conditions. In contrast, a large share of world cotton production
never enters international trade. Only the stocks of cotton available to the international market may be price responsive, while world stocks in general are not.

Finally, a small, but significant, downward bias was found in the price of the December cocoa and cotton futures contracts. Also, the year to year variability in the price of the December cocoa and cotton futures contract was found to increase slightly as the delivery month approaches. These results suggest a slight mean-variance trade-off for the prospective futures trader. That is, revenues may on average be smaller if anticipated exports are forward priced on futures markets. However, the variance in these export revenues may be less than the variance of cash market revenues.
References


-. "Futures Trading and Less-Developed Countries." London: City University Business School, February, 1981.

-. "Optimal Hedging on Futures Markets for Commodity Exporting Nations." London: City University Business School, undated.


--- Foreign Agricultural Circular, Sugar, 1981.

