The White Shrimp Futures Market: Lessons in Contract Design and Marketing

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ABSTRACT

The successful introduction of futures contracts to industries unfamiliar with futures markets is likely to become increasingly important as futures exchanges move to alternative governance structures (e.g., for-profit corporations), trading platforms evolve (i.e., electronic/Internet trading), and regulatory requirements relax. 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 largely conforms to the traditional criteria for a successful futures market, the contract's performance is disappointing in terms of liquidity, basis behavior, and ultimately, hedging effectiveness. Furthermore, nonpar-size delivery options embedded in the contract design likely impact basis behavior for certain hedges. While these reasons contributed to the ultimate demise of the contract, a general lack of knowledge regarding futures markets among the shrimp industry was also a factor. Given these findings, pragmatic implications for the introduction and marketing of new futures contracts into new industries are discussed. [JEL/EconLit: Q130, Q140, G130] © 2002 Wiley Periodicals, Inc.

1. INTRODUCTION

The Minneapolis Grain Exchange (MGE) introduced futures on Western white shrimp in July of 1993.[1] The shrimp industry initially greeted the contract with much enthusiasm and fanfare (Shaw, 1993). The contract was the first exchange-traded, risk-management contract available to the aquaculture industry allowing for the hedging of volatile shrimp prices. After a relatively successful launch, volume and open interest quickly dwindled (Fig. 1). White shrimp futures' monthly average volume from its inception in 1993 through June 2000 was 51 futures contracts and 16 options contracts per month. Month-end open

[1]The MGE also introduced a futures contract on black tiger shrimp (*Panaeus monodon*) that calls for par delivery of 21- to 25-count shrimp of Eastern Hemisphere origin. This contract has experienced problems very similar to the white shrimp contract discussed in this article (see Martinez-Garmendia & Anderson, 1999, 2001). The Chicago Board of Trade unsuccessfully launched a U.S. gulf shrimp contract in the 1960s (Sandor, 1978).

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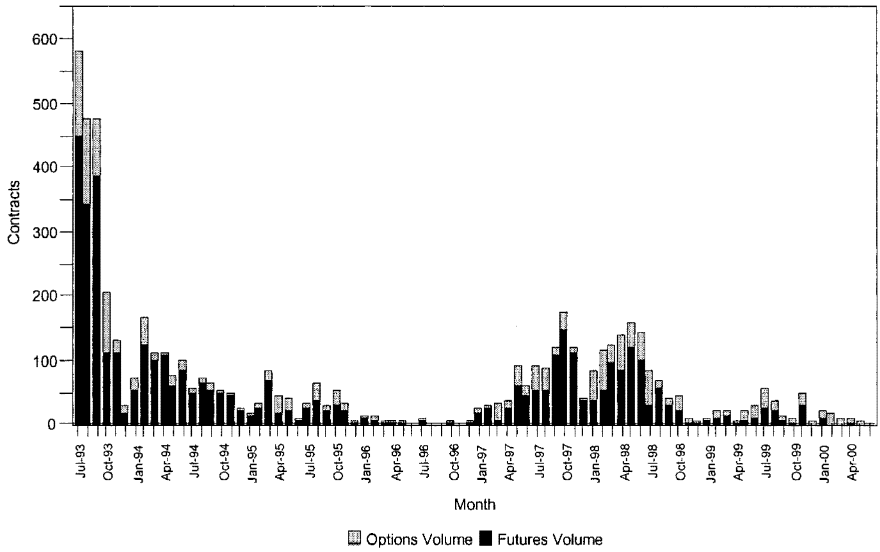

Figure 1 Monthly futures and options volume, July 1993 to May 2000.

interest averaged 16 futures and 16 options. However, trading volume and open interest was not uniformly distributed through time. The highest volume was recorded during the first partial month of trade with a total of 567 futures and options trading during July of 1993. 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 declined gradually into early 1996.[2] The average monthly volume of trade in 1996 was eight 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 waned until the contracts effectively stopped trading in June of 2000.

Developing a successful futures contract is not an easy proposition. Forty percent of the futures contracts introduced in the United States are delisted prior to their fifth year of trading (Carlton, 1984). In contrast, the MGE white shrimp futures survived 5 years. While the white shrimp futures contract was not wildly successful, it did outlive other food-related contracts introduced in recent years such as the boneless beef, beef trimmings, and broiler contracts. Clearly, there must have been some commercial demand for the white shrimp contract for it to survive as long as it did, but ultimately it was not accepted by the industry. Are there lessons to be learned from the white shrimp futures contract as risk management products are expanded to new markets?

It is important that futures exchanges and research institutions look closely at the design, performance, and potential performance, of new risk management products for two reasons. First, opportunities for growth in derivatives markets may arise in industries (e.g., aquaculture, dairy, natural resources, and power) or countries (see Peck, 2000) without a tradition of futures markets. Second, the success rate of new contracts is rather poor

[2]This pattern of initial high volume is not uncommon (see Thompson, Garcia, & Wildman, 1996). It can largely be attributed to “floor support” by local traders and exchange members who have a vested interest in a contract’s success.

(Carlton, 1984), and it has not improved in recent years (e.g., Thompson, Garcia, & Wildman, 1996). This is especially true for industries that are new to futures trading (e.g., Bollman, Thompson, & Garcia, 1996). The ability to successfully introduce new contracts may take added importance as futures exchanges consider new governance structures (e.g., for-profit) as their roles evolve in the presence of modern electronic marketplaces, and as the regulatory framework evolves to allow greater competition among traditional exchanges and electronic marketplaces.

Therefore, the objective of this research is to examine the design and performance of the MGE white shrimp futures contract in order to identify if there are specific and unique factors that contributed to its demise. First, in order to draw practical recommendations and conclusions concerning the introduction of new risk management tools, the traditional and necessary requirements for successful futures contracts are outlined. Second, the structure of the shrimp industry is examined, especially in the context of how the shrimp industry, and white shrimp in particular, fit the outlined criteria for successful futures contracts. Next, the design and performance of the white shrimp futures contract is evaluated including the examination of the historical basis behavior and eventual hedging effectiveness of the contract throughout its trading life. Finally, implications of this analysis are presented and lessons are drawn that should be insightful to exchanges and economists alike as they consider the development and introduction of new futures contracts.

2. CONDITIONS FOR SUCCESSFUL FUTURES MARKETS AND THE MARKET FOR WHITE SHRIMP

Black (1986), Gray (1978), Hieronymus (1996), Silber (1981), and others (see Leuthold, Junkus, & Cordier, 1989, pp. 18–20) propose necessary conditions for a successful futures contract. The standard list includes such economic necessities as relative homogeneity of the commodity, a large and well-defined underlying cash market that lends itself to standardization, adequate price volatility, a competitive marketplace, economic need (i.e., hedging demand), the ability to attract speculators (i.e., build liquidity), and the free flow of public information. In addition to these factors, the contract must be well designed in that it favors neither longs nor shorts.

A classic example of a successful futures contract is corn. In fact, the corn market possesses all of the traditional characteristics of a successful futures contract. First, corn is a relatively homogeneous product that lends itself well to standardization and grading. That is, U.S. No. 2 yellow corn is a well-defined product regardless of where it is produced or by whom. Second, cash prices for corn are quite volatile, with annualized standard deviations in excess of 20%, creating a need for both producers and users of corn to manage this price volatility. Also, the industry is highly competitive, with literally thousands of producers, handlers, and end-users. The public information flow regarding corn is abundant, with the U.S. Department of Agriculture providing weekly export sales, growing conditions, supply and usage estimates, and production estimates. Finally, the Chicago Board of Trade has a presumably well-designed futures contract, which is apparent since the contract has both large commercial and speculative usage. In fact, the corn futures market is one of the most successful agricultural futures markets, with average monthly volume in excess of 1.310 million futures contracts in 1999.

A successful futures contract need not have an industry structure as ideal as corn. A good example is the live cattle market (Wachenheim & Singley, 1999). The cash market is characterized by consolidation in the feeding and packing industries. Because of this, cash prices are largely determined by private treaty, and they are poorly reported. Also, it is difficult to assign a standardized grade to the underlying commodity (live cattle) as opposed to the end product (beef). In addition, branded beef products are a growing trend (e.g., Certified Angus Beef), thus beef is becoming a less homogeneous commodity in the true sense. With an annualized standard deviation of around 15%, price volatility is relatively low compared to many commodities. Given this, the trade in live cattle futures is active, with the contract averaging over 300,000 per month in 1999. With respect to industry structure, the shrimp market falls somewhere between corn and live cattle.

Total world shrimp production is estimated at 5.78 billion pounds (whole weight). Of this, 75% (4.335 billion pounds) are wild or ocean caught and 25% (1.455 billion pounds) are farm raised.[3] Over 75% of U.S. shrimp imports are products of aquaculture. Shrimp farming is a growing industry worldwide, with farmed shrimp production increasing 10% from 1990 to 1997. Of farmed shrimp, 70% are black tiger shrimp (*Panaeus monodon*) and are produced in the Eastern Hemisphere (primarily Thailand, Indonesia, and China). The remaining 30% of farm-raised shrimp are white shrimp (*Panaeus vannamei*), which are produced in the Western Hemisphere and commonly referred to as "Western white shrimp". Western white shrimp production is estimated at 437.0 million pounds with a value of 1.22 billion dollars. The leading producers of Western white shrimp are Ecuador with 66% of total production, followed by Mexico, Honduras, and Colombia with 8%, 6%, and 5%, respectively. The United States imports 65% of the white shrimp farmed in Latin America, with the remainder going to Europe (30%), Asia (3%), and local markets (2%). The structure of the Ecuadorian industry is representative of the shrimp industry in Latin America. Ecuador has over 1,800 farms, with ownership spread over 1,000 different entities. There are 64 shrimp packing plants and 81 firms that officially exported shrimp products in 1997, with the 10 largest firms exporting 60% of the total.[4] In addition, there were 115 importing firms on record, with the 10 largest handling 55% of the total volume of shrimp that came into the United States. The above data suggest that the white shrimp cash market is relatively large and with a competitive structure.

Despite its relatively large size, within the United States, there is not a formal or centralized cash market for shrimp. Ex-warehouse wholesale prices are negotiated on a transaction-by-transaction basis, with prices and market conditions distributed through an array of methods. These methods include fax, electronic mail, and electronic seafood exchanges. However, the dominant method of trade is personal communication via the 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 (Urner Barry, Inc., 1998).[5] The Urner Barry price is the result of a biweekly survey of wholesale buyers and sellers as to the prices at which they transact. Reported cash prices are volatile with annual standard deviations in excess of 15%. While there is some attempt by packers to brand their product, end-users typically ignore this for commodity

[3] Unless otherwise noted, the production statistics refer to calendar year 1997 and are taken from Rosenberry (1997). Clearly production statistics change from year to year; in particular, Ecuadorian production fell with an outbreak of "White Spot" disease. Nonetheless, the 1997 statistics are basically representative of the industry structure during the life of the white shrimp futures contract.

[4] The following data are taken from ESTADISTICA CIA.LTDA: Importacion y Exportacion (1997), a monthly trade report.

[5] 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).

grade products (e.g., headless, shell-on shrimp), which lend themselves fairly well to standardized grading procedures.

Timely fundamental data on the shrimp market are limited, suggesting a lack of free-flowing public information. This is especially true relative to other agricultural commodities such as grains and livestock. However, the U.S. Census Bureau does record and release monthly import and cold-storage holdings data for shrimp. The National Marine Fisheries Service also 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. The scarcity of public data and prices would make a successful shrimp futures contract an important vehicle for information aggregation and price discovery in the shrimp cash market.

In summary, while the white shrimp market is not perfectly suited for a futures market, it does possess several of the criteria for a successful futures market to some degree. Thus, one would expect there to be the potential to support a modestly successful futures contract for Western white shrimp. If this is the case, the issue then becomes one of contract design and performance.

3. CONTRACT DESIGN AND PERFORMANCE

Exchanges attempt to design contracts that will be attractive to both the industry and to potential speculators. To foster commercial interest, the contract specifications need to conform to industry trade practices and designed such that basis risk is minimized. Ultimately, basis risk needs to be smaller than the absolute price risk of the cash commodity to foster successful hedging. Furthermore, if the contract favors either sellers or buyers, this may discourage both commercial and speculative use of the product jeopardizing its long-run success. This section outlines the contract specifications for the Western white shrimp contract and presents the data and resulting analysis used to determine basis risk and hedging effectiveness of the contract.

3.1. Contract Specifications

As of 1998, the MGE futures contract calls for par delivery of 5,000 net pounds of 41- to 50-count (pieces per pound), block-frozen, headless, shell-on, white shrimp, usually of the *Panaeus vannamei* species. Two other species of Western Hemisphere white shrimp, *Panaeus occidentalis* and *Panaeus stylirostris*, are also allowed under par delivery but are almost never tendered for delivery. Each lot must be a single brand from a single packer held in an approved warehouse within 50 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 to 60 pieces per pound are deliverable at a discount of \$0.90 per pound, and larger 36- to 40-count and 31- to 35-count shrimp are deliverable at premiums of \$0.10 and \$0.35 per pound, respectively. In fact, most deviations from the par product typically occur through the delivery of alternative sizes. Furthermore, 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.

While this information reflects contract specifications as of December 1998, the contract had numerous changes since its inception. Beginning with the September 1994 contract, there was a change in the premium schedule for nonpar deliveries. The December 1995 contract reflected a change from U.S. Grade A shrimp to MGE Class 1 shrimp. Then, starting with the August 1997 contract, there was again a change in the premium schedule. There were also additions and deletions to par delivery locations and regular warehouses. For instance, New York City warehouses were approved in November of 1993 and those in Jacksonville, Florida, in December of 1996. These changes were generally driven by industry requests with the goal of increasing trade volume (personal interviews). By and large, these changes did not succeed in building industry interest in the contract. As shown in the following sections, they apparently provided no material improvement in overall contract performance.

3.2. Cash and Futures Price Data

In analyzing the volatility and correlations between cash and futures prices, basis relationships, and subsequently the hedging effectiveness of the Western white shrimp futures contract, monthly prices for the nearby futures contract and six cash market-prices are used. The six-cash-price series includes the par delivery species of alternative sizes: Ecuador white (white) 51 to 60s, 41 to 50s, 36 to 40s, and 31 to 35s. The data set also includes the par size, 41 to 50s, of two nondeliverable species: Thailand black tiger (tiger) and Gulf of Mexico domestic brown shrimp (gulf). White shrimp and gulf shrimp prices reflect East Coast locations (i.e., New York City), and the tiger shrimp prices reflect West Coast locations (i.e., Los Angeles) as reported by Urner Barry (Urner Barry, Inc., 1998). These markets represent hedging opportunities across deliverable sizes for white shrimp and also cross-hedging opportunities for nondeliverable markets of the par size (41 to 50s).[6] This monthly dataset extends from the first full month of futures trading, August 1993, through May 2000, allowing for 82 monthly observations of cash and futures prices. This is a relatively large time series compared to other studies of new futures contracts (e.g., Thompson, Garcia, & Wildman, 1996). Each time series, both cash and futures, are constructed using the last observation for each month for both cash and futures. The specific futures price used is the last trading day of the month for 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). Since cash prices are reported only on Tuesdays and Thursdays, there could be an observation where the cash price and futures price are for different days of the week. For example, a cash price may be from a Thursday while the futures price is from a Friday. However, any problems arising from the nonsynchronous nature of the data is thought to be minimal for monthly analysis.

Stationarity of the data is first tested with both the augmented Dickey-Fuller test (ADF) and with the Phillips-Perron test. Both tests indicate that the price series are nonstationary in levels and stationary in price changes, so the following analysis focuses on stationary price changes. 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.

Table 1 (upper panel) presents the summary statistics for monthly price changes in the nearby futures contract and the six-cash-price series. The highest monthly standard de-

[6] See Dahlgran (2000) for a discussion and application of cross hedging.

TABLE 1. Summary Statistics: Monthly Price Changes and Basis, July 1993 to May 2000

	Price Changes[a]						
	Nearby Futures	White 41–50s	Tiger 41–50s	Gulf 41–50s	White 51–60s	White 36–40s	White 31–35s
Mean	0.0001	0.0044	0.0028	0.0060	0.0046	0.0043	0.0046
SD	0.0565	0.0486	0.0329	0.0519	0.0532	0.0424	0.0418
	Cash-Futures Basis[b]						
		White 41–50s	Tiger 41–50s	Gulf 41–50s	White 51–60s	White 36–40s	White 31–35s
Mean		0.0404	0.0002	0.0137	−0.0818	0.1951	0.2793
SD		0.0515	0.0780	0.0789	0.0622	0.0816	0.1040

[a]Price changes are the log relative price change, $\Delta p_t = \ln(P_t/P_{t-1})$. There are 82 monthly observations.
[b]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 nearby futures price. There are 83 monthly observations.

viation is that of the futures price, 5.65% monthly and 19.6% annualized, and the lowest is the tiger 41 to 50s at 3.29% monthly and 11.4% annualized. Using an F-test across market pairs, the null hypothesis of equal variances can only be rejected (5% level) for those pairs including tiger 41 to 50s (results not shown). All other markets are characterized by statistically equivalent variance. This is important for comparing measures of hedging effectiveness later in the analysis.

3.3. Basis Risk and Hedging Effectiveness

Basis variability is a major contributor to either the success or failure of a contract. If the cash-futures basis is perceived to be too variable, there will likely be little hedging demand for the contract. To facilitate comparison of basis across the various cash prices examined, the basis is measured as the log relative basis (see Garcia & Sanders, 1996; Liu, Brorsen, Oellermann, & Farris, 1994). That is, the cash-futures basis at time *t* is measured as $\text{basis}_t = \ln(CP_t/FP_t)$, where CP_t is the month-end cash price and FP_t is the month-end nearby futures price. Summary statistics for the basis are presented in the lower panel of Table 1. Not unexpectedly, the size of the basis varies considerably across the different species and sizes of shrimp. The average levels range from a −8.18% for the smaller white 51 to 60s to a 27.93% premium for the larger white 31 to 35s.[7] Also not surprisingly, basis variance tends to increase as we deviate from the par delivery market (white 41 to 50s). Figure 2 illustrates these basis patterns for three sizes of Ecuador white shrimp: 41 to 50s, 51 to 60s, and 36 to 40s.

Comparing the standard deviation of each cash market with the standard deviation of its respective basis (Table 1) represents the relative risk for a completely unhedged (hedge

[7]The average basis level for the par delivery product, Ecuador white 41 to 50s, is 4.04% and statistically greater than 0 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-Garmendia & Anderson, 1999).

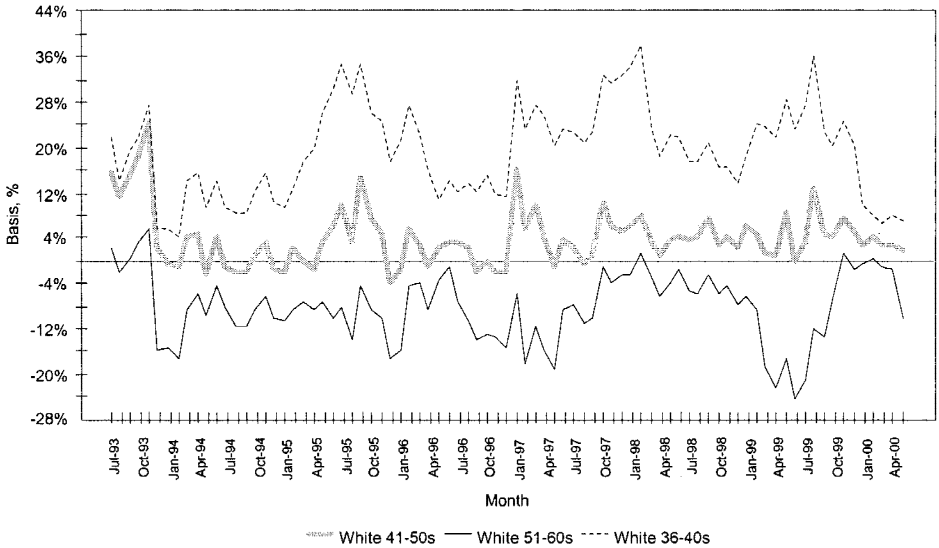

Figure 2 Cash-nearby shrimp futures basis, July 1993 to May 2000. The basis at time *t* is measured as $\ln(CP_t/FP_t)$, where CP_t is the month-end cash price and FP_t is the month-end futures price.

ratio = 0.0) and fully hedged positions (hedge ratio = 1.0), respectively.[8] 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. This result is consistent with other research on shrimp futures (see Martinez-Garmendia & Anderson, 1999; Maynard, Hancock, & Hoagland, 2001). Given Leuthold, Junkus, and Cordier's (1989, p. 70) common interpretation of hedging as "to avoid the highly risky spot or flat price positions and accept lower risk basis or premium positions," this result certainly does not build the case for a potentially successful contract. However, a further examination of hedging efficiency is needed beyond a simple comparison of cash and basis variability.

Measures of total hedging efficiency should include basis risk as well as market depth cost (liquidity) and trading cost or commissions (Pennings & Meulenberg, 1997a, 1997b). While we do not explicitly consider market depth cost or commissions, it is clear from the volume of trade that liquidity was generally poor and the cost of immediate execution could easily exceed 3% of the underlying product value (personal interviews).[9] Hence, our focus is on the basis risk component of hedging efficiency, specifically *ex post* hedg-

[8]This implicitly assumes that neither the mean price change nor basis contains a predictable component (Garcia & Sanders, 1996). Also, since the cash and futures price series are nonstationary (i.e., contain unit roots), the basis levels as defined implicitly assume that cash and futures are cointegrated where the cointegrating regression has a slope of 1 (Liu, Brorsen, Oellermann, & Farris, 1994).

[9]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.

TABLE 2. Correlation Matrix for Monthly Shrimp Price Changes, July 1993 to May 2000[a]

	Nearby Futures	White 41–50s	Tiger 41–50s	Gulf 41–50s	White 51–60s	White 36–40s	White 31–35s
Nearby Futures	1.0000						
White 41–50s	0.6076	1.0000					
Tiger 41–50s	0.3833	0.7038	1.0000				
Gulf 41–50s	0.3047	0.3384	0.4373	1.0000			
White 51–60s	0.6156	0.8454	0.6393	0.4624	1.0000		
White 36–40s	0.4087	0.8092	0.6369	0.3286	0.6431	1.0000	
White 31–35s	0.3764	0.7115	0.5860	0.2558	0.5381	0.8557	1.0000

[a]These are simple correlation coefficients between price changes, $\Delta p_t = \ln(P_t/P_{t-1})$. The standard error of the estimate is $(1/n\text{-}3)^{0.5}$. So, with n=82, the standard error is 0.1125 and a correlation greater than 0.2238 is statistically different from 0 at the 5% level (two-tailed t-test).

ing efficiency. To estimate *ex post* hedging efficiency, the following simple linear regression model is estimated:

$$\Delta cp_t = \alpha + \beta \Delta fp_t + e_t \tag{1}$$

where Δcp_t is the change in the cash price over month *t*, Δfp_t is the change in the nearby futures price during month *t*, β is the minimum variance hedge ratio, and the resulting R-squared is a measure of hedging effectiveness (Leuthold, Junkus, & Cordier, 1989, pp. 93–94). Care is taken to calculate Δfp_t such that it does not reflect changes between different contract months, but only changes in the price of the nearby contract. For instance, during the month of December, Δfp_t is the change in the January contract. Using the R-squared as a summary measure of hedging effectiveness is consistent with Ederington's use of simple correlation coefficients (Ederington, 1979).[10] Further, the R-squared can be consistently compared across markets when they have equal variances. As discussed in section 4.2, this is the case for all the cash markets except the tiger 41 to 50s. Simple correlation coefficients are also estimated in order to determine the degree to which cash and futures prices move together. The simple correlation coefficients across all the series are shown in Table 2, and the estimates of (1) are shown in Table 3.

In Table 2, all of the correlation coefficients are statistically different from 0 at the 5% level. Predictable cash-futures price movement is important for successful hedging, particularly cross hedging. While cross hedging allows producers and users to hedge shrimp of different species or sizes to that designated in the white shrimp contract, it also can foster additional liquidity of the contract. Not surprisingly, the largest cash–futures correlation was with the nearby futures and white 41 to 50s (par delivery species and size) at .61 and the smallest was between nearby futures and gulf 41 to 50s at .30. While the strength of the correlations between the nearby futures and tiger and gulf shrimp is relatively modest, the fact that they are positive and significant still provides the opportunity for cross hedging (Anderson & Danthine, 1981). The strongest cash price correlations

[10]Malliaris and Urrutia (1991; see also Geppert, 1995) demonstrate that hedging effectiveness and hedge ratios are unique for a given hedge horizon. Furthermore, if cash and futures are cointegrated, then as the hedge horizon increases, hedging effectiveness converges toward one (Geppert, 1995). Here, we do not pursue the implications of cash-futures cointegration as it is not central to the objectives of the article.

TABLE 3. Hedging Effectiveness Regression, $\Delta cp_t = \alpha + \beta \Delta fp_t + e_t$, July 1993 to May 2000

	White 41–50s	Tiger 41–50s	Gulf 41–50s	White 51–60s	White 36–40s	White 31–35s
β-estimate[a]	0.5223	0.2230	0.2802	0.5794	0.3067	0.2784
Standard Error	0.1060	0.0871	0.0979	0.0829	0.0766	0.0989
R-squared	0.3692	0.1469	0.0928	0.3790	0.1671	0.1417

[a]The model is estimated with ordinary least squares (82 monthly observations). Heteroskedasticity is tested for using White's test and serial correlation is tested for with a Lagrange multiplier test. If the model displays heteroskedasticity, then it is reestimated using White's heteroskedastic consistent estimator. If there is serial correlation, then it is re-estimated using the Newey-West estimator (see Hamilton, 1994, p. 218).

exist between the various sizes of white shrimp. The correlation coefficients between the white 41 to 50s and 51 to 60s as well as the white 31 to 35s and white 36 to 40s are near .85. The cash price correlations are noticeably lower across different species for the same size of shrimp.

Given the simple correlation coefficients between cash and futures (Table 2, first column), the regression results presented in Table 3 are not particularly surprising. *Ex post* hedging effectiveness, as measured by R-squared, is relatively low. The highest R-squared (.3790) is actually with a nonpar size: the white 51 to 60s. The second highest is .3692 with the par white 41 to 50s. As we deviate from these two markets, the R-squared falls into the range of .09 to .17. Among the markets with statistically equal variance, the minimum variance hedge ratios, β, range from a high of .5794 for white 51 to 60s to a low of .2784 for white 31 to 35s. Note: the minimum variance hedge ratios are all statistically different from 0 at the 5% level. However, they are also statistically less than 1 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*. This result is consistent with the highly variable *ex ante* hedge ratios documented by Martinez-Garmendia and Anderson (1999).

This point should not be overlooked. The MGE and others (e.g., Dore & Bowman, 1993) suggest that futures hedges should be placed on a pound-for-pound equivalence with cash positions (i.e., $\beta = 1.0$). Figures 3 and 4 illustrate the hedging effectiveness (R-squared) that accompanies various hedge ratios.[11] With 82 observations, an R-squared greater than .0472 is indicative of a statistically significant reduction in risk (5% level, F-test). It is clear from the figures that pound-for-pound hedging would have statistically reduced risk only for the white 51 to 60s and 41 to 50s (Fig. 4). In general, statistically significant risk reduction is constrained to relatively small intervals. For instance, gulf brown 41 to 50s would have required a hedge ratio between .10 and .50 (Fig. 3) and white 36 to 40s would have required a hedge ratio between .05 and .60 (Fig. 4).

To compare and contrast these results with comparable data over the same time period, the hedging effectiveness of the frozen pork bellies and live-cattle futures market is calculated and presented in Figure 5. The illustration paints a stark contrast between these two successful futures contracts and shrimp futures. Pork bellies provide statistically significant risk reduction over the .05 to 1.65 range of hedge ratios and live cattle over the range of .05 to 2.05. In both cases, the minimum-variance hedge ratio (β) is not statisti-

[11]The data underlying Figures 4 and 5 are simply estimates of equation (1), where β is constrained to a particular hedge ratio and the corresponding R-squared is recorded.

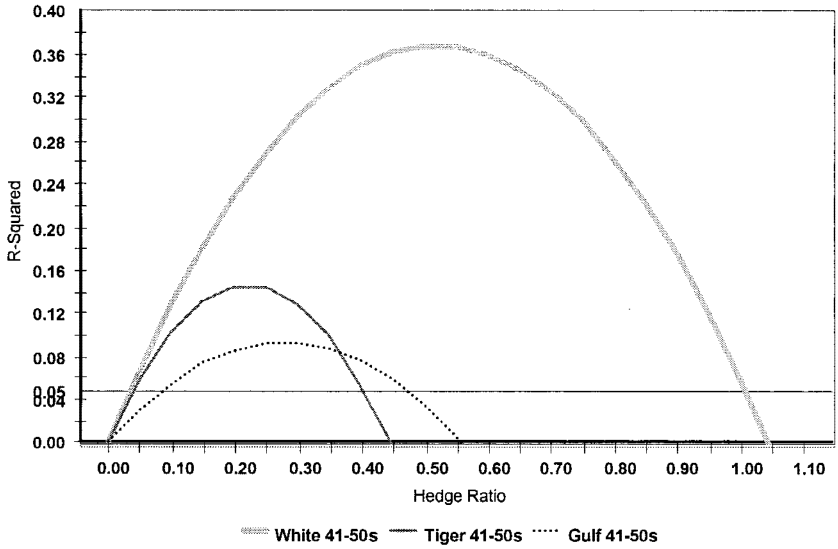

Figure 3 Shrimp futures hedging effectiveness across various hedge ratios. This graph is generated by estimating the hedging effectiveness equation, $\Delta cp_t = \alpha + \beta \Delta fp_t + e_t$, constraining the hedge ratio, β, to a particular level and then recording the R-squared. The horizontal bar reflects the level of R-squared necessary (.0472) to achieve statistically significant risk reduction at the 5% level with 82 observations (F-test).

cally different from 1.0 and statistically significant risk reduction is robust to the hedge ratio utilized. This cannot be said for the shrimp futures contract. This particular result is not surprising and it follows directly from the data presented in Tables 1 and 2. Notably, it highlights that hedgers utilizing pound-for-pound hedging most likely had unsatisfactory results in the shrimp futures market. Furthermore, given that this was a new tool to the industry, most market participants followed the pound-for-pound hedging recommendations extolled in exchange literature (personal interviews). This strategy would not have statistically decreased risk for most cash shrimp markets or sizes, and given the execution costs (Pennings & Meulenberg, 1997a, 1997b), likely did not result in an economically material decline in risk for any market. In fact, it might have actually increased risk in some cases.

3.4. Cheapest-to-Deliver and Basis Risk

Martinez-Garmendia and Anderson (1999, 2001) find that delivery options based on a fixed premium and discount schedule is a potential design flaw in the contract. In essence, the specification favors sellers, ultimately discouraging trade interest. Could the MGE have known this prior to launching the contract? To investigate this possibility, we simulate the performance of the original contract specifications in the 5 years prior to the launch of the futures contract.[12] This is accomplished by calculating a cheapest-to-deliver

[12] Blue et al. (1998) used historical simulations to examine the risk of the old crop–new crop spread in Hedge-to-Arrive contracts.

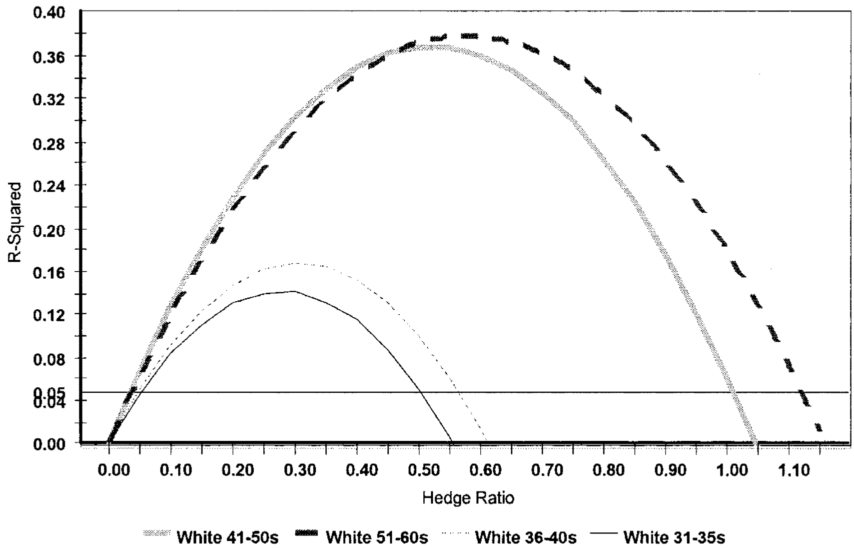

Figure 4 Shrimp futures hedging effectiveness across various hedge ratios. This graph is generated by estimating the hedging effectiveness equation, $\Delta cp_t = \alpha + \beta \Delta fp_t + e_t$, constraining the hedge ratio, β, to a particular level and then recording the R-squared. The horizontal bar reflects the level of R-squared necessary (.0472) to achieve statistically significant risk reduction at the 5% level with 82 observations (F-test).

cash price and using it as a proxy for the futures price. Cash price and simulated basis variability is examined in the pre-futures interval from January 1988 through May 1993.

The white shrimp futures contract contains numerous delivery options: species, size, and delivery location. Here, we focus only on the premium and discount schedule for various sizes of the par species. In particular, we use the premium and discount schedule that was in place at the start of trading (July 1993) and look at the previous 5 years of historical data (January 1988 through May 1993) to replicate a cheapest-to-deliver price. Specifically, the initial contract specifications called for nonpar size delivery of 51 to 60s at −\$0.50, 41 to 50s at par, 36 to 40s at +\$0.45, and 31 to 40s at +\$1.05 per pound. Based on this schedule, the cheapest-to-deliver (CTD) price is calculated as follows:

$$P_t^{CTD} = \text{Min}\{P_t^{51's} + 0.50, P_t^{41's}, P_t^{36's} - 0.45, P_t^{31's} - 1.05\}$$

where P_t^{CTD} is the cheapest-to-deliver price at time t, and the prices in the argument of Min represent the cash market prices for each size at time t adjusted for their delivery premium or discount. The P_t^{CTD} is calculated using month-end prices, so it captures those months when on the first notice day the delivery options would finish at- or in-the-money. For example, on November 30, 1988, the cash prices were as follows: $P^{51s} = 3.40$, $P^{41s} = 4.00$, $P^{36s} = 4.30$, $P^{31s} = 4.95$. So, according to the above relationship, $P_t^{CTD} = \text{Min}\{3.90, 4.00, 3.85, 3.90\} = 3.85$. In this particular example, all nonpar sizes are cheaper to deliver than the par 41 to 50s, but, the cheapest to deliver is the 36 to 40s at \$3.85 per pound. That is, the seller of a futures contract—who is obligated to deliver at a fixed price—would maximize profits by purchasing 36 to 40s on the cash market to meet their delivery ob-

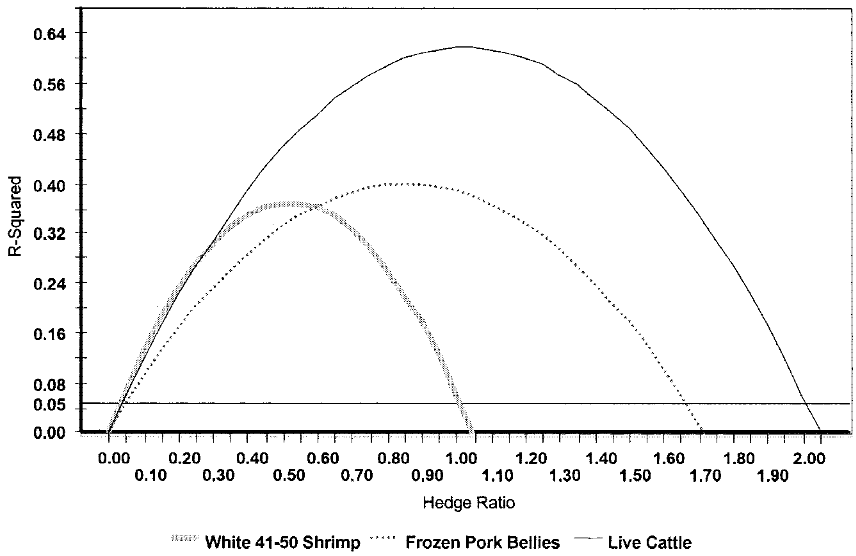

Figure 5 Hedging effectiveness of shrimp, frozen pork bellies, and live cattle. This graph is generated by estimating the hedging effectiveness equation, $\Delta cp_t = \alpha + \beta\Delta fp_t + e_t$, constraining the hedge ratio, β, to a particular level and then recording the R-squared. The horizontal bar reflects the level of R-squared necessary (.0472) to achieve statistically significant risk reduction at the 5% level with 82 observations (F-test). The data for frozen pork bellies and live cattle are estimated using comparable data as that used for shrimp: month-end USDA cash prices and nearby futures.

ligation against the futures contract. So, the simulated futures price would equal \$3.85. A hedger who was expecting the par 41 to 50s to converge to a near 0 basis at delivery would find cash 41 to 50s trading at a \$0.15 over the futures. It is easy to see how changes in the CTD price due to changes in market premiums or discounts can create volatility in the basis.

In the simulation period from January 1988 to May 1993 (65 month-end observations), the nonpar delivery options frequently finish in-the-money. That is, the par 41-to-50–size white shrimp is not the cheapest to deliver. In fact, par size 41-to-50 white shrimp is the CTD in only 12 of the 64 simulated delivery periods. The nonpar 51 to 60s are CTD in 31 of the months, followed by the 31 to 35s in 17 and the 36 to 40s in 15 of the months.[13]

Using the CTD price (P_t^{CTD}) as a proxy for the futures price, summary statistics for the cash-futures basis are calculated in the period prior to futures trading (January 1988 to May 1993). The summary statistics are presented for monthly price changes in the upper panel of Table 4 and the CTD basis in the lower panel. Not surprisingly, over this interval the variability of the simulated basis is greater than the cash price variability for every market. Furthermore, the simulated basis' standard deviations are similar to those actually observed during the period of futures trading (lower panel of Table 1). This suggests that the white shrimp futures contract's performance could have been anticipated. A historical simulation would have suggested that the nonpar-size delivery options were going

[13]The total number of months equals 75 because there are 11 months where CTD was equivalent among two or more different sizes.

TABLE 4. Summary Statistics for Monthly Price Changes and Spread between Cheapest-to-Deliver Price (CTD) and Cash Shrimp Prices, January 1988 to May 1993

	Price Changes[a]						
	CTD Cash	White 41–50s	Tiger 41–50s	Gulf 41–50s	White 51–60s	White 36–40s	White 31–35s
Mean	0.001	0.0042	0.0026	0.0019	0.0039	0.0015	−0.0007
SD	0.052	0.0464	0.0369	0.0447	0.0371	0.0509	0.0468
	CTD-Cash Spread[b]						
		White 41–50s	Tiger 41–50s	Gulf 41–50s	White 51–60s	White 36–40s	White 31–35s
Mean		0.0487	−0.0364	0.0438	−0.0936	0.1747	0.3022
SD		0.0477	0.0777	0.0632	0.0564	0.0553	0.0563

[a]Price changes are the log relative price change, $\Delta p_t = \ln(P_t/P_{t-1})$. There are 64 monthly observations.
[b]The spread or simulated basis at time t is measured as $\ln(CP_t/P_t^{CTD})$, where CP_t is the month-end cash price and P_t^{CTD} is the month-end cheapest-to-deliver cash price. There are 65 monthly observations.

to frequently be in-the-money and create relatively large basis volatility for hedges involving a particular shrimp size.

4. DISCUSSION

4.1. Industry Response

Although the shrimp market is characterized by some of the elements necessary for a successful futures contract, ultimately the industry did not adopt futures to manage price risk. There probably is not a single reason for this. The data and analysis presented suggest that the contract's performance as a risk-reduction tool was less than ideal. However, it is not clear if the performance is due to an inherent design fault, 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 may have prevented the trade from attempting the cash-futures arbitrage? There are many possible answers including the seller's delivery options. It is also questionable as to whether or not the shrimp market fits the classic model for a successful futures market for the following reasons. 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. End-users, though, 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).

Ultimately, there may not be an economic need for the contract. That is, the industry may use alternative, less costly mechanisms to deal with price risk. In fact, the internal cost of implementing a hedging program is probably underestimated by outside observers. These costs include such things as the education of traders and upper management, adjustment of accounting practices, risk management considerations, and record keeping that ties together cash and futures positions. In an industry that has no prior experience with futures markets, these costs are likely to be particularly large. Thus, as an alternative, end-users may simply buy on the spot market every day and be content to pay the average market price over time, which is then passed along to the ultimate consumer. Packers, exporters, and importers routinely attempt back-to-back transactions; thereby, they do not carry 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 relevance to business objectives. While the liquidity problem exists, it is easily remedied by addressing the second reason. Why is the futures market not relevant to an importing firm's business objectives? The specific reasons cited indicate little knowledge of futures as a risk management tool and the role of the cash-futures basis relationship in hedging. 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 a deeper educational effort is needed. Either the industry needs to be more fully educated about how to incorporate futures into their business, or outside researchers need to learn more about how the shrimp industry really operates as well as the industry's attitudes and current mechanisms for managing risks (Pennings & Leuthold, 2000).

4.2. Lessons for Contract Design and Marketing

In this section, we list some of the pragmatic recommendations for the design and marketing of futures contracts. Some of these may seem obvious and even somewhat frivolous. Nonetheless, based on the poor success rate of new contract introductions, no stone should be left unturned.

Let the customers drive the process. If the industry, in aggregate, does not want a futures contract, then even a perfectly designed and marketed contract is likely to fail. The industry should be an integral part of the contract design and specification process. They already have an understanding of the cash trade that is unlikely to be matched by staff economists. Additionally, it gives them a sense of ownership and vested interest in the contract's success.

Industry leaders must support the concept. All industries have their respected leaders—whether individuals, companies, or trade organizations. If these "bell cows" refuse to participate in the contracts or provide poor word-of-mouth advertising, then the contracts will have an uphill battle to gain commercial acceptance.

Firm executives must be sold on and must embrace the concept. Without a mandate to move toward futures-based pricing and risk management from the executive level (board of directors, CEO, CFO, and SVPs), it will not happen. Despite the willingness and best intentions of (say) purchasing managers, merchants, or the sales force, firms will not (and often cannot) utilize futures and options without a mandate from the executive level. Implementing a futures-based risk management program is costly. It impacts the treasury, accounting, tax, purchasing, sales, and corporate reporting functions of the firm. It may even require the hiring of specialized personnel in one or more of these areas. Clearly, this type of decision is made at the top of the organization.

Understand cash-market trade practices. No two cash markets are exactly alike. Cash trade practices can and do differ dramatically across seemingly similar markets. Price determination as well as grades and standards should be well understood. The futures contract should not require the industry to perform functions outside of their ordinary merchandising activities.

Simulate contract performance. This lesson cannot be overstated, because one bad experience with futures and commercial players rarely come back for more. Flawed contract designs are never obvious, and their effects almost always arise during times of extreme events. It is difficult to anticipate these events, and there is often not enough historical data for new markets to place reliable probabilistic expectations on their occurrence. One alternative to mitigate this problem is to use Monte Carlo or other simulation methods to explore possible pricing and basis behavior. This will also provide valuable information concerning basis risk and hedge ratios that can be passed along to industry participants.

Educate, Educate, and Educate. Do not assume that personnel within firms understand risk management products (futures and options) and how to utilize them in their business. They are preoccupied managing day-to-day business operations. They have diverse educational backgrounds and are unlikely to be specialists in risk management.

5. SUMMARY AND CONCLUSIONS

Research on new futures contracts is often performed with sparse data (e.g., Thompson, Garcia, & Wildman, 1996; Bollman, Thompson, & Garcia, 1996). Here, we have a relatively rich data set spanning nearly 7 years with which to examine the MGE white shrimp futures contract's performance in terms of basis and hedging effectiveness. While the shrimp market possesses many of the characteristics for successful futures markets, and realized some success in early trading, it ultimately failed. Specifically, the ex post analysis suggests that the basis risk of a fully hedged position (hedge ratio =1.0) in the par commodity actually 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*. A simple historical simulation suggests that problems with nonpar delivery and the value of the embedded delivery options should have been known prior to the start of trading. Furthermore, it is possible that the shrimp industry has devised less costly ways of dealing with price risk and simply had no demand for a futures contract.

This 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, 1993, 1997). Rather, a stronger role in firm-level education by exchanges, consultants, or public institutions may be required. Alternatively, these industries may already be effectively managing 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. In fact, the "culture" of the industry may not be amenable to the successful launch of a futures contract despite the perceived need by some industry participants and outsiders alike. It is imperative that exchanges closely examine these issues prior to launching new risk management tools.

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