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They Trade Shrimp in Minneapolis? An Examination of the MGE White Shrimp Futures Contract

Dwight R. Sanders and Joost M. E. Pennings^{*}

The successful introduction of risk management products to industries unfamiliar with futures markets (e.g., dairy, aquaculture, and environmental resources) is likely to become increasingly important as futures exchanges consider alternative structures (e.g., for-profit) and the trading platform evolves (*i.e.*, electronic trading). Here, we examine the performance of the Minneapolis Grain Exchange's white shrimp futures contract, one of the first futures contracts aimed at the aquaculture industry. Although the market structure conforms to most of the traditional criteria for a successful futures contract, the contract's performance is disappointing in terms of liquidity and hedging effectiveness. It is not clear if this is due to a poorly designed contract or a lack of participation (*i.e.*, cash-futures arbitrage) required for convergence and a predictable basis.

Introduction

Forty percent of the futures contracts introduced in the United States are delisted prior to their fifth year of existence (Carlton). The Minneapolis Grain Exchange's (MGE) White Shrimp futures survived their fifth year with a monthly average trading volume of 87 contracts. Clearly, this is not a wildly successful futures contract in terms of volume; but, then again, it has outlived other food-related contracts introduced in recent years (e.g., broilers). This raises an interesting research problem: What is preventing the shrimp industry from more fully adopting the futures contract? Or, why do the MGE White Shrimp futures cling to life?

It is important that exchanges and research institutions address this type of problem for two reasons. First, growth in derivatives markets may arise in industries without a tradition of futures markets (e.g., aquaculture, dairy, natural resources, and power) as opposed to expansion in industries with established markets (e.g., another pork or beef contract). Second, the success rate of new contracts is rather poor (Carlton), and it hasn't improved in recent years (e.g., Thompson, Garcia, and Wildman). This is especially true for new or non-traditional industries (e.g., Bollman, Thompson, and Garcia). The ability to successfully introduce new contracts may take added importance as futures exchanges consider new governance structures (e.g., for-profit) and as their roles evolve in modern electronic marketplaces.

It is the objective of this research to examine the market structure of the shrimp industry and evaluate the performance of the MGE White Shrimp futures contract. Specifically, we examine the shrimp industry's structure and market characteristics within the traditional requirements for a successful futures market. Black, Gray, Hieronymus, and others (see Leuthold, Junkus, and Cordier) propose necessary conditions for a successful futures contract. The standard list includes such economic necessities as a well-defined and large underlying cash market, price volatility, cross-hedge liquidity, residual basis risk, a competitive marketplace, economic need, and the ability to attract speculators (*i.e.*, build liquidity). In addition to these factors, the contract must be well-written: it favors neither longs nor shorts. The shrimp market's conformity to these standards is examined. Deviations and their potential impact are

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highlighted. In the following sections, we examine the traditional criteria in detail. First, however, the basic biological and production features of the shrimp industry are presented.

Production

Total world farmed shrimp production is estimated at 1.445 billion pounds (whole weight).¹ Seventy percent of the farmed shrimp are black tiger shrimp (*Panaeus monodon*) produced in the Eastern Hemisphere (primarily Thailand, Indonesia, and China). The remaining 30% are white shrimp (*Panaeus vannamei*) produced in the Western Hemisphere (primarily Ecuador, Mexico, and Honduras). Farmed shrimp production increased 10% from 1990 through 1997.

White Shrimp Production

Western white shrimp production is estimated at 437.0 million pounds with a value of 1.22 billion dollars. The leading producers are Ecuador with 66% of the total, followed by Mexico, Honduras, and Colombia with 8%, 6%, and 5%, respectively. The United States imports 65% of white shrimp farmed in Latin America with the remainder going to Europe (30%), Asia (3%), and local markets (2%).

Production Process

White shrimp are predominately grown in semi-intensive farming operations. These operations consist of 35 to 40 acre ponds which are stocked with 100,000 to 300,000 postlarvae.² The shrimp are fed a high protein supplement consisting mostly of fishmeal. Feed costs represent roughly 50% of production costs. Near the equator, the ponds can produce 3 or 4 crops per year that yield 450 pounds per acre. The shrimp are harvested at the desired size count (pieces per pound). Product is sold into the export market in a variety of forms (cooked or raw, shell-on or peeled). The typical commodity form is headless shell-on tails that are frozen in five-pound blocks and packed ten to the case. Block-frozen shrimp has a cold storage life up to 18 months. The most common size ranges are 51-60, 41-50, and 31-40 pieces per pound (headless, shell-on).

Ecuador's Production Industry

Production data on the shrimp industry is difficult to obtain. However, Ecuador publishes the most complete data set of firms and the size of their business. Thus, this is used as a gauge for the overall industry. Ecuador produces 66% of the western white shrimp. In 1997, they exported a total of 240 million pounds valued at 872 million dollars. Of the total, 142 million pounds valued at 559 million dollars was exported to the United States.

Ecuador has 343 shrimp hatcheries and 21 facilities that produce seedstock. There are over 1800 farms producing on 450,000 acres of ponds. Farm ownership is spread over 1000 different entities. There are 64 shrimp packing plants in Ecuador.

For the year 1997, Ecuador reported 81 firms as officially exporting shrimp products. The ten largest firms exported 60% of the total.³ Of the product that went into the United States,

¹ Farmed production accounts for roughly 25% of world shrimp production. The other 75% are wild-caught. Unless otherwise noted, the production statistics refer to calendar year 1997 and are taken from Rosenberry.

² Postlarvae is the fourth stage in the shrimp development cycle (see Rosenberry). Postlarvae can be either wild-caught or purchased from commercial hatcheries.

³ The following data is taken from *ESTADISTICA CIA.LTDA: Importacion y Exportacion*, a monthly trade report.

there were 115 importing firms of record. The ten largest U.S. importers handled 55% of the volume.

The degree of vertical integration within Ecuador's production and marketing channel is difficult to gauge. However, the largest exporters also tend to own some packing plants as well as farms. Yet, the above data suggest that the industry is relatively large with a competitive structure.

Ecuador's Marketing Channel

Two-thirds of Ecuador's shrimp production occurs around the Gulf of Guayaquil. Farmed production is marketed both directly to packers and to brokers/dealers who may purchase for themselves or on behalf of packers. In either case, prices are determined by competitive bids for a pond's entire production (by size). Payment is made after sorting and grading at the packing plant. Finished product is then sold to exporters. The exporter may be separate from the packing plant, or the packing plant can own an exporting company. Product then passes from exporter to an importing entity in the destination country.

Consumption

World shrimp consumption increased by 10.8% from 1990 through 1997. Shrimp consumption in the United States is 2.7 pounds per person, and it has increased at an annualized rate of 2.1% per year since 1990.⁴ Of the total shrimp consumed in the U.S., 80% is imported and the other 20% is wild-caught during the Gulf of Mexico season. Three countries supply 60% of the U.S. shrimp imports. Thailand leads in imports to the U.S. at 25.0% followed by Ecuador and Mexico with 23.7% and 11.3 %, respectively.

U.S. Marketing Channel

Shrimp is brought into the United States by importing firms who deal directly with foreign exporters or packing plants. Ecuadorian white shrimp is usually purchased by the importer F.O.B. Guayaquil in U.S. dollars. Shipping time to the U.S. is approximately ten working days. After passing Food and Drug Administration (FDA) inspections for sanitation, shrimp entering the U.S. moves directly to an end-user (i.e., retailer or foodservice) or processor (e.g., breader) or goes into a cold storage facility until a final sale is made.⁵

Within the United States there is not a formal or centralized cash market. Ex-warehouse wholesale prices are negotiated transaction-by-transaction. Prices and market conditions are distributed through an array of methods. This includes faxes, electronic mail, and electronic seafood exchanges. However, the dominant method of trade is via personal communication (i.e., telephone). Because there is lack of centralization and communication within the domestic market, the benchmark for the cash "market price" has become the Urner Barry survey.⁶ The Urner Barry price is the result of a biweekly survey of wholesale buyers and sellers as to the prices at which they transact.

⁴ U.S. import data is provided by personal communication from the National Marine Fisheries Service, Fisheries Statistics and Economics Division.

⁵ Total shrimp in cold storage averaged 42 million pounds over the period from 1994 through 1998. This is roughly 6% of annual consumption or a three-week supply.

⁶ The National Marine Fishery Service publishes a New York wholesale price each Friday. However, this is essentially an offer price that is not considered reputable by industry participants (personal interviews).

Fundamental Data

Timely fundamental data on the shrimp market is fairly limited. The U.S. Census Bureau records and releases monthly import and cold storage holdings data. The National Marine Fisheries Service records statistics on the domestic fishery (catch and domestic ex-vessel prices for gulf shrimp). Annual consumption and production data are available from the Foreign Agricultural Organization of the United Nations and the National Marine Fisheries Service, but these data are much too delayed to have meaningful price impacts.

Futures Contract

The Minneapolis Grain Exchange introduced futures on western white shrimp in July of 1993.⁷ The industry initially greeted the contract with much enthusiasm and fanfare (Shaw). However, after a relatively successful launch, volume and open interest quickly dwindled (see Figure 1). Notably, interest in the contract did not completely disappear, which indicates at least some commercial demand for the product. In the following sections we examine the contract specifications and underlying cash market in the context of traditional requirements for a successful futures contract.

Contract Specifications⁸

The MGE futures contract calls for par delivery of 5,000 pounds (net weight) of 41-50 count, block frozen, headless, shell-on, white shrimp (usually *Panaeus vannamei*).⁹ Each lot must be a single brand from a single packer held in an approved warehouse within fifty miles of New York City, Jacksonville, Miami, or Tampa. West Coast delivery (Los Angeles) receives a \$0.07 per pound premium. Alternative sizes are deliverable on a fixed premium or discount schedule. Shrimp that count 51-60 pieces per pound are deliverable at a discount of \$0.90 per pound, and larger 36-40 and 31-35 count shrimp are deliverable at a premiums of \$0.10 and \$0.35 per pound, respectively. Shrimp must meet the technical standards for MGE Class 1 Shrimp (roughly equivalent to U.S. Grade A). There is a contract listed for each calendar month.

Contract Activity

Since inception, white shrimp futures' monthly average volume is 62 futures contracts and 26 option contracts. Month end open interest has averaged 18 futures and 18 options. However, the volume (and open interest) is not uniformly distributed through time (see Figure 1). The highest volume was recorded during the first (partial) month of trade with a total of 567 futures and options trading. Open interest peaked at the end of the first full month of trading (August, 1993) with a total of 252 futures and options open. From that point forward, trade

⁷ The MGE also introduced a futures contract on black tiger shrimp (*Panaeus monodon*) that calls for par delivery of 21-25 count shrimp of Eastern hemisphere origin. This contract has experienced problems very similar to the white shrimp contract discussed in this paper (see Martinez-Garmendia and Anderson). The Chicago Board of Trade unsuccessfully attempted a U.S. gulf shrimp contract in the 1960's (Sandor).

⁸ The information in this section is provided by the Minneapolis Grain Exchange and reflects contract specifications as of December 1998. The contract has had some substantive changes since its inception. Beginning with the September 1994 contract, there was a change in the premium schedule for non-par deliveries. The December 1995 contract reflected a change from U.S. Grade A shrimp to MGE Class 1 shrimp. The premium schedule was altered again for the August 1997 contract. The impact of these changes on basis behavior is an area for further research.

⁹ Two other species of Western Hemisphere white shrimp (*Panaeus occidentalis* and *Panaeus stylirostris*) are allowed under par delivery. However, they are almost never tendered for delivery. Deviations from the par product typically occur in the alternative sizes.

declined gradually into early 1996. The average monthly volume of trade in 1996 was 8 total futures and options contracts. There was a slight resurgence in 1997 and 1998 to an average trade level of 78 futures and options per month. Volume and open interest seem to be waning into the end of 1998.

Cash Market Characteristics

Shrimp prices are relatively volatile and correlated across similar sizes and species. Figure 2 shows nearby shrimp futures prices along with two sizes of a par species, Ecuador whites. The graph alludes to a reasonable correlation across the market prices as well as likely cross-hedging possibilities and basis opportunities for cash merchandising.

The statistical analyses focus on the monthly prices for the nearby futures contract and six cash market prices.¹⁰ The six cash price series include the par delivery species of alternative sizes, Ecuador white (white) 51-60's, 41-50's, 36-40's, 31-35's. The data set also includes the par size, 41-50's, of two non-deliverable species: Thailand black tiger (tiger) and Gulf of Mexico domestic brown shrimp (gulf). These markets represent hedging opportunities across deliverable sizes for white shrimp and also cross-hedging opportunities for non-deliverable markets of the par size (41-50's).

The price series are non-stationary in levels (Dickey-Fuller test).¹¹ So, the statistical analysis focuses on stationary price changes (Dickey-Fuller test). To reduce heteroskedasticity problems, prices are transformed to natural logarithms, $p_t = \ln(P_t)$. Therefore, price changes, $\Delta p_t = \ln(P_t/P_{t-1})$, can be interpreted as percent changes or returns. The data extends from the first full month of futures trading, August 1993, through December 1998 (65 observations).

Table 1 presents the summary statistics for monthly price changes in the nearby futures contract and the six cash price series. The highest monthly standard deviation is that of the futures price (5.1% monthly, 17.8% annualized) and the lowest is the tiger 41-50's at 3.2% monthly (11.3% annualized). The upper off-diagonal of Table 2 shows the p-values from an F-test for equality of variances among the price changes. The null hypothesis of equal variances is only rejected (5% level) for those comparisons involving the black tiger 41-50's. Otherwise, we cannot reject that the variances are the same across the other markets. This is important for comparing measures of hedging effectiveness later in the analysis

Basis Risk

To facilitate comparison across markets, the basis is measured as the log relative basis (see Garcia and Sanders, and Liu, Brorsen, Oellermann, and Farris). That is, the cash-futures basis at time t is measured as $\text{basis}_t = \ln(\text{CP}_t/\text{FP}_t)$, where CP_t is the month-end cash price and FP_t is the month-end nearby futures price. The summary statistics for the basis are presented in Table 3. Not unexpectedly, the average basis level ranges from -7.9% for the smaller white 51-60's to a

¹⁰ Cash prices are reported on Tuesdays and Thursdays. The time series are constructed using the last observation for each month. The futures price is the last trading day of the month. Therefore, there could an observation where the cash price is from (say) a Thursday and the futures price is from (say) Friday. However, any problems arising from the non-synchronous nature of the data is thought to be minimal for monthly analysis. The futures price is the nearby futures contract where the delivery month has not been entered (e.g., at month-end April, the May contract's price is utilized).

¹¹ Stationarity is tested with both the augmented Dickey-Fuller test (ADF) and with the Phillips-Perron test. Both tests indicated that the price series are non-stationary in levels and stationary in price changes.

28.4% premium for the larger white 31-35's.¹² Figure 3 illustrates the basis for three sizes of Ecuador white shrimp.

Comparing the standard deviation of each cash market (Table 1) with the standard deviation of its basis (Table 3) represents the relative risk for a completely unhedged (hedge ratio = 0.0) and fully hedged positions (hedge ratio = 1.0), respectively.¹³ For each of the six markets, the basis has a larger standard deviation than price: basis risk is at least as large as the price risk. On the surface, this certainly does not build the case for a potentially successful contract.

Basis risk tends to increase as we deviate from the par delivery market (white 41-50's). Equality of basis variance across the markets is tested with an F-test, and the p-values are presented in the lower off-diagonal of Table 2. Equality of basis variance cannot be rejected for the white 41-50's and 51-60's. Generally, the basis variance tends to be statistically larger as we deviate from the par delivery market.

Hedging Effectiveness

Measures of total hedging efficiency should include basis risk as well as market depth cost (liquidity) and trading cost or commissions (Pennings and Meulenberg). Here, we do not explicitly consider market depth cost or commissions. It is clear from the volume of trade that liquidity is generally poor and the cost of immediate execution can easily exceed 5% of the underlying product value (personal interviews).¹⁴ Hence, our focus is on the basis risk component of hedging efficiency. To estimate the *ex post* hedging efficiency, the following simple linear regression model is estimated (Leuthold, *et al.*):

$$\Delta cp_t = \alpha + \beta \Delta fp_t + e_t$$

Where, Δcp_t is the change in the cash price over month t , Δfp_t is the change in the futures price during month t , β is the minimum variance hedge ratio, and the R-squared is a measure of hedging effectiveness (Leuthold, *et al.*). Using the R-squared as a summary measure of hedging effectiveness is consistent with Ederington's use of simple correlation coefficients. Further, the R-squared can be consistently compared across markets when they have equal variances. This is the case for all the cash markets except the tiger 41-50's (see Table 2). The simple correlation coefficients across all the series are shown in Table 4, and the estimates of (1) are in Table 5.

In Table 4, all of the correlation coefficients are statistically different from zero at the 5% level. The strongest cash price correlation exists between the various sizes of white shrimp with the white 41-50's and 51-60's having a correlation coefficient of nearly 0.85. The correlations are noticeably lower across different species for the same size of shrimp. The lowest cash price correlation is 0.43 between white 41-50's and gulf brown 41-50's.

¹² The average basis level for the par delivery product, Ecuador white 41-50's, is 3.788% and statistically greater than zero at the 1% level (two-tailed, t-test). The consistently positive basis likely reflects the value of the cheapest-to-deliver option that is granted to the seller of futures contracts (Martinez-Garmenia and Anderson).

¹³ This implicitly assumes that neither the mean price change nor basis contains a predictable component (Garcia and Sanders).

¹⁴ Note, it is not clear that the cash market provides any advantage in terms of liquidity or transaction costs. The cash market is commonly quoted with a \$0.10 per pound bid-ask spread and an importer may have to "discount" product by as much as \$0.20 per pound to make an immediate sale. The typical cash shrimp broker makes \$0.05 per pound versus round-turn futures commissions of \$25 or \$0.005 per pound for a 5,000 pound contract.

Given the simple correlation coefficients between cash and futures (Table 4), the regression results presented in Table 5 are not particularly surprising. *Ex post* hedging effectiveness, as measured by R-squared, is relatively low. The highest R-squared is actually with a non-par size: the white 51-60's, and the second highest is 0.276 with the par white 41-50's. As we deviate from these two markets, this R-squared falls into the range of 0.10 to 0.12. The minimum variance hedge ratios, β , range from a high of 0.53 for white 51-60's and a low of 0.21 for tiger 41-50's. Note, the minimum variance hedge ratios are all statistically different from zero at the 5% level. However, they are also statistically less than 1.0 at the 5% level. This indicates that although there is an *ex post* hedge ratio that statistically reduces price risk, it is unlikely that a practitioner would know it *ex ante*.

Discussion and Summary

Industry Response and Discussion

Although the shrimp market contains many of the elements necessary for a successful futures contract, the industry is clearly not adopting futures to manage price risk. The reason for this is not clear. The data suggest that the contract's performance as a risk reduction tool has been less than ideal. However, it is not clear if the contract's performance is due to some inherent fault in contract design, or if it is due to the industry's failure to perform the cash-futures arbitrage that results in convergence and a predictable basis. If the cash-futures arbitrage is not being attempted, whatever the reason, then the data will undoubtedly show poor hedging effectiveness.

What is keeping the trade from attempting the cash-futures arbitrage? The shrimp market does not completely fit the classic model for a successful futures market. First, the cash market is not liquid and not easily accessible. This makes arbitrage costly for an economic agent not established in the market. Second, it is not clear if shrimp are truly a homogeneous commodity. Importing companies attempt to differentiate their product with brands. However, end-users claim that they do not care about importers' brands. Third, the industry does not widely accept third party grades and standards even though the product does lend itself to this type of grading. Furthermore, although trade groups exist (e.g., National Fisheries Institute), the cash industry has not established standardized trade practices (e.g., grades, contract rules, and dispute resolution).

The industry may use alternative, less costly, mechanisms to deal with price risk.¹⁵ End-users may simply buy on the spot market every day and be content to pay the average market price, which is then passed along to the ultimate consumer. Packers, exporters, and importers attempt back-to-back transactions; thereby, they do not carrying inventory that is not pre-sold. Finally, the various segments of the industry may earn margins that include a risk premium sufficiently large to compensate them for taking the price risk. The futures market may have failed to attract speculators who could bear this price risk more efficiently.

An informal survey of industry participants (mostly importers) found the reasons for not utilizing futures fell in two general areas: 1) a lack of liquidity, and 2) a perceived lack of

¹⁵ The internal cost of implementing a hedging program is probably under-estimated by outside observers. The costs include such things as education of traders and upper management, accounting practices, risk management considerations, and record-keeping that ties cash and futures positions. In an industry that has no prior experience with futures markets, these costs are particularly large.

relevance to business objectives. The liquidity problem exists; however, it is easily remedied by solving the second reason.

Why is the futures market not relevant to an importing firm's business objectives? The specific reasons cited indicate a lack of understanding of futures as a risk management tool and the cash-futures basis relationship. For instance, one firm simply stated: "This industry doesn't need another speculative tool, we have enough risk the way it is." This type of response indicates that an educational effort is needed. That is, either the industry needs to be educated about how to incorporate futures into their business, or outside researchers need to learn more about how the shrimp industry really operates.

Summary and Conclusions

Research on new futures contracts (e.g., Thompson, *et al.*; Bollman, *et al.*) is often relegated to a posthumous evaluation with sparse data. Here, we have a relatively rich data set (65 monthly observations) with which to examine the MGE white shrimp futures contract's performance in terms of basis and hedging effectiveness. The *ex post* analysis suggests that the basis risk of a fully hedged position (hedge ratio = 1.0) in the par commodity increased risk over an unhedged position (hedge ratio = 0.0). Hedging effectiveness could have been enhanced with a minimum variance hedge ratio, but it is unlikely that practitioners would have applied this *ex ante*. It is not clear if the empirical results are driven by a contract that is poorly designed, or if the industry's failure to perform cash-futures arbitrage generates poor data. Also, the industry may not be using the contract because they have devised less costly ways of dealing with price risk.

The research is important because it provides insight into the process of introducing futures contracts to new industries. In these instances, it may be necessary that educational efforts go beyond simple seminars and pamphlets (e.g., Minneapolis Grain Exchange). Rather, a stronger role in firm-level education by exchanges, consultants, or public institutions may be required. Alternatively, these industries may effectively manage price risk through innovative cash transactions. Thus, despite satisfying the typical criteria for a successful futures market, the perceived economic benefits of adoption may not exceed the costs. It is important that exchanges closely examine these issues prior to launching new futures contracts.

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Table 1. Summary Statistics for Monthly Price Changes of Futures and Cash Shrimp Prices, 1993-1998

	Nearby Futures	White 41-50's	Tiger 41-50's	Gulf 41-50's	White 51-60's	White 36-40's	White 31-35's
Mean	-0.00271	0.00093	0.00060	0.00125	0.00147	0.00171	0.00134
St. Dev.	0.05148	0.04500	0.03248	0.05204	0.04685	0.04202	0.04187

Note: price changes are the log relative price change, $\Delta p_t = \ln(P_t/P_{t-1})$. There are 65 monthly observations

Table 2. P-values from Tests of Equality of Variances in Monthly Price Changes (upper diagonal) and Basis Levels (lower diagonal), 1993-1998

	Nearby Futures	White 41-50's	Tiger 41-50's	Gulf 41-50's	White 51-60's	White 36-40's	White 31-35's
Nearby Futures		0.2850	0.0003	0.9311	0.4527	0.1069	0.1008
White 41-50's			0.0100	0.2480	0.7496	0.5846	0.5649
Tiger 41-50's		0.1773		0.0002	0.0039	0.0412	0.0442
Gulf 41-50's		0.0006	0.0338		0.4025	0.0896	0.0843
White 51-60's		0.9056	0.1424	0.004		0.3869	0.3713
White 36-40's		0.0013	0.0573	0.8218	0.0009		0.9769
White 31-35's		0.0000	0.0002	0.0892	0.0000	0.0546	

Note: the upper off-diagonal contains p-values from an F-test for variance equality in price changes, $\Delta p_t = \ln(P_t/P_{t-1})$. The lower off-diagonal contains p-values from an F-test for the equality of basis variance across the markets, where the basis at time t is measured as $\ln(CP_t/FP_t)$. There are 65 monthly observations.

Table 3. Summary Statistics for Monthly Basis between MGE Nearby Shrimp Futures and Urner Barry Cash Shrimp Prices, 1993-1998

	White 41-50's	Tiger 41-50's	Gulf 41-50's	White 51-60's	White 36-40's	White 31-35's
Mean	0.03788	0.02108	0.01920	-0.07948	0.19483	0.28354
St. Dev.	0.05451	0.06414	0.08385	0.05333	0.08512	0.10387

Note: the basis at time t is measured as $\ln(CP_t/FP_t)$, where CP_t is the month-end cash price and FP_t is the month-end futures price. There are 65 monthly observations.

Table 4. Correlation Matrix for Monthly Shrimp Price Changes

	Nearby Futures	White 41-50's	Tiger 41-50's	Gulf 41-50's	White 51-60's	White 36-40's	White 31-35's
Nearby Futures	1.0000						
White 41-50's	0.5256	1.0000					
Tiger 41-50's	0.3318	0.6915	1.0000				
Gulf 41-50's	0.3282	0.4257	0.5328	1.0000			
White 51-60's	0.5777	0.8494	0.5932	0.5820	1.0000		
White 36-40's	0.3284	0.8066	0.6544	0.4273	0.6958	1.0000	
White 31-35's	0.3307	0.7274	0.6291	0.3230	0.6282	0.8503	1.0000

Note: simple correlation coefficients between price changes, $\Delta p_t = \ln(P_t/P_{t-1})$. The standard error of the estimate is $(1/n-3)^{0.5}$. So, with $n=65$, the standard error is 0.127 and a correlation greater than 0.2489 is statistically different from zero at the 5% level (two-tailed t-test).

Table 5. Hedging Effectiveness Regression, $\Delta c p_t = \alpha + \beta \Delta f p_t + e_t$

	White 41-50's	Tiger 41-50's	Gulf 41-50's	White 51-60's	White 36-40's	White 31-35's
β estimate ¹	0.45958	0.20939	0.33183	0.52578	0.26815	0.26902
Standard. Error	0.13783	0.12145	0.15940	0.09358	0.13279	0.09670
R-squared	0.27632	0.11013	0.10775	0.33383	0.10791	0.10941

¹The model is estimated with ordinary least squares. The standard diagnostic tests are utilized. If the model displays heteroskedasticity, then it is re-estimated using White's heteroskedastic consistent estimator.

Figure 1: White Shrimp Futures and Options Volume
Monthly, July 1993 - December 1998

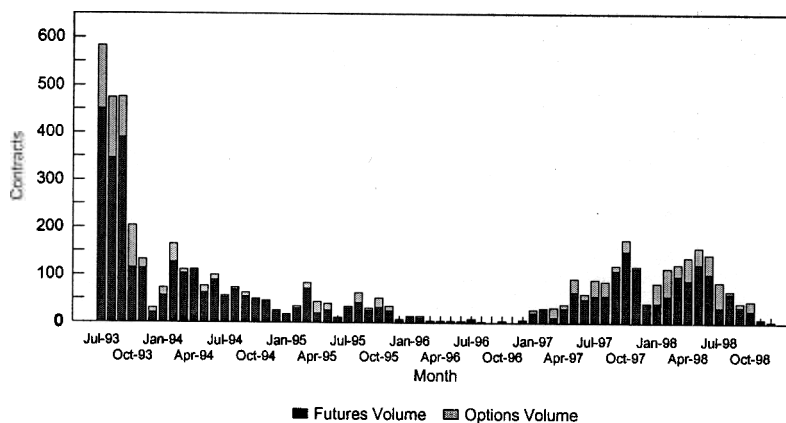


Figure 2: Shrimp Prices
Month-End, July 1993 - December 1998

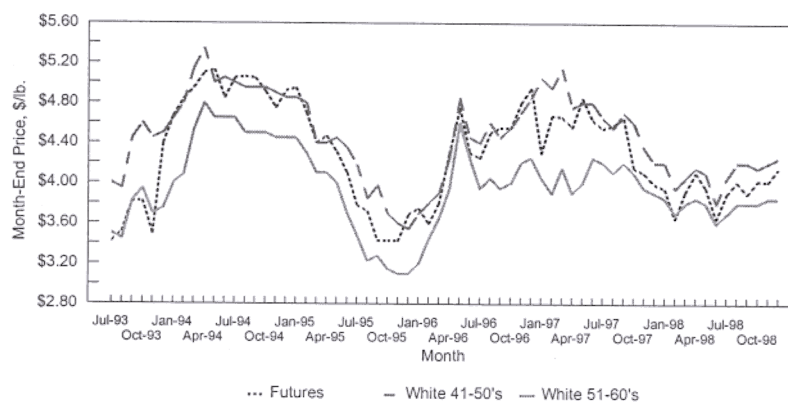


Figure 3: Shrimp Basis Levels
Month-End, July 1993 - December 1998

