PRICE DETERMINATION IN THE U.S. SHRIMP MARKET

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Abstract

The monthly and quarterly price determination processes for 31–40 and 21–25 size classes of raw-headless shrimp were examined to determine price leadership between market levels. Causal relationships were assessed using Haugh-Pierce, Sims, and Granger methods. Price models at the retail, wholesale, and exvessel market levels were estimated. Economic factors analyzed were income, prices of competing products, landings and imports of raw headless shrimp, total retail supply, beginning stocks, and marketing costs.

Monthly prices generally exhibited unidirectional causality from exvessel to retail price. Quarterly prices were determined interdependently among market levels. Price responses between market levels were found to be symmetric with beginning stocks, landings, and imports of own-size shrimp the most important determinants of price.

Key words: shrimp, prices, causality.

The U.S. shrimp industry is the most valuable component of the nation's commercial fishing industry when measured in terms of dockside value. Landings for 1984, of which 91 percent originated from the southern coastal regions from Texas to North Carolina, were valued at $488.4 million (U.S. Dept. of Commerce [b]). The shrimp industry has recently exhibited considerable instability and price volatility throughout its market system. In general, shrimp prices have been falling since 1982, with divergent trends between larger and smaller size classes of shrimp and between market levels. Several factors are suspected to have contributed to this state of flux, such as limited domestic shrimp supplies, increasing dependency on tariff-free imports of wild catch and increasing amounts of mari-cultured product, disproportionate increases in costs of production (i.e., fuel, financing, and marine insurance), and fluctuating domestic economic conditions.

The domestic production sector is presently characterized as overcapitalized and fully exploited. This condition has led to increased competition for limited domestic stocks and declining catch per unit of effort. In addition, the apparent concentrated nature of the shrimp wholesaling-processing sector (less than 20 firms control approximately 90 percent of total domestic output) has been suggested to have encouraged monopsonistic pricing (wholesaling and processing activities are often both carried out by a given firm). The production sector of the industry has repeatedly requested restrictive measures on imports to improve their price situation and, thereby, relieve their current cost-price squeeze. Others have suggested new marketing organizations and increased promotional programs to bolster prices and/or to redistribute alleged excess profits which are conjectured to exist at some market levels.

Previous research on such marketing issues has focused on either one size class or a single market level (Thompson and Roberts; Doll; Hopkins). Other research has addressed a specific component of the industry, such as imports (Prochaska and Keithly). No research has been conducted to determine price relationships between adjacent market levels for various size classes of shrimp. These relationships are of key importance given that different size classes impact different segments of the retail market. In addition, previous research has failed to address the dynamic nature of price transmission between adjacent market levels. Examining the causal direction of price formation and the nature of price linkage between market levels will provide insight into the degree of competitiveness which

exists in the market. Without an understanding of these dynamic relationships, differential price changes resulting from shifts in various price determinants and the implementation of restrictive policy measures cannot be analyzed at alternative market levels and for other market dimensions, such as those defined by product size class. Efficient policy must be concerned with these differential impacts at alternative market levels.

The objective of this paper is to examine the nature of price relationships between market levels and to identify the determinants of price at each market level for two size classes of raw-headless shrimp, the predominant product form. A general conceptual model of price formation in the shrimp industry at three market levels is presented. An assessment of the causal (lead/lag) and symmetry properties of price transmission between market levels follows. These empirical findings aid in the final specification of retail, wholesale, and exvessel (producer) price models for two major size classes (21–25 and 31–40 count) of raw-headless shrimp. This paper represents a component of a recent larger study regarding prices in the domestic shrimp industry (Adams).

A MODEL OF THE U.S. SHRIMP MARKETING SYSTEM

The vertical marketing system for shrimp products can be conceptualized as consisting of four major linkage points for adjacent market levels: consumer/retailer, retailer/wholesaler-processor, wholesaler-processor/first handler, and first handler/producer. These general market level interfaces are present in the domestic shrimp market where most shrimp produced domestically are off-loaded at a fish house (first handler) and sold to a wholesaler and/or processor. The first handler for imported product is normally a broker. The domestic and imported product is then processed under retailer or processor brand name and sold into the retail market. The preponderance of shrimp sales by value, and most likely by volume, occurs in the institutional (away-from-home consumption) retail market (Keithly).

Given that the supply of raw shrimp product is determined in the short-run primarily by environmental conditions affecting domestic production and by world market conditions affecting the supply of imports offered to domestic brokers; the supply of raw product to each market level is relatively price inelastic (Doll; Grant and Griffin). Treating sup-

ply as exogenous, a set of implicit market level demand expressions for a given size class of shrimp normalized on price is given by

$$(1) \quad R_t = f[M_{1t}, D_t, Q_{1t}],$$

$$(2) \quad W_t = f[M_{2t}, C_{r_t}, Q_{2t}],$$

$$(3) \quad F_t = f[M_{3t}, C_{w_t}, Q_{3t}], \text{ and}$$

$$(4) \quad P_t = f[M_{4t}, C_{f_t}, Q_{4t}],$$

where R_t, W_t, F_t, and P_t are prices received in period t for a given size class of shrimp by retailers, wholesaler-processors, first handlers, and producers, respectively; Q_1, Q_2, Q_3, and Q_4 are quantities offered by retailers, wholesaler-processors, first handlers, and producers, respectively; C_r, C_w, and C_f are costs of marketing inputs associated with offering the product to consumers, retailers, and wholesaler-processors, respectively; D is a set of consumer demand shifters such as income and price of substitutes; t is the time subscript; and each M_i represents a set of prices consisting of subsets of current or lagged endogenous and exogenous prices appropriate for a specific market level. Information to aid in the exact specification of each M_i emerges from the assessment of the causal direction among prices associated with adjacent market levels.

Data availability places restrictions on the estimation of equations (1) through (4). Sufficent data are not available to describe the transaction between the first handlers and wholesaler-processors. Therefore, only expressions (1), (2), and (4) are estimated. The explicit price demand expressions to be estimated are specified for a given size class of raw-headless shrimp. The retail price expression represents the demand by consumers for the retail product and is specified as a function of quantities of raw-headless shrimp moving through the retail market and other variables which may capture shifts in retail demand (income and a price index of competing meat products). The wholesale price expression represents the demand by retailers for wholesale raw-headless product and is specified as a function of quantities moving through the wholesale market (the sum of beginning inventories of frozen shrimp and imports of the specific size class and all other sizes) and a cost index of marketing inputs utilized by the wholesaler-processor. The exvessel price expression represents the demand by first handlers for raw product at

dockside and is specified as a function of the quantities offered to first handlers (domestic landings of the specific size class and other sizes) and a cost index of marketing inputs utilized by the first handlers. In addition to the predetermined variables discussed above, findings regarding the direction of causality are used to indicate whether each price expression should be a function of current and lagged exogenous price, lagged endogenous price, or both. Given that shrimp supplies are considered to be exogenous, supply expressions for each market level and size class are not considered.

CAUSALITY AND SYMMETRY TESTING

In the presence of highly competitive markets, auctions, and the increased use of computerized marketing techniques, rapid adjustment of prices to changes in supply and demand may be evident. However, in less competitive and less organized markets (such as those for many seafood products), the notion of short-run disequilibrium and the possibility of slower price adjustment warrants investigation of the inherent dynamic properties of price transmission and causal direction as information flows between equilibrium points among adjacent market levels in a lead/lag fashion. Though economic theory suggests the structural specifications of the model, a priori information is not sufficently detailed to suggest the exact specifications of leads, lags, and other dynamic components of price transmission. These relationships should be asssessed to provide additional information for model specification.

Identifying Causal Relationships

There have been numerous studies investigating the direction of price causality in agricultural markets (Bessler and Brandt; Bessler and Schrader; Miller; Spreen and Shonkwiler). However, no studies have been published which test the direction of causality between prices representing vertical market levels in the U.S. seafood market. Causality between two theoretically related time series is defined in the Granger sense as "Y_t is causing X_t if we are better able to predict X_t using all available information, than if the information apart from Y_t had been used" (Granger, p. 428). Three empirical approaches which have been used extensively in the literature to identify the causal relationship between two time series are the Granger, Sims, and Haugh-Pierce methods (Haugh; Pierce; Sims). These

methods essentially relax the constraint imposed by the Granger requirement that "all available information" be used in predicting X_t by only taking into account Y_t and the past history of X_t.

The Haugh-Pierce method contrasts with other methods in that techniques of determining residual cross correlations are employed to infer causality between two time series. More importantly, the resulting causal inferences and residual cross correlations can then be used in a two-step dynamic regression procedure to arrive at a suggested specification of the lead/lag relationship which exists between the two time series (Haugh and Box). Assume initially that two time series X_t and Y_t (i.e., prices for adjacent market levels) can be represented by

(5) $\phi(B) X_t = u_t$, and

(6) $\Theta(B) Y_t = v_t$,

where $\phi(B)$ and $\Theta(B)$ are invertible polynomial filters in the lag operator B, and the residuals u_t and v_t are white noise processes. The filters are univariate time series models identified and estimated through the Box-Jenkins approach. Haugh suggests that, due to the absence of autocorrelation among the residuals, cross correlations between u_t and v_t can be used to infer causality between X and Y. Pierce provides alternative conditions for residual cross correlation significance at lag k which are used to make inferences regarding the specific nature of the causal relationship between X and Y (i.e., unidirectional, instantaneous, feedback, or independence). Given an implied causal relationship between X and Y, a dynamic shock model can be given that connects the orthogonal residuals u_t and v_t. Assuming unidirectional causality from X to Y, the dynamic shock model is

(7) $v_t = V(B) u_t + \delta(B) a_t$,

where a_t is an error process and $V(B)$ and $\delta(B)$ are polynomials in the lag operator B. Each parameter in $V(B)$ is the bivariate regression coefficient relating v_t to u_{t-k}. Given that the order and parameters of the polynomial $V(B)$ are known, the original filter expressions are substituted in the dynamic shock model giving

(8) $\Theta(B) Y_t = V(B)\phi(B) X_t + \delta(B) a_t$.

Isolating Y_t and completing the necessary

simplification yields a distributed lag, or transfer function, which expresses Y_t as a function of current and/or lagged X_t given as

(9) $Y_t = \psi(B)X_t + \lambda(B) a_t$.

The polynomials $\psi(B)$ and $\lambda(B)$ suggest a lead/lag structure between adjacent market levels which is revealed and supported by the data. Once the transfer function relating prices X and Y for each market level interface has been identified, the lead/lag structures (e.g., current and/or lagged prices) are included in a more complete explanatory model of the market.

Testing the Symmetric Nature of Price Transmission

The speed and extent with which price changes are passed to adjacent market levels may not be equivalent for price increases or decreases. Thus, a market may be characterized by a lack of symmetry in vertical price transmission. Recent trends in shrimp prices have exhibited such divergence or convergence between prices at adjacent market levels, particularly as prices move through peaks or troughs. At the retail/wholesaler-processor interface, this asymmetry may be a function of: (1) the cost of changing prices on current inventories, (2) the need to move perishable product types quickly, or (3) simply the reluctance by retailers to relinquish a price peak once it is established. In addition, the desire to maintain most efficient use of capacity may result in retail price rigidity as wholesale prices vary. If monopsonistic pricing tendencies exist among lower market levels, wholesale price increases, for example, may not be passed down to first handlers or producers with the speed and degree of price decreases. If this were the case, one market level may be able to control the price spread through influencing price at an adjacent market level. The existence of this phenomenon in the U.S. shrimp market is at least implied by recent legislation calling for aid in establishing cooperatives and market orders in the producer sector.

This study uses a modified version of the Wolframm model, as suggested by Gollnick, to examine the symmetric nature of price response between market levels (Wolframm; Young). This form of the Wolframm model has been used in previous studies of price behavior in more traditional agricultural markets (Van Dijk; Ward).

DATA

Retail price represents grocery and food store prices for raw-headless shrimp in the Baltimore, Maryland, metropolitan area. This price reflects at-home consumption of shrimp. Institutional prices, which would reflect away-from-home consumption of shrimp, are not available. Wholesale price is the ex-warehouse price in the New York metropolitan area as reported for the New York Fulton fish market. Exvessel price is a weighted average for all species of shrimp by size class landed in the Gulf and South Atlantic. Price, inventory, landings, supply, and import data were obtained from published and unpublished National Marine Fisheries services sources (U.S. Department of Commerce [c] and [d]). Although the price data do not reflect a national or regional average, they are used by industry in establishing prices for local production and marketing for respective market levels.

Cost index data for seafood processing and wholesaling were not available on a consistent time series basis. Therefore, cost index data for the processing, wholesaling, and retailing of general agricultural food products were obtained from the U.S. Department of Agriculture. This cost index for agricultural food products was assumed to be a proxy for the costs associated with seafood processing and marketing. Income and consumer price index data were obtained from published Bureau of Economic Analysis and Bureau of Labor Statistics reports, respectively (U.S. Department of Commerce [a] and U.S. Department of Labor).

The data collected from these secondary sources are on a monthly basis. Quarterly data used in the analysis are constructed from the monthly data as unweighted three-month averages (price, income, and index data) and unweighted three-month totals (supply, landings, and import data). Price data by size class are available for the period 1968 to 1981. The remaining quantity, cost, and income data represent only the period 1972 to 1981. Therefore, 168 monthly observations are available for an analysis of causal direction among prices at alternative market levels. However, estimation of price models is restricted to 120 observations due to limitations on landings and import data by size class.

EMPIRICAL FINDINGS AND DISCUSSION

Causal Relationships

The Haugh-Pierce test for causality is employed to examine whitened monthly and

quarterly price changes for 21–25 (larger) and 31–40 (smaller) count raw-headless shrimp for exvessel, wholesaler-processor, and retail market levels. Though not presented here, causal relationships found using the Granger and Sims tests were in general agreement with the Haugh-Pierce findings.

The causality tests provided in Table 1 indicate that upward unidirectional causality exists between the three market levels on a monthly basis such that exvessel price causes wholesaler-processor price and wholesaler-processor price causes retail price. An unexpected exception to this generalization is found between the exvessel and wholesaler-processor prices for the larger shrimp, where no unidirectional causality occurs. Adjacent market levels are instantaneously related on a monthly basis. The test applied to quarterly data for both size classes provides no evidence of unidirectional causality between the price series representing any two adjacent market levels. However, instantaneous causality exists between adjacent market levels on a quarterly basis. These findings suggest that the price determination process is, in general, recursive from exvessel to retail market levels on a monthly basis and simultaneous on a quarterly basis. The monthly price determination process may be dominated at the exvessel level through exogenous variations in supply, with insufficient time for retail factors to play an important part in determining prices. Thus, consumer market signals do not appear to have a dominant impact on exvessel price on a short-term month-to-month basis. However, a three-month period allows sufficient time for feedback of market signals to occur among retail, wholesaler-processor, and exvessel market levels, resulting in a simultaneous price determination process.

Identification of the transfer functions for monthly and quarterly data suggests lag structures of differing lengths for each size

class. Price transmission between adjacent market levels for the larger shrimp generally exhibits a longer lag structure (lagged two periods) than that for the smaller shrimp (lagged one period). In addition, the price adjustment between the exvessel and wholesaler-processor levels requires one additional time period for the larger shrimp, while price movement between the retail and wholesaler-processor levels requires one additional time period for the smaller shrimp. The slower adjustment in prices suggests the larger shrimp are being held in inventory longer, with the smaller, more versatile shrimp being pushed to the retail market in a shorter period of time, possibly through different market outlets. These findings suggest that the markets for the two size classes of shrimp function differently over time. The transfer functions, however, only suggest the nature of the lag structure. The extent by which these lag relationships are found to be significant in the estimated price models is shown in the next section.

Symmetry Tests

Given the causal relationships suggested by the Haugh-Pierce tests, an analysis of the symmetric nature of price responses between adjacent market levels was performed only on monthly data. Symmetric price movements were found to characterize price changes for both size classes of shrimp. Dependent price response was found not to be related to direction of causal price change. This finding suggests that no one market level is able to effectively control the price spread between adjacent market levels represented by the data.

Price Models

Price dependent equations for the three market levels are estimated for both size classes. Only models estimated using quarterly data are presented. The causality findings

TABLE 1. SUMMARY OF MONTHLY AND QUARTERLY HAUGH-PIERCE CAUSALITY TESTS USING EXVESSEL (E), WHOLESALE (W), AND RETAIL (R) PRICE DATA BY SIZE CLASS, 1968–1981

Null Hypothesis[b]		Test[a]			
		Monthly		Quarterly	
		31–40	21–25	31–40	21–25
E ←—/—→ W		118.65*	137.87*	47.66*	49.21*
E —/—→ W		21.16*	13.61	3.87	4.31
W —/—→ E		6.40	6.40	3.40	2.16
W ←—/—→ R		45.03*	58.25*	32.42*	20.35*
W —/—→ R		30.18*	44.02*	10.09	3.33
R —/—→ W		9.32	13.10	3.63	4.07

[a]Table entries are Chi-square values with 6 and 12 degrees of freedom for quarterly and monthly tests, respectively. Asterisked values were significant at least at the 90 percent level, indicating a rejection of the null hypothesis.

[b]No instantaneous or unidirectional causality indicated by ——/——→ which reads "does not cause."

suggest simultaneous price determination among market levels on a quarterly basis. For this reason, and because the error terms of the quarterly models are contemporaneously cross correlated, the models are estimated using three stage least squares (3SLS) procedures. The final form of the estimated coefficients is derived utilizing procedures outlined in Goldberger. Given that identification of the transfer functions suggests lag structures to be present in quarterly price adjustment, the final form represents the long-run relationship between each endogenous variable and the exogenous variables of the model.

Price interrelationships between market levels are estimated for each size class. Structural estimates are presented in Table 2. Of the various lagged prices suggested through identification of the dynamic shock models and transfer functions, most are insignificant and are not included in the final models. Lagged endogenous prices are included, however, to correct for serial correlation. Retail prices for both size classes appear to require at least one period to fully adjust. In addition, the prices for the larger shrimp are characterized by significant lagged adjustment at both the retail and wholesaler-processor level. Stronger relationships are found between exvessel and wholesaler-processor prices than between retail and wholesaler-processor prices.

In general, the estimated price models correspond to a priori expectations. For the larger size shrimp, retail prices are inversely

TABLE 2. ESTIMATED QUARTERLY RELATIONSHIPS[a] AMONG EXVESSEL (E), WHOLESALE (W), AND RETAIL (R) PRICES FOR 21–25 AND 31–40 COUNT RAW-HEADLESS SHRIMP, 1972–1981

Explanatory Variables	21–25 Count Shrimp			31–40 Count Shrimp		
	R_t	W_t	E_t	R_t	W_t	E_t
R_t		.189 (.198)[b]			− .057 (.075)	
W_t	.481 (.088)		.858 (.028)	.708 (.146)		.932 (.039)
E_t		.839 (.102)			.978 (.091)	
R_{t-1}	.701 (.073)	− .181 (.090)		.557 (.081)	− .017 (.043)	
W_{t-1}		.176 (.054)				
Income[c]	− .0001 (.0005)			− .0011 (.0004)		
Total Supply[d]	− .0052 (.0054)			.0045 (.0057)		
CPIM[e]	.0034 (.0040)			.0045 (.0042)		
Stocks[f]		− .0023 (.0016)			− .0014 (.0014)	
Imports:[g] Own		− .0079 (.0551)			− .0113 (.0326)	
Other		.0003 (.0019)			− .00003 (.0013)	
Landings:[h] Own			− .0598 (.0244)			− .0084 (.0086)
Other			− .0014 (.0011)			− .0005 (.0008)
Cost[i]		.0017 (.0009)	− .0002 (.0006)		.0006 (.0076)	− .0006 (.0006)

[a]Price effects are 3SLS estimates.

[b]The values in parentheses are the estimated standard errors of the parameter estimates.

[c]Nominal (1972) disposable income in billion dollar units.

[d]Estimated as total disappearance from wholesale market of all sizes of raw-headless shrimp.

[e]Deseasonalized consumer price index for red meat and poultry products (1972 = 100).

[f]Beginning inventories of raw-headless fresh and frozen shrimp in million pound units.

[g]"Own" imports are 21–25 or 31–40 count imports. "Other" imports refer to all other size classes of raw-headless shrimp imports in million pound units.

[h]Own" landings are 21–25 or 31–40 count shrimp. "Other" landings are all other size classes of Gulf and South Atlantic shrimp landings in million pound units.

[i]Total food marketing cost index (1967 = 100).

related to total supply. For 31–40 shrimp, however, the opposite relationship was found. The estimated coefficient associated with consumer income was negative and too small to establish income as a major factor determining quarterly price changes. This result is consistent with previous studies which used monthly and quarterly data for a given level of the shrimp market, while the income effect is usually stronger on an annual basis (Doll; Hopkins; Thompson and Roberts). The estimated positive coefficient associated with the price index for other meat products suggests that red meat and poultry serve as substitutes for both size classes of shrimp. The parameter estimates associated with beginning stocks, landings, and imports in general had the expected negative relationship with price.

From computation of the final form, the estimated long-run impact multipliers expressed as price flexibilities are reported in Table 3. As was found in the structural estimates, the coefficients associated with income and total supply have either wrong or inconsistent signs across size classes. The substitution effect between other meat products and shrimp appears to be greater for the smaller size class of shrimp. Smaller size shrimp prices appear to be more sensitive to changes in landings, imports, and beginning stocks than larger size shrimp prices.

The effect of marketing costs of intermediate goods and services for all food products points out the difference between short-run and long-run effects. In the structural models, the estimated coefficient of marketing costs was positive for wholesale prices and negative for exvessel prices for both size classes. These results are consistent with the notion that increases in marketing costs place upward pressure on wholesale prices but reduce the level wholesalers are willing to pay for their raw product. The final form flexibilities, however, are positive for both size classes and all three market levels. This result occurs because increases in marketing costs initially cause increases in wholesale prices, and since wholesale and exvessel prices are closely linked, eventually exvessel prices also increase. Increases in marketing costs have a larger effect on larger size prices. This may be explained by higher costs associated with a larger, more expensive product which is more likely to be stored in frozen form for a longer period of time.

SUMMARY AND CONCLUSIONS

The primary purpose of this study was to evaluate the dynamic nature of price determination and to assess the differential impacts various price determining factors have on alternative market levels of the U.S. shrimp industry. Different market levels, as well as different size count shrimp markets, were analyzed. Partial or independent effects of causal variables such as imports, landings,

TABLE 3. PRICE FLEXIBILITIES [a] FOR SPECIFIED PREDETERMINED VARIABLES AT EXVESSEL (E), WHOLESALE (W), AND RETAIL (R) MARKET LEVELS FOR 21–25 AND 31–40 COUNT RAW-HEADLESS SHRIMP, 1972–1981

Predetermined variables	21–25 Count Shrimp			31–40 Count Shrimp		
	R	W	E	R	W	E
Income[b]	− .2833	− .1829	− .2028	− .1345	− .0130	− .0131
Total Supply[c]	.7549	.4860	.5397	− .3196	− .0345	− .0349
CPIM[d]	1.5657	1.0079	1.1198	.4367	.0484	.0483
Stocks[e]	− 1.2827	− 1.1436	− 1.2703	− .4474	− .3918	− .3949
Imports:[f]						
Own	− .1966	− .1754	− .1947	.0227	.0199	.0201
Other	− .3041	− .2703	− .0301	.0576	.0499	.0509
Landings:[g]						
Own	− .2519	− .2245	− .2561	− .1974	− .1729	− .1963
Other	− .2622	− .2339	− .2667	− .1466	− .1284	− .1458
Cost[h]	.2440	.2129	.1903	1.0481	.9194	.9131

[a]Values are flexibilities derived at the means from quarterly final form estimates.

[b]Nominal (1972) disposable income in billion dollar units.

[c]Estimated as total disappearance from wholesale market of all sizes of raw-headless shrimp in million pound units.

[d]Deseasonalized consumer price index for red meat and poultry products (1972 = 100).

[e]Beginning inventories of raw-headless fresh and frozen shrimp in million pound units.

[f]"Own" imports are 21–25 or 31–40 count imports. "Other" imports refer to all other size classes of raw-headless shrimp imports in million pound units.

[g]"Own" landings are 21–25 or 31–40 count shrimp. "Other" landings are all other size classes of Gulf and South Atlantic shrimp landings in million pound units.

[h]Total food marketing cost index (1967 = 100).

beginning inventories, income, marketing cost, and prices of competing meat products were developed. This information is vital for accurately predicting the consequences of the specific policy questions and also is necessary for a complete understanding of the economic relationships which exist within the U.S. shrimp marketing system.

No single level in the marketing system appears to have sufficient market power to acquire an unequal share of the benefits or avoid an unequal share of the costs of increased or reduced trade. On a monthly basis, it may appear that the exvessel market level leads other levels in determining prices. However, this probably is due to factors other than market power, such as wide month-to-month variations in landings, marketing response time, and time required for market information to fully permeate the system. The latter criterion was suggested by the upward recursive nature of monthly price changes compared to the simultaneous nature of quarterly price movements. Although prices are simultaneously determined on a quarterly basis, price increases from restrictive trade policies will be passed on to higher market levels with proportionally larger price increases. In addition, price responses were found to be symmetric. Thus, no evidence was found to support the presence of monopsonistic pricing in the market. The weaker linkage found between retail and wholesale-processor prices than for the wholesaler-processor and exvessel prices suggests policy measures administered at the retail level (i.e., market promotional programs) may have less of an impact on the total system than will policy measures administered at the lower market levels, such as implementation of cooperatives or market orders.

The estimated price relationships suggest all market levels will be impacted by changes in imports and/or policy measures. Impacts are nearly equal at the wholesale and exvessel level but are considerably greater at the retail level. Impacts at the retail and wholesaler-processor market levels will likely take longer to be fully realized than at the producer level. On a size class basis, the prices for small shrimp appear to adjust more rapidly to change in market conditions.

Although the direction of price impacts is generally the same for the two size shrimp classes analyzed, there are some differences in terms of the magnitude of the effects. The market for smaller shrimp appears to be much more affected by changes in domestic landings and imports. Prices for larger shrimp, on the other hand, are more sensitive to the total costs of marketing.

The findings of this analysis may be used in further research to address two topics of increasing concern in the domestic shrimp market: increasing levels of imported cultured shrimp and the popularity of closure policies for domestic shrimp stock management. Cultured shrimp are arriving predominantly in the 31–40 size class, with less seasonality than wild-caught supplies. Closure policies, which are used to protect smaller shrimp in shallow Gulf waters, tend to result in an abundance of shrimp in the 31–40 size class. These developments are noteworthy considering that this study has suggested that the market for smaller shrimp is already subject to larger price responses than the larger count shrimp market for comparable changes in certain causal factors in the domestic market. This model can be used to assess the impacts of such structural change in the market.

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