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Price Discovery in the World Sugar Futures and Dominican Republic Cash Market

Abstract

This paper examines the relationship between #11 sugar futures prices traded in New York and the world cash prices for exported sugar. It was found that the futures market for sugar leads the cash market in price discovery. However, we fail to find evidence that changes in the cash price causes changes in futures price, that is, causality is unidirectional from futures to cash. The finding of cointegration between futures and cash prices suggests that the sugar futures contract is a useful vehicle for reducing overall market price risk faced by cash market participants selling at the world price (i.e., not enjoying favorable trade incentives). Further reliability on the usefulness of the WSF as a price discovery market is found through the impulse response functions; a shock in the futures price innovation generates a quick (one month) and positive response in futures and cash prices; but not vice versa.

Key Words

Speculation, futures markets, world price, Dominican Republic, sugar, hedging

JEL: Q11, Q13, Q17.

Introduction

The United States (US) recently completed a free trade agreement with the Dominican Republic (DR). This has generated concern among some observes concerning the impact such an agreement will have on the DR, and on the US and world price for sugar (American Sugar Alliance, 2003; Agricultural Technical Advisory Committee for Trade in Sweeteners and Sweetener Products, 2004). One argument made is that increased imports of sugar to the US from the DR will result in a lowering of the domestic price of sugar to that of the world price, forcing both US and DR producers to compete at the world price. This, in turn, will have a negative impact on the DR sugar industry.

The Dominican Republic (DR) is the second largest country in the Caribbean after Cuba. Its sugar industry is likewise second in value of production in that region, and sugar exports account for a significant amount of total sugar production. For the past several decades, the DR has exported a large percentage of its sugar production to the U.S., both during the period when imports were unrestricted and under the more recent tariff-rate quota (TRQ) system. The TRQ system is of considerable commercial value to the DR sugar industry, with imports amounting to 185,300 metric tons raw value (about 17% of U.S. total TRQ in 2002/03). However, this amount is down 48 percent from six years ago (USDA/ERS, January 2003). Not all DR exports of sugar to the U.S., however, fall under the TRQ system. In fact, a significant share of the exports falls under a quota-exempt system (Skully, 1998).

In recent years, world sugar prices have been in decline refined sugar. In the DR, sugar mill numbers have declined and the sector has moved towards privatization. Opponents of the current free trade agreement argue that this will continue if all DR sugar exports are traded at the world price.

If critics of the free trade agreement are right, DR producers will not only face lower average prices, but increased price risk as well. The US sugar price over recent times has proven more stable than the world price (Figure 1). If the trade agreement results in an increase in US imports sufficient to keep the US market from being insulated from the world price, the DR will likely face both lower prices and increased price risk for their exports. Thus, the DR sugar industry may need to adopt a price risk management program to insure that they can lock in attractive prices when they do exist, and not completely expose themselves to the volatility of the world cash market.

An important question in addressing risk management issues is whether market instruments, such as futures contracts, can be effectively used to manage export price risk, and whether the futures market contributes positively to overall price discovery in the world sugar market. The #11 sugar futures contracts currently traded at the New York Coffee, Sugar and Cocoa Exchange do play a role in the calculation of prices for non-execution of the re-export provisions of the "quota-exempt import program" administered by the USDA, but their overall role in world market price discovery is less clear.

The concept of using futures markets to manage export price risk in less-developed countries (LDC) is not new (e.g., Thompson,1985; Gimmel,1985). Recent empirical research in futures markets suggests that for a hedge to result in overall price risk reduction there must be a stable and predictable relationship between cash and futures price movements. Testing for this relationship in futures-cash price pairs in U.S. produced commodities has received considerable attention, but work examining price relationships between futures markets in developed countries and cash prices for LDC produced commodities is less extensive (Fortenbery and Zapata, 2004).

If we view a futures price at time t for delivery at time t + k as the expectation of the cash price in period t + k, the relationship between futures and cash prices is defined by the order of integration of cash price (Bessler and Covey, 1991). Testing for this relationship (cointegration) provides evidence as to which price series leads overall price discovery, and the extent to which one price can be used to predict the other. If the futures/cash price relationship is found to be stable and predictable, then cash market participants can effectively use futures positions to minimize cash price risk.[1]

The pricing function of world sugar futures (WSF) has received limited research interest but represents an important market for sugar producers and exporters from LDC countries, as well as U.S. processing and merchandising firms. A unique aspect of the WSF (sugar # 11) contract is the specification of cane sugar delivery, stowed in bulk, *fob* from any of 28 foreign countries of origin (including the DR), as well as the US.

The purpose of this paper is to investigate whether a statistical relationship (cointegration) exists between price movements in the world cash market (the market that will become relevant for DR sugar exports if the free trade critics are right), and the futures market for world #11 sugar. It identifies the components that drive the temporal and spatial price relations between the two sugar markets, and identifies whether the New York futures market provides a useful risk management tool for producers and exporters of DR sugar. This information is of significant importance to producers, processors, importers and exporters trading the cash commodity, and speculators in both the cash and futures markets. It also sheds light on whether some of the potential risks resulting from the DR free trade agreement can be managed through existing market institutions.

The paper proceeds as follows: first we provide a short discussion of literature related to price dynamics in both storable and non-storable commodities, as well as previous work with sugar markets. Second, we describe the basic modeling structure used in this analysis and describe our specific model specification. Next, the data are described, followed by a discussion of the specific results generated for sugar markets. Finally, we present a set of conclusions and opportunities for further work.

Review of Literature

Despite the relative absence of work on sugar markets, the dynamics of price formation has received attention across a wide range of commodities. The seminal work of Garbade and Silber (1983) provided the theoretical foundation for much of the work that has been done. They developed a partial equilibrium model to explain characteristics of price movements in cash and futures markets for storable commodities. Their goal was to test for efficiency in both functions of futures markets: risk management and price discovery.[2] Garbade and Silber argued that the elasticity of supply for arbitrage services is constrained by both storage and transaction costs.

Thus, futures contracts will not, in general, provide perfect risk transfer facilities over short-run horizons. However, over the long run, cash and futures prices should be integrated.

Theoretically, the degree of market price integration over short horizons is a function of the elasticity of supply of arbitrage services. Garbade and Silber tested this relationship for seven commodities. While they found all markets are integrated over a month or two, there was considerable slippage between cash and futures markets over shorter time intervals, especially for grains (corn, wheat and oats). Gold and silver were highly integrated even over one day, but results indicated that there is nontrivial risk exposure to hedgers over short time intervals (e.g., a week) in the futures markets for grains and, to a lesser extent, copper and orange juice.

The existence of a price discovery function in futures markets hinges on whether price changes in futures markets lead price changes in cash markets more often than the reverse. Garbade and Silber found that in general futures dominate and lead cash market price changes. Their evidence suggests that the cash markets in wheat, corn, and orange juice are satellites for their respective futures markets, with about seventy-five percent of new information incorporated first in futures prices and then flowing to cash prices. This seems to also be the case for gold, although data limitations prevented a conclusive statement. Price discovery for silver, oats, and copper, however, were more divided between the cash and futures markets.

Bessler and Covey (1991) studied the futures/cash price relationships for slaughter cattle, a non-storable commodity. They used daily settlement prices for the nearby live cattle futures contract from August 21, 1985 through August 20, 1986, and daily average cash prices (per cwt.) for direct sale of choice 900-1300lbs. slaughter cattle steers in the Texas-Oklahoma market. Their cash series reflected a direct rather than auction sales market for slaughter cattle. Thus, their cash series included sales throughout the entire five-day business week.

For a sample of 261 observations on daily live cattle prices, they obtained mixed results. Within sample fits (conducted on the first 130 data points) indicated that both cash and futures prices were generated by processes not statistically distinguishable from a random walk. Tests for cointegration based on residuals from a static regression (using the same 130 data points) showed marginal support for the cointegration hypothesis between cash and nearby futures prices. No cointegration was discovered between cash prices and more distant contracts. The results are consistent with the suggestion that the greater the temporal spread between futures and cash prices, the greater the degree of independence.[3]

Thompson, McNeill and Eales (1990) conducted one of the few studies on sugar markets. They examined the price impacts of delivery specifications for sugar futures by comparing sugar price behavior to price behavior in cocoa futures contracts. Their specific focus was on the seven weeks prior to contract expiration. Futures contracts for sugar and cocoa exhibit numerous similarities, except that cocoa contracts differ from sugar in delivery points. Cocoa has three delivery points in the US while sugar has none.

The Thompson et al. study provided answers to several related questions regarding the performance of the WSF contract. Empirical analysis was conducted using what they referred to as Paul-Type tests for liquidation bias and changes in volatility (Paul, 1986). However, this analysis differs from that used by Paul in two ways. Paul examined only the spread between the expiring contract and next maturity. Thompson et. al also examined the spread between the second and third expiring contracts to determine whether any price bias could be the behavior of the second maturing contract rather than the behavior of the maturing contract.[4] The second difference is that Paul calculated weekly average price spreads based on daily closing prices (mostly settlement prices). Thompson et. al used settlement price data from expiration days, and comparable data from each Thursday up to seven weeks prior to expiration.

Results suggest that the volatility of the sugar market appears to consistently increase in the final two weeks of trading in the expiring sugar contract. In the case of cocoa contracts, conversely, volatility seems to decrease, but not by a statistically significant amount. Regression results for sugar reveal that a relative decline in the price of the expiring contract and increasing volatility as expiration approaches does not occur simply because the contract is expiring. The driving force behind price behavior in the expiring contract appears to be due to changes in the open interest of the expiring contract.

Objectives

The objective here is to build on the work of Thompson et. al by explicitly examining the price dynamics between cash and futures prices for sugar. Specifically, we want to test whether the sugar futures contract is in fact providing price discovery benefits to sugar market participants, or whether the cash market (as was previously found with oats, copper, and silver) sometimes leads the futures market in price discovery. Additionally, and perhaps more importantly, we want to examine the extent to which the sugar futures contract fulfills its risk management function. Similar to previous work in other commodities, cointegration and exogeneity between futures and cash markets is tested. It is often useful to estimate what happens to cash prices when a one-time shock on the innovations of the futures price equation is imposed. Thus, impulse response functions for both series are estimated.

Data

The data used in this analysis consists of the average monthly New York closing futures prices for world #11 sugar deliverable on the contract from 01/90 - 04/02, and monthly world #11 sugar cash prices for the same period. This gives a total of 148 data points for both series. Futures contracts on sugar #11 are specified in trading units of 112,000 lbs. (50 long tons). Prices are quoted in cents per pound and there is no daily price limit in contrast to many other agricultural commodity futures contracts. Deliverable quality is specified as raw centrifugal cane sugar based on 96^0 average polarization. Futures contracts are traded for delivery in the months of March, May, July, and October. The analysis that follows focuses on the nearby futures price; that is the price for the contract closet to maturity. For example, in January the futures price considered is the price for March delivery since this is the closest delivery month following January. On first notice day (i.e., the first day on which physical delivery can be made against a given futures contract), the expiring contract is dropped and the next contract closest to maturity is observed.

Figure 2 shows the relationship between raw sugar cash and nearby futures prices over time. Note the high degree of linear correlation between world cash prices and nearby futures prices. From January 1990 to January 1995 (Figure 2) the co-movement was nearly identical. However, the relationship appears to have become less stable in recent years. Figure 2 suggests that there is considerable volatility in sugar prices, implying significant price risk for exporters selling at the world price. In addition, it appears that both mean price levels and mean basis levels have changed over time.[5] This leads to the question of whether there has been a significant structural change in the futures/cash price relationship for sugar.

When a market agent uses a futures contract to hedge against cash price risk, they are essentially trading cash price risk for basis risk. As long as unanticipated changes in basis levels are less than unanticipated changes in price levels, a futures hedge is overall price risk reducing. However, as basis risk increases, the effectiveness of a hedge in guaranteeing a specific cash price to a market agent deteriorates. If basis risk should match or exceed cash price risk, then the use of a futures contract can actually increase the risk faced by a cash market agent. Thus, a necessary condition for a futures contract to fulfill its risk reducing role in commodity markets is for basis risk to be somewhat predictable, and less than price risk (for a more complete discussion see Fortenbery and Zapata, 1993). If cash and futures markets exhibit non-stationarity in individual price levels, but are found to be cointegrated, then this necessary condition is likely to be met (Zapata and Fortenbery, 1996).

Pearsons' correlation analysis reveals a very high correlation (estimated coefficient of 0.96) between the cash and futures prices. This implies there is a strong relationship between the two price series, and provides anecdotal evidence that both series respond similarly to changes in sugar market fundamentals. The data reveals mean prices of 9.83 and 10.29 cents/lb. for futures and cash respectively, with associated standard deviations of 4.77 and 2.35. The presence of unit-roots in prices is tested using the augmented Dickey-Fuller statistic.

Pricing Model

Financial market pricing theory states that market efficiency is a function of how fast and how much information is reflected in prices. The rate at which prices exhibit market information is the rate at which this information is disseminated to market participants. A model of this behavior can be specified as (Garbade and Silber):

(1) $$\begin{bmatrix} C_t \\ F_t \end{bmatrix} = \begin{bmatrix} \alpha_c \\ \alpha_f \end{bmatrix} + \begin{bmatrix} 1-\beta_c & \beta_c \\ \beta_f & 1-\beta_f \end{bmatrix} \begin{bmatrix} C_{t-1} \\ F_{t-1} \end{bmatrix} + \begin{bmatrix} e_t \\ e_t \end{bmatrix}$$

where t refers to day, and C and F are the logarithms of the cash and futures prices, respectively. The coefficients β_c and β_f reflect the impacts of the previous day's price in one market on the other market's price. In this light it is expected that $\beta_c = 0$ and $\beta_f = 0$. The constant terms α_c and α_f reflect any trends in the price series. The ratio $\beta_c / (\beta_c + \beta_f)$ provides an indication of the level of price discovery occurring in each market. If the ratio is equal to one, implying that $\beta_f = 0$, then the cash price follows the future price, and price discovery originates in the futures markets. In this case, the cash market is referred to as a pure satellite of the futures market. If $\beta_c = 0$, the ratio is between zero and one and implies mutual adjustment and feedback of the two market's prices to each other.

Econometric Specification

The dynamic version of the Garbade-Silber model that is often used in empirical evaluations of futures-cash price relationships assumes that futures and cash prices maintain the structural relationship (the long-run component) derived from partial equilibrium theory and that deviations from such equilibrium are quickly corrected (are short-lived); this component in the model is defined an error-correction term for cointegrated series. Short-term price fluctuations are accounted for by adding lagged changes of futures and cash prices as is commonly done in vector autoregressive models with integrated series. This model is commonly known as an error-correction model (ECM) and can written as:

$$(2)\quad \begin{bmatrix} \Delta F_t \\ \Delta C_t \end{bmatrix} = \begin{bmatrix} g_{0,1} \\ g_{0,2} \end{bmatrix} + \begin{bmatrix} g_{11,1} & g_{12,1} \\ g_{21,1} & g_{22,1} \end{bmatrix} \begin{bmatrix} \Delta F_{t-1} \\ \Delta C_{t-1} \end{bmatrix} + \ldots + \begin{bmatrix} g_{11,p} & g_{12,p} \\ g_{21,p} & g_{22,p} \end{bmatrix} \begin{bmatrix} \Delta F_{t-p+1} \\ \Delta C_{t-p+1} \end{bmatrix} - \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} \begin{bmatrix} c_{11} & c_{12} \end{bmatrix} \begin{bmatrix} F_{t-p} \\ C_{t-p} \end{bmatrix} + \begin{bmatrix} e_{1,t} \\ e_{2,t} \end{bmatrix}$$

If an equilibrium relationship exists between cash and futures prices then $y_t = (F_t\ C_t)'$ is cointegrated with $Cy_t = z_t$, where z_t is a stationary error term about a mean of zero, suggesting that in equilibrium $Cy_t = 0$ such that the C coefficients may take the values (1 –1). Details on the estimation of this model can be found in Johansen et al. (1988; 1990). An excellent practical guide to estimation and testing is the RATS/CATS software. This approach requires the identification of unit roots, lag length and cointegration properties of the series. In this application, unit-root properties are identified with the Augmented Dickey-Fuller tests (ADF), lag length with the SC information criterion (SC), and cointegration with Johansen-Juselius

Lambda Max and Trace statistics. Typically applications would use Granger-type causality tests to study lead-lag relationships. As suggested by the Granger representation theorem (Engle and Granger), when cointegration is found then there is causality (long-run) in at least one direction; either from futures to cash or vice versa. This hypothesis is tested in model (2) using a t-type test (RATS/CATS)[6]. Since the interest of this study is to identify the time path followed by either futures or cash price to a one-unit shock in the innovations of each series (impulse response functions), Reimer and Lutkelpohl's approach for error-correction models is used to estimate impulse response functions for the WSF price dynamics.

Results

The nearby WSF price for contract #11 at New York and the world cash price for sugar (New York delivery in dollars) are plotted in Figure 2. Two observations from this figure are, first, the closeness of the relationship between futures (WSF) and cash prices (with a possible change in this relationship in 1995), and second, the volatile and declining prices for sugar from 1990 to 2002. The second feature, a possible change in the price mean and variance over time, suggests the possibility of nonstationary behavior in both series. Futures and cash prices were tested for unit-roots using augmented Dickey-Fuller(ADF) tests. The ADF value was -1.83 for futures and -2.34 for cash, which for a 10% level critical value (-2.57) would suggest one unit-root in both series. This result is consistent with changes in price behavior over time.

Based on the finding of non-stationarity, cointegration tests were conducted using Johansen's maximum likelihood procedure. The relationship between cash and futures prices was tested using an error-correction model (ECM) with lag length set at 2 based on the SC criteria. The Lambda-max statistic of 11.15 is significant at the 10% level (10.29) for no cointegration and takes a value much smaller than the critical value for the null hypothesis of one cointegrating relation. This suggests long-run co-movement (cointegration) between New York nearby futures and the world cash prices for sugar. The test for autocorrelation yields Lung-Box values with p-values much higher than 0.05, suggesting no autocorrelation. Autoregressive conditional heteroskedasticity does not appear to be a problem as the ARCH effects are not significant.

The cointegration tests suggest a predictable long-run price relationship between futures and cash prices for world sugar. On the surface, then, it appears that the New York sugar futures contract can be used to reduce market price risk for cash market participants exporting at the world market price. However, as noted above, the anecdotal evidence from Figure 2 is that the futures/cash price relationship has changed over time. Specifically, it appears that basis structure may have changed since 1995.

Splitting the data series into pre and post January 1995, calculating separate volatilities, and then applying an F-test to assess for statistical differences verifies that in fact basis risk has increased in recent years. Thus, while the futures market still provides risk-reducing opportunities for cash market participants, its risk-reducing performance has deteriorated in recent years.

The specific factors contributing to increased sugar market basis risk are not apparent from the analysis here. However, a couple of observations can be made. Building on work by Witherspoon (1993), Fortenbery and Zapata (2003) showed a correlation between increased speculative activity in coffee futures contracts and increased price volatility (they did not examine basis volatility directly). If speculators are dominated by technical traders who essentially are noise traders (that is traders more focused on patterns revealed by past price activity rather than market fundamentals) their placement of market orders based on interpretations of historical market momentum and direction may result in a market over-shooting its fundamental price (this could happen in either direction). The larger their market share in the futures, the further the market might overshoot "fundamental" value. If the commercial firms who dominate cash trade do not follow futures into the more extreme price ranges, basis levels would become more volatile (cash prices would tend to have a narrower trading range when then futures when futures are being driven by noise traders). From figure 3 it does appear that the market share of speculators relative to commercial traders has been growing over time.[7] The simple linear trend line shows positive slope. While it is unclear what the proper balance is between speculative and hedging activity (Witherspoon provides a theoretical model showing the possibility of excessive speculation, but to date there have been no confirmations of its existence in any specific commodity market), it is clear the relative market share between speculators and hedgers has been changing. Given the increase in basis risk coupled with increased market share of speculators, current market composition in sugar futures may warrant more careful study.

Dynamics Price Relationships

The existence of cointegration between WSF and cash prices for exported sugar implies Granger Causality either from futures to cash or vice versa. This result is theoretically justified by the Granger representation theorem. In practice, it implies that deviations from the equilibrium relationship between WSF and world cash prices are corrected at a speed b_1 and b_2 as given in model (2). A t-test (e.g., RATS/CATS) on such coefficients of the error-correction model suggests that the speed of adjustment is significant in the cash price equation but not in the futures price equation; note that in a bivariate system, the t-test is equivalent to a Wald test. That is, large positive deviations from the cointegrating relation between the nearby futures prices for world sugar in the New York Exchange and world cash prices for sugar are significantly corrected in the following period for the cash market. On the other hand, the results from this analysis indicate that cash prices have no impact on nearby New York futures prices since the corresponding t-value in the cash price equation is not insignificant. This means that there is long-run Granger Causality from futures to cash but not *vice-versa.*

When such price dynamics exit, an important piece of information is the time path followed by futures and cash prices when there is a one-unit shock in the innovations of either. Figures 4-5 present such responses. In Figure 4, the response of both futures and cash suggest that a one-time shock to a futures price causes an immediate jump in both futures and cash prices, with the futures prices jumping faster than cash prices. Also note that futures and cash prices settle at a positive equilibrium after three months. A very different time profile is shown in Figure 5 where a one-time shock to cash prices is imposed. Note that in this case, futures prices do not immediately respond, and when they do, it is to settle at a point slightly below the previous equilibrium. The response in cash price to its own innovation, however, causes a positive jump in cash prices but eventually the response returns to that of futures at slightly below the previous equilibrium.

Summary and Conclusion

This paper examines the price discovery and risk management contributions of the #11sugar futures contract traded at the New York Coffee, Sugar and Cocoa Exchange. In general, it was found that the futures market for sugar leads the cash market (measured as the cash price of Dominican Republic #11 sugar) in price discovery. However, we fail to find evidence that changes in the world cash price causes changes in futures prices. In other words, price change causality is unidirectional from futures to cash.

The finding of cointegration between futures and cash prices suggests that the sugar futures contract is a useful vehicle for reducing overall market price risk faced by cash market participants. However, the basis has become more volatile over time, implying that the price risk opportunities provided through futures hedges are less effective at reducing price risk than was the case in earlier time periods. The impulse response analysis lends support to the usefulness of the WSF as a price discovery market. It is found that once there is a shock in the futures price innovation, both futures and cash prices respond relatively quickly (one month) and positively

Exact causes of increased sugar market basis risk were not specifically tested, and should be the focus of further work. If basis volatility is linked to either futures market structure or market composition (i.e., is a function of the relative market share of speculators versus hedgers), continued deterioration might be expected, and changes may need to be made in either futures contract design, or specific trading rules if the overall market goal is to maintain a futures contract that provides maximum risk management opportunities to entities involved in the production, processing, and trade of sugar.

Table 1. Cointegration Between WSF and Dominican Republic Cash Prices, 1990-2000.

Null Hypothesis	Lambda Max	Trace	L-Max (90%)	Trace (90%)
r=0	11.15	17.30	10.29	17.30
r ≤1	6.15	6.15	7.50	6.15
Residual diagnostics	ARCH(2)	Lung-Box (36)	SC criterion	
Futures	0.17	p-value=0.40	-12.05	
Cash	0.32			

Notes: The ARCH(2) is a test for autoregressive conditional heteroskedasticity of order 2. The Lung-Box statistics for no autocorrelation is for bivariate residuals for 36 degrees of freedom. The SC criterion is also for both series.

Figure 1. World vs. US Sugar Prices.

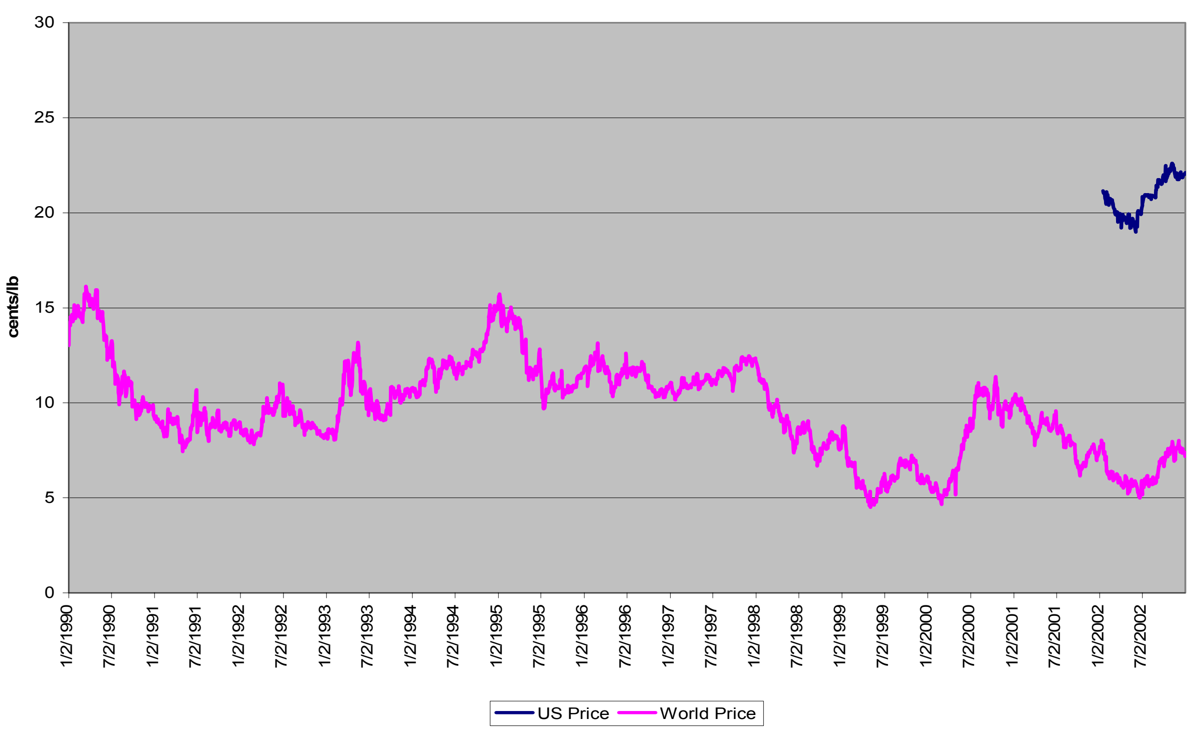


Figure 2. Cash and Futures (#11) Sugar Prices, 1990-2002.

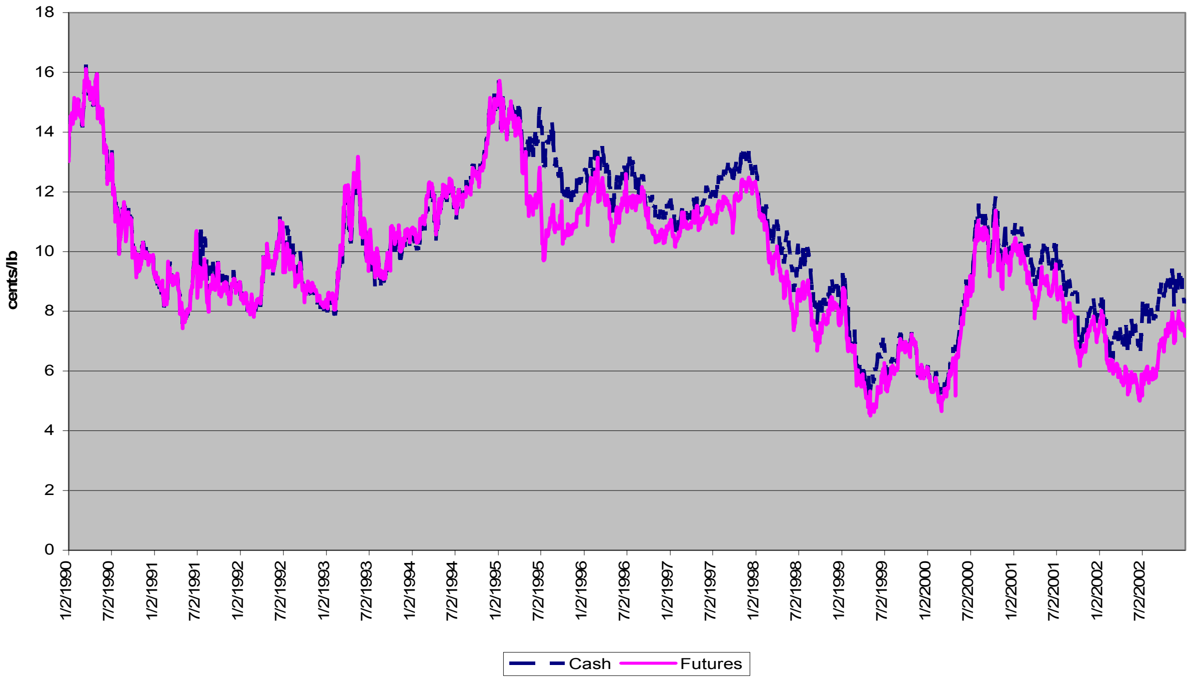
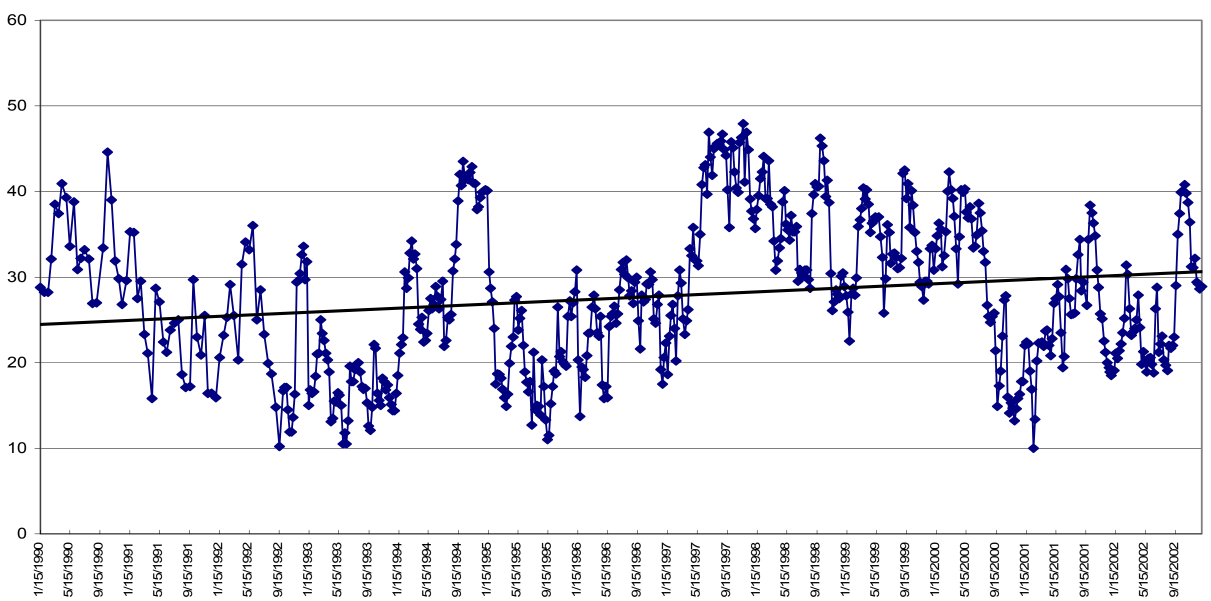


Figure 3. Percent of Total Open Interest Represented by Non-Commercial Traders.



Source: Commodity Futures Tradng Commision, Commitment of Traders Reports

Figure 4. Responses of Futures and Cash Prices for World Sugar to a Shock in Futures Prices

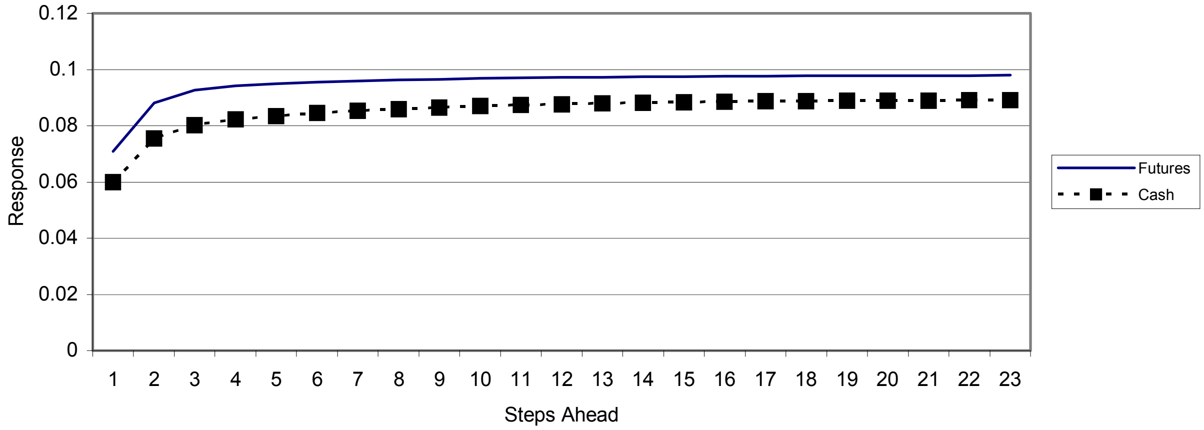
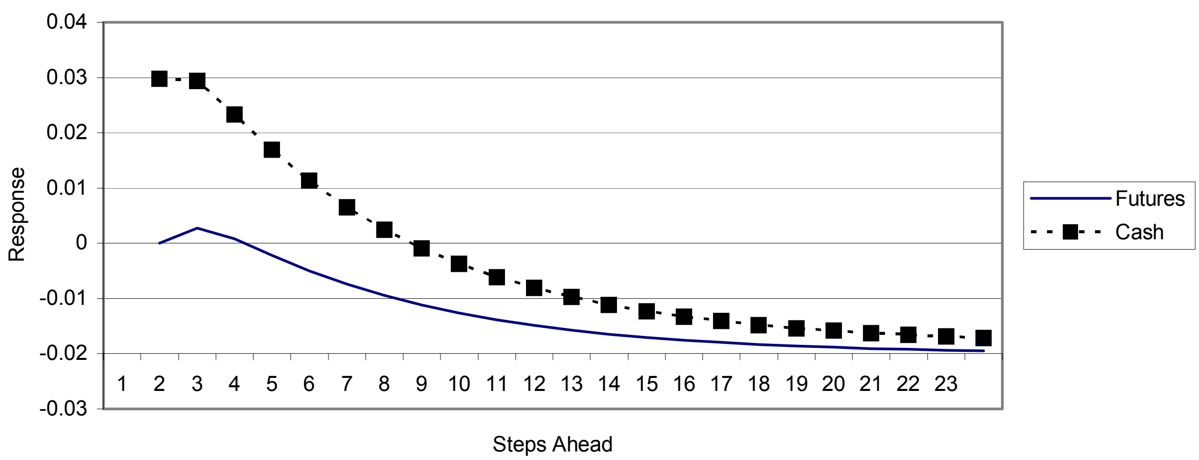


Figure 5. Responses of Futures and Cash Prices for World Sugar to a Shock in Cash Prices



End Notes

[1] As pointed out by an anonymous reviewer, this does not constitute a measure of the optimal hedge strategy. However, if the relationship between futures and cash prices at a later date is predictable, than an expected later net cash price resulting from a hedged position can be accurately forecast, thus price risk is reduced.

[2] For a complete discussion of the social function and benefits of futures trading, see Powers.

[3] While this has been a general conclusion, it is important to note that Zapata and Fortenbery, in examining markets for storable commodities, showed that this result could be the result of a mis-specified model. They argued that storage costs themselves maybe non-stationary, and the longer the time between a cash price observance and futures contract expiration, the more important the storage cost function becomes in determining relative price dynamics. They showed that explicitly accounting for storage costs in a cointegration framework can result in detecting cointegration between current cash prices and prices for futures contracts as much as a year from delivery, even though bi-variate tests (i.e., using only the cash and futures price series) suggested an absence of cointegration.

[4] The second expiring contract is the next contract to expire after the nearby contract. The third expiring contract is the contract that expires immediately after the second expiring contract.

[5] Basis is the difference between futures and cash prices for a given commodity. It is generally calculated as cash minus futures price.

[6] The t-test is equivalent to a Wald test for bivariate models.

[7] The market percentages presented in figure 2 represent the ratio of non-commercial open interest to total market open interest. It does not account fro smaller non-reporting traders who may be speculators (and in the case of sugar are likely dominated by speculators since there are few small producers or processors in the U.S., and does not account for speculative activity

among commercial category of traders. Thus, in all likelihood, the ration understates market share of speculators.

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