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Integration of United States, Thailand and Philippine Canned Tuna Markets

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Abstract

In this study we investigate price integration in the United States, Thailand and Philippine canned tuna markets by employing a dynamic model of spatial price differentials to determine how rapidly and completely price information is transmitted from one market to another over time. When the United States is assumed to be the central canned tuna market, we find that the Thai canned tuna market operates independently of price conditions in the United States. On the other hand, the Philippine market is well integrated with the United States market in the sense that a change in the United States price is quickly and effectively communicated to the Philippine market. These results are shown to have significant implications with regard to measures the United States might take to control the flow of canned tuna imports from Southeast Asia.

Introduction

In the early 1980s there began a rapid and substantial increase in the volume of canned tuna imported into the United States (US), the world's principal market for canned tuna. Intense competition from foreign processors began to develop when tuna packed in water started to surpass tuna canned in oil in popularity among US consumers, and rising production costs within the US tuna industry contributed to record high prices at the exvessel, wholesale and retail levels. This combination of events, plus a disparate tariff[1] on tuna

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[1]The US tariff on imports of canned tuna packed in oil is different from that on imports of tuna not packed in oil. Tuna in oil is subject to a 35% tariff. Canned tuna not in oil is under a tariff rate quota which allows imports up to 20% of the previous year's domestic production, excluding production at American Samoa, to enter at 6% ad valorem, and imports above the quota level enter at 12.5% ad valorem.

canned in water, provided an unprecedented opportunity for low-cost imports to inundate the strongest growing segment of the US tuna market - tuna packed in water for sale to private label and institutional customers. From 1981 through 1986, the amount of canned tuna imported into the US more than tripled, increasing by more than 90% between 1983 and the end of 1986 alone. Thailand and the Philippines have become the major sources of these imports, together accounting for over 75% of the total imports in 1986 (Table 1).

Table 1. U.S. imports (tonnes) for consumption by principal sources of tuna in airtight containers (oil and water), 1983-1986.

Source	1983	1984	1985	1986
Canada	957	-	40	-
Ecuador	-	404	2,352	1,303
Indonesia	1,197	1,010	631	370
Japan	9,267	12,207	10,774	4,799
Malaysia	1,401	731	1,763	1,091
Philippines	14,554	10,102	13,999	12,719
South Korea	31	37	26	656
Spain[1]	60	97	153	108
Taiwan	8,504	8,152	10,669	12,990
Thailand	18,150	40,766	55,757	69,226
Other	1,482	271	1,085	952
Total	55,604	73,779	97,249	107,555

Notes: [1]Mainly oil packed.
Source: US Department of Commerce, Bureau of the Census.

Penetration of the US canned tuna market by Thai and Philippine processors was considered severe enough to prompt various members of the US industry (vessel owners, processors and cannery workers) to join together and petition the US International Trade Commission (ITC), under Section 201 of the Trade Act of 1974, for tariff relief from imports of canned tuna packed in water (Herrick and Koplin 1986). Although the industry was unsuccessful both in this attempt and in subsequent attempts to have protective tariff legislation enacted, industry's concern over the rapid growth of canned tuna imports indicates a need to assess the nature and extent

of market integration between the Southeast Asian and US canned tuna markets, and thereby provide a fundamental understanding of how these markets work.

Markets may be integrated to different degrees and along some dimensions but not others. The flow of canned tuna from Southeast Asia into the US institutional/private label market is evidence of market integration on the basis of commodity flows. When the prices of a good that is produced in spatially separated markets are functionally related, market integration on the basis of price is said to exist. The purpose of this paper is to examine empirically price integration in the US, Thai and Philippine canned tuna markets. We restrict our attention to the institutional/private label canned tuna market in the US, since this market has been most greatly impacted by the rise in imports.

Market Integration and Price Analysis

Market Integration

Markets that are integrated on the basis of price are those in which prices do not behave independently. Geographical links or interregional trade has received the most attention. Two major issues of these spatial price linkages have been most frequently examined: whether markets are integrated, and if so, the extent and nature of this integration.

Dynamic Spatial Price Differentials

Ravallion (1986) recently proposed a dynamic model of spatial price differentials for a tradeable good which avoids the inferential dangers of static price correlations (Harriss 1979) and which also provides a more cohesive analytical procedure than other regression approaches (Timmer 1974; Harriss 1979; Petzel and Monke 1979-1980). By using *a priori* information on the most likely directions of price linkages from a central market to local markets, Ravallion's model permits each local price series (P_i) to have its own dynamic structure, allows for any correlated local seasonality or other characteristics, and provides for an interlinkage with other local markets. Moreover, the alternative hypotheses of market integration

and market segmentation are encompassed within a more general model, thereby allowing for nested statistical testing. Finally, Ravallion's dynamic model distinguishes between the concepts of instantaneous market integration and the less restrictive idea of integration as a long-run target of the short-run dynamic adjustment process. Thus, if short-run adjustment is statistically rejected by the data, so that trade does not immediately adjust to spatial price differentials, it is possible to determine if there is any long-run tendency toward market integration.

Ravallion proposed the following econometric model of a T-period series of prices for N regions:

$$P_{it} = \sum_{j=1}^{J} a_{ij}P_{it-j} + \sum_{j=0}^{J} b_{ij}P_{1t-j} \qquad \text{... 1)}$$

$$+ c_iX_{it} + e_{it}, \quad i = 2,...,N,$$

where market 1 is the central market, X_i (i = 1,2,...,N) is a matrix of nonprice influences on local markets, the e's are appropriate error processes, J is the number of time periods to be lagged, and the a's, b's and c's are parameters to be estimated.

Several hypotheses about interregional trade and market integration can be formulated as linear parameter restrictions on equation (1) (Ravallion):

1. *Market Segmentation.* The null hypothesis of local market segmentation states that changes in the central market prices will have no effect, immediate or lagged, on prices in the i^{th} local market. Market i could be called segmented if:

$$b_{ij} = 0, \quad j = 0,1,...,J, \qquad \text{... 2)}$$

which can be determined by imposing the linear parameter restriction (2) on equation (1), and testing this restricted model against the unrestricted model of equation (1) with an F-test. Nonrejection of the restricted model or null hypothesis indicates that the price in local market i depends only on its own lagged values and local market characteristics.

2. *Short-Run Market Integration.* A price change in the central market will be immediately and fully passed on to the i^{th} local market price if:

$$b_{i0} = 1 \qquad \text{... 3)}$$

This hypothesis, in addition, requires that there be no lagged effects on prices in the future:

$$a_{ij} = b_{ij} = 0, \quad j = 1,2,...,J \qquad \text{... 4)}$$

If both (3) and (4) are accepted as parameter restrictions, then market i is integrated with the central market within one time period.

A weaker form of short-run market integration will also be tested, in which the lagged effects need only vanish on average:

$$\sum_{j=1}^{J} a_{ij} + \sum_{j=1}^{J} b_{ij} = 0 \qquad \text{... 5)}$$

3. *Absence of Local Market Characteristics.* This hypothesis assumes that:

$$c_i = 0 \qquad \text{... 6)}$$

where c_i is a vector if there is more than one local market characteristic. Testing this hypothesis is of interest when local prices are suspected to have different seasonality than the central market. In this case, X_{it} can be defined as a matrix of dummy variables.

4. *Long-Run Market Integration.* A long-run equilibrium is one in which market prices are constant over time, undisturbed by any local stochastic effects. Thus, when $P_{it} = P_i^*$, i = 2,...,N, $P_{1t} = P_1^*$ and $e_{it} = 0$ for all t, equation (1) takes the form:

$$P_i^* = \frac{P_1^* \sum_{j=0}^{J} b_{ij} + X_{it}c_i}{1 - \sum_{j=1}^{J} a_{ij}} \qquad \text{... 7)}$$

Long-run market integration now requires that:

$$\sum_{j=1}^{J} a_{ij} + \sum_{j=0}^{J} b_{ij} = 1 \qquad \text{... 8)}$$

If this linear parameter restriction is not rejected by an F-test, then the short-run process of price adjustment described by the model is consistent with an equilibrium in which a unit increase in the central market price is fully passed on in local market prices.

Markets where previous central market prices and the past spatial price differentials are the primary determinants of local prices (rather than previous local prices) are well linked in the sense that supply and demand conditions in the central market are effectively communicated to local markets. The central market influences local market prices irrespective of previous local conditions in the long run, even though traders may fail to connect the two markets through commodity flows in the short run (Timmer 1974). Acceptance of the short-run restrictions [(3) and (4) or (5)] implies long-run market integration but the reverse is not necessarily true.

If the long-run market integration restriction is not rejected, then more efficient estimates of the remaining parameters and more powerful statistical tests are provided by reestimating the model with long-run market integration imposed. Equation (1) under long-run integration can be written in the following equivalent form (Ravallion 1986):

$$P_{it} - P_{it-1} = (a_{it} - 1)(P_{it-1} - P_{1t-1}) \qquad \ldots 9)$$

$$+ \sum_{j=2}^{J} a_{ij} (P_{it-j} - P_{1t-j}) + b_{10}(P_{1t} - P_{1t-1})$$

$$+ \sum_{j=1}^{J-1} (b_{10} - 1 + \sum_{k=1}^{J} a_{ik} + b_{ik}) (P_{1t-j} - P_{1t-j-1})$$

$$+ c_i X_{it} + e_{it}.$$

Changes in local market prices, $P_{it} - P_{it-1}$, are then attributable to changes in central market prices and past spatial price differentials between local and central market prices. The latter variables allow for the possibility that the markets are not observed in an integrated equilibrium at a given time period, so that there is feedback from prior disequilibria.

Ravallion proposes the following sequence of nested F-tests for the different null hypotheses. First, test for long-run integration. If the null hypothesis of long-run market integration is rejected, then tests for short-run market integration and market segmentation are conducted. If long-run market integration is not rejected, then it should be imposed on the model with successive tests based on a restricted form such as equation (9).

It is possible that central and local market prices in equation (1) are formed simultaneously. Such an occurrence introduces a simultaneous equation problem, so that parameter estimates could be biased and inconsistent. Ravallion points out that the simultaneity in the system can be easily dealt with by using an appropriate instrumental variables estimator such as the two-stage least squares estimate of equation (1). This is obtained by replacing P_{1t} by its predicted values from the reduced form equation obtained from a regression of P_{1t} against its own lagged values, the lagged values of prices in all local markets, dummy variables, and time trend variables. The number of lagged periods might be limited by the corresponding degrees of freedom that are available.

Any lagged effects in the model are likely due to sluggishness in price adjustment, delays in transportation and expectations formation under price uncertainty (Ravallion). A lag of six months was chosen as a maximum period over which price responses would take place. In addition, two nonprice variables (X_{it}) were included as likely influences on local market prices. First, the influence of seasonality is accounted for by quarterly dummy variables for winter, spring, summer and fall. Second, the possibility of long-term effects from increasing Southeast Asian exports is described by a linear time trend.

The Data

Average monthly wholesale prices, 1983 through 1986, for a standard case of US water packed, private-label, light meat canned tuna were obtained from the National Marine Fisheries Service's Market News Service, Southwest Region. These are free-on-board (f.o.b.) prices at the canner's terminal. US prices were adjusted for inflation using the gross national product (GNP) implicit price deflator.

Prices for canned tuna processed in the Philippines and Thailand were obtained from the United Nations Food and Agriculture

Organization's Globefish Data Base for the years 1983 through 1986. The Globefish prices represent the monthly average cost and freight (c.f.) charges paid by US importers for a standard case of light meat, water packed canned tuna in US dollars. Thai and Philippine canned tuna prices were adjusted for inflation by the use of their respective GNP implicit price deflators.

Empirical Results

United States - Southeast Asian Market Integration

While the United States and Southeast Asian canned tuna markets are integrated by commodity flows, it is less clear if they are integrated by prices. The Ravallion approach allows a comprehensive assessment of this possible integration of these canned tuna markets by prices. Because of the large commodity flow of canned tuna from Southeast Asia to the United States, it is reasonable to assume that canned tuna price leadership, if any, is likely to come from the US. Consequently, the US wholesale market was specified as the central market and the Thai and Philippine markets were specified as the local markets. The unrestricted model given by equation (1) for six lagged periods (J = 6) was estimated by two-stage least squares. These regression results for the unrestricted model given in equation (1) are reported in Table 2. The autocorrelation and partial autocorrelation plots for the residuals for six lagged periods indicated that serial correlation did not present a problem of any importance.

The importance of the local market characteristics was first examined in each local market by an F-test of the null hypothesis given in equation (6) that the seasonal dummy variables and linear time trend are each zero. While the seasonal dummy variables and linear time trend did contribute in a significant way to the unrestricted model for price formation in the Philippine market, they were not important as a group in the formation of prices in the Thai market. Consequently, the final version of the unrestricted model given in equation (1) does not have any local market characteristics for Thailand, but the linear time trend and seasonal dummy variables are included for the Philippines. These final versions were then used for the hypotheses tests on the form of market integration.

Table 2. Parameter estimates of unrestricted dynamic model of spatial price differentials for United States, Thailand (Thai) and Philippine (Phil) canned tuna markets.

Variable	US=central Phil=local	US=central Thai=local	Thai=central Phil=local	Phil=central Thai=local
Intercept	-14.519	1.755	-3.295	3.253
	(10.69)	(0.091)	(1.295)	(1.846)
Spring dummy	-0.403	-0.308	-0.553	0.296
	(0.217)	(0.337)	(0.151)	(0.431)
Summer dummy	0.302	-0.072	-0.312	-0.042
	(0.275)	(0.306)	(0.183)	(0.270)
Fall dummy	0.083	-0.074	-0.167	-0.044
	(0.158)	(0.209)	(0.124)	(0.184)
Trend	0.084	0.010	-0.036	0.021
	(0.061)	(0.115)	(0.010)	(0.019)
Prices				
Local [t-1]	0.494	0.694	0.111	0.638
	(0.178)	(0.252)	(0.168)	(0.214)
Local [t-2]	0.180	-0.051	0.022	-0.087
	(0.188)	(0.245)	(0.173)	(0.231)
Local [t-3]	0.278	0.148	0.123	-0.122
	(0.211)	(0.436)	(0.191)	(0.255)
Local [t-4]	0.102	-0.304	0.402	-0.399
	(0.188)	(0.240)	(0.149)	(0.223)
Local [t-5]	-0.155	0.117	-0.050	0.251
	(0.195)	(0.267)	(0.150)	(0.252)
Local [t-6]	-0.111	0.132	-0.104	0.085
	(0.189)	(0.201)	(0.141)	(0.244)
Central [t-0]	1.341	-0.001	0.417	1.004
	(0.675)	(1.586)	(0.346)	(0.627)
Central [t-1]	-0.679	0.040	-0.089	-0.450
	(0.458)	(0.800)	(0.282)	(0.283)
Central [t-2]	0.018	0.037	0.039	0.068
	(0.302)	(0.358)	(0.175)	(0.226)
Central [t-3]	0.682	0.354	0.064	-0.127
	(0.330)	(0.471)	(0.164)	(0.249)
Central [t-4]	-0.219	-0.314	0.198	-0.192
	(0.312)	(0.361)	(0.174)	(0.192)
Central [t-5]	0.075	0.072	0.147	0.024
	(0.310)	(0.368)	(0.195)	(0.194)
Central [t-6]	-0.138	-0.162	0.154	0.057
	(0.330)	(0.424)	(0.180)	(0.185)

Note: Two-stage least squares estimates of unrestricted model given by equation (1). [t-j] denotes current time t less j time periods. Standard deviations in parentheses.

The results from these F-tests are reported in Table 3, and all hypothesis tests were evaluated at a 1% level of significance.

Table 3. Hypothesis tests for the integration of United States, Thailand (Thai), and Philippine (Phil) canned tuna markets.

	Null hypothesis	Central market/Local market US/Thai	US/Phil[1]	Thai/Phil[1]	Phil/Thai
1.	No local market characteristics (time trend, seasonality)	.537* (4,24)	3.193 (4,24)	6.719 (4,24)	.765* (4,24)
2.	Long-run integration	8.203 (1,28)	1.480* (1,24)	.389* (1,24)	5.322 (1,28)
3.	Short-run integration	37.860 (12,28)	1.824* (12,25)	4.692 (12,25)	17.848 (13,28)
4.	Short-run integration (weak form)	24.255 (2,28)		5.523 (2,25)	5.407 (2,28)
5.	Market segmentation	1.121* (7,28)			1.492* (7,28)

Notes: The unrestricted model is equation (1) for J=6 estimated using two stages least squares. The table gives F-tests of the linear restrictions on the model implied by each null hypothesis. Distributions of F-test statistics given in parentheses of form (numerator degrees of freedom, denominator degrees of freedom).

[1]Short-run integration tests conditional upon maintained hypothesis of long-run integration as given in equation (9).

*Indicates non-rejection of null hypothesis at 1% level of significance.

The null hypothesis of long-run market integration between the US central market and the Thailand local market, following equation (8), was rejected. Tests for the short-run market integration between the US central market and the Thai local market were then performed with both the strong, equations (3) and (4), and weak, equation (5), forms of short-run market integration being rejected. Based on these findings we tested the alternative null hypothesis that the local Thai market was segmented from the US central market, equation (2), and it was decisively not rejected. The overall

results, reported in Table 3, indicate that market segmentation by prices is the most likely relationship between the Thai local and US central canned tuna markets.

The null hypothesis of long-run market integration by prices between the US central market and the Philippine local market was not rejected. Therefore, in order to obtain more efficient estimates of the parameters and more powerful statistical tests for the short-run market integration hypotheses tests for the Philippines, the model was respecified with long-run integration imposed as in equation (9). All tests were then conducted against this restricted form, and it was found that the null hypothesis of strong short-run market integration between the US central market and the Philippines local market could not be rejected. (Regression results are available from the authors upon request.)

To summarize the empirical results to this point, the US central and Thailand local wholesale, canned tuna markets were likely to have been price segmented over the period 1983-1986. Under these conditions, changes in US market prices will have no effect, immediate or lagged, on the Thailand local market. Instead, the Thai market price depends only upon its own lagged values: Thai canned tuna markets operated independently of the US market. Should the issue of tariff relief from canned tuna imports resurface, then the general lack of Thai responsiveness to US price changes and other market information could be a major consideration in policy formation.

During the 1983-1986 period, the US central and Philippine local wholesale, canned tuna markets were well integrated by prices in the sense of a long-run tendency in the short-run adjustment process. Continuation of these circumstances indicates that changes in Philippine prices can be attributed to changes in US prices and past spatial price differentials between the US and Philippine markets. Supply and demand conditions in the US central market will be communicated effectively to the Philippine local market and influence prices there irrespective of previous local conditions.

Southeast Asian Market Integration

Because the US did not emerge as the overall price leader with respect to canned tuna price formation in Thailand and the Philippines, we extended our investigation to examine price formation solely within these two Southeast Asian markets.

The unrestricted model, equation (1), was first estimated with the Philippine market as the local market and the Thai market as the central market for six lagged periods (J = 6). The regression results are shown in Table 2. Local market characteristics were found to significantly influence price formation in the Philippine market. The null hypothesis of long-run integration between the Thai central market and the Philippine local market was not rejected and the model was reestimated, equation (9), with long-run integration imposed to further test for short-run market integration. (Regression results are available from the authors upon request.) The null hypotheses of strong and weak short-run market integration between the Thai central market and the Philippine local market were each rejected. The results from these hypotheses tests are shown in Table 3.

Secondly, the Thai market was specified as the local market and the Philippines as the central market. The unrestricted, six-period lag (J = 6) model, equation (1), was first estimated. The regression results are reported in Table 2. Based on an F-test, local market characteristics did not make a statistically significant contribution to this model's overall explanatory power, and a revised version, without these variables, was estimated for the hypotheses tests on the form of market integration.

After the null hypothesis for long-run market integration between the Philippine central market and the Thai local market was rejected, tests for short-run market integration were conducted. Null hypotheses for both the strong and weak forms of short-run market integration were rejected. Given these findings, we tested the alternative null hypothesis of market segmentation for Thailand (as the local market) which indicated conclusively that Thai prices, during the period of interest, were formed independently of Philippine prices. Table 3 presents the results of these hypotheses tests.

In summary, Philippine canned tuna prices did not appear to exert any influence, immediate or lagged, on the current price in the Thai market during the 1983-1986 period. As in the case where the US was hypothesized to be the central market, the price in the Thai market depends only upon its own lagged values. On the other hand, the current price in the Philippine market did depend on current and past prices in the Thai market based on our finding of long-run market integration when the Philippines was specified as the local market and Thailand was the central market.

Conclusions

In this study, we examined the US, Thailand and Philippine canned tuna markets for several forms of long-run and short-run integration by prices.

We found that the Thai canned tuna market operated independently of the price conditions in the US and Philippine markets, i.e., market segmentation occurred. Thus, changes in the US and Philippine market prices during the 1983-1986 period had no effect, immediate or lagged, on the Thai market. The Thai market price instead depended only upon its own lagged values.

The Philippine market during this period was responsive to supply and demand conditions in both the US and Thai markets. The Philippines and US markets were well integrated in the sense that a change in the US price was quickly and effectively communicated to the Philippine market within one month, and exerted significant influence on the Philippine market prices.

The Philippine and Thai markets were integrated by market prices in the long run, but not in the short run. Although the latest price change in the Thai market was not immediately and fully passed on to the Philippine market, Thai prices over the previous six months did have a significant effect on the current price in the Philippine market. To the extent that Philippine prices respond to Thai prices, but not vice versa, this establishes Thailand as a price leader.

Our findings concerning Thai market integration on the basis of price, in conjunction with the relative volumes of US imports of canned tuna from Thailand - market integration on the basis of commodity flows - during the period 1983-1986, are not uniquely associated with a particular type of market organization, or industry structure.[2]

The empirical results can be interpreted in several different ways. First, the results are consistent with the situation within the Thai tuna processing industry recently described by Crough (1987) where excess canning capacity exists in a number of competing firms utilizing some of the most advanced canning technology available.

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[2]The analysis covers a period of rapid expansion of tuna markets in the Southeast Asian region, 1983 through 1986. Therefore, the results may not be indicative of the long-term industry organization that may evolve within the region, and hence, long-term relationships with export markets such as the US.

Such circumstances would provide an opportunity, and an incentive, for firms to expand production since increased output would be realized at constant or even decreasing unit costs. Thus, it would not be unexpected to observe increased exports of Thai canned tuna while prices remain relatively unresponsive to changing supply and demand conditions in the US market.

Results from our analysis of price formation in the Thai canned tuna market are also in keeping with a monopsonistic or an oligopsonistic intermediate market for Thai canned tuna destined for the US wholesale market. With either a single US importer/purchaser of the Thai product, or with collusion among only a few significant purchasers, we would expect greater disparity between the price paid to Thai processors - the import price which we observe - and wholesale price observed for the comparable US product. By virtue of their concentrated purchasing power, importers are in a position to establish an import price that is relatively insensitive to changing supply and demand conditions in the US wholesale canned tuna market.

Finally, our results could be taken as evidence of a trade policy on the part of Thailand aimed at securing a dominant share of the private label/institutional market for canned tuna in the United States. Such a policy would not only erect barriers for potential entrants into the US market, but as in the case of the Philippines, creates a price leadership situation in which existing competitors must constantly respond to Thai prices in order to maintain a share of the market.

Further research is required to determine the appropriateness of the Southeast Asian-US canned tuna market scenarios presented above, and possibly other alternatives. Nonetheless, any interest of the United States in guiding the flow of canned tuna imports might best be dealt with through import quotas rather than increased tariffs. The former would directly limit the volume of imports, while the latter might not. The impact of an increased tariff is less certain, since Thai exports have not been responsive to changes in US supply and demand conditions. If Thailand is willing to accept lower prices in order to maintain or increase canned tuna exports in response to an increased tariff, the benefits from an increased tariff in the form of increased public revenues may be more than offset by the costs to the US tuna industry from further erosion of its market share.

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