Staff Paper

Farm-Retail Price Spreads in a Changing Economy

William G. Tomek

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The USDA started publishing farm-retail price spreads, i.e., gross marketing margins, in 1935 (Ogren), and these statistics have been controversial over much of their 60 year history. The controversies relate both to how spreads are measured and to how the resulting numbers are interpreted. In this paper, I first review selected issues in computing margins and then turn to the issue of interpretation. Finally, I draw some conclusions about the value and use of price spread estimates and about possible changes in estimating them.

The purpose of constructing price spreads and the associated market basket statistics is to "to measure variations over time both in the charges for marketing services and in the farm value share of consumer dollars spent on these foods" (Harp, p. 8). Price spreads, properly estimated, provide a useful descriptive measure of the performance of markets. This does not, however, eliminate the need for periodic review of definitions of the foods to be included in the spread estimates and of how the spreads should be measured. There are, no doubt, trade-offs between the benefit of measuring the desired margins and the costs of measurement.

Also, the leap from description to prediction and prescription is a large one. It is possible to describe trends in gross margins, but far more difficult to provide definitive explanations of these trends. Hence, it is difficult to prescribe how to reduce margins. As illustrated in an appendix to this paper, an increase in the supply of a farm commodity that lowers farm and retail prices can result in a larger margin even though the market is competitive and efficient. Economic principles do not require that farm and retail prices move together in an exact one-to-one fashion. An upward trend in a margin could indicate growing monopoly power or other market inefficiencies, but it need not. I return to these points in the concluding section.

Measuring Price Spreads

Price spreads are computed for selected foods produced from farm commodities of domestic origin. As just noted, one objective is to estimate the farm-value share of the retail price. The foods used in the margin computations tend to be "basic" or "common" products, where the computations can rely on readily available prices. The margins for individual foods are also aggregated into a market basket, and an index of farm-retail price spreads is published for the aggregate market basket. For example, using 1982-84 = 1.0 as a base, the following estimated indexes for the market basket in 1995 were obtained: retail cost, 1.514, farm value, 1.056, and the farm-retail spread, 1.761. The nominal spread for the market basket increased 76% over the 12 year period.

The basic computation for an individual food is $P_t - gF_t = M_t$ where P = retail price, F = farm price, g = conversion factor to obtain the farm value for a farm quantity equivalent to the quantity sold at retail, M = margin, and the subscript t indicates that the margin pertains to the particular "tth" time period (a month, quarter, or year). For a composite commodity like beef, the retail price, P, is a weighted average of the retail prices of component cuts of beef.

The potential exists for controversy or misinterpretation for all parts of the computation. The retail-level prices are obtained from the Bureau of Labor Statistics (BLS), who sample retail food prices in order to estimate the Consumer Price Index (CPI). The prices are obtained via valid sampling procedures, though of course are subject to sampling error. If prices are collected during a special sale period, these lower prices are reflected in the sample. If the sample is taken when "regular" prices prevail, these are the prices reported. Since a variety of stores across the country are sampled, the resulting prices reflect what is happening in the nation.

The marketing margin for choice beef, by definition, uses retail prices for the choice grade, and therefore the margin does not pertain to all sales of fresh beef. To be consistent in constructing a margin for choice beef, the weights used to obtain the average retail price are proportions based on the processing of a choice beef carcass. These weights are not the same as the proportions of individual beef cuts to total beef sales, because foodstores sell some fresh beef derived from other grades. The weights are also fixed (although revised occasionally), which implies that retailers have no flexibility in varying the use of the beef carcass. So, the average retail price used to estimate the marketing margin for choice beef is not the same as the average price of all beef sales in grocery stores. Moreover, it does not represent the price of beef sales in other outlets, such as cafes, or in other forms, such as canned beef stew. (The discussion of the price spread for beef is based on White, et al. and Duewer, 1996.)

As an aside, it is useful to recall that other spreads in the market basket are also defined in a similar, precise fashion. The margin for apples is for fresh fruit, and not for apple sauce or apple juice (though a separate margin is estimated for juice). Price spreads are estimated for white bread, sandwich cookies, and soda crackers, but not for other breads, pastas, cakes, and cookies. In each instance, the spread is computed for a specific commodity and does not pertain to all uses of wheat. The specific definition of margins must be kept in mind in evaluating and interpreting them.

Continuing with the beef example, the farm price (F) for a month is a simple average of weekly prices of live choice steers, specifically Live 65-80% Choice Steers. The weekly prices are, in turn, a weighted average of prices of direct marketings to packers in five regions: Texas-Oklahoma, Kansas, Colorado, Nebraska, and Iowa-Southern Minnesota. The weights are based on confirmed sales by region. These price series are collected and reported by AMS. Thus, the farm price can be considered "representative" rather than an average price based on a probability sample of all transactions.

The average farm price is multiplied by 2.4, based on the assumption that it takes 2.4 pounds of live animal to produce one pound of retail meat. Put another way, a 1,150 pound steer is assumed to be transformed into a 724 pound carcass, which with removal of some bone, fat, and moisture, results in 478.4 pounds of salable meat at retail. This is the "fixed proportions" assumption used in estimating the marketing margin in U.S. data. These constants are revised occasionally. (Similar conversions are made in computing retail consumption, because consumption data are based on a balance sheet of production, imports, exports, and inventory changes, all converted to a retail-weight equivalent.)

The computation of the choice-beef margin is completed by subtracting the estimated value of the hide and other byproducts. This is not shown in the equation above, and is not discussed in this paper.

The retail prices are sometimes criticized as not representing the actual sales prices because they may miss the low price (large volume) sale periods. As noted above, however, the data collection process should provide a sample of price specials (sales), but whether these sales receive proper weight is a matter of debate. A second criticism is that the retail prices do not represent all beef sales, but this misses the point that the intent is to measure margins for a specifically defined form of the commodity, i.e., not to measure a margin for "all" beef. Indeed, the intent is to avoid the problem of measuring changes in margins that are caused by changes in the form of the commodity, such as added processing or increased purchases of beef for away-from-home use.

There is uncertainty about the adequacy of the farm price as a representation of the prices received by producers for the sale of choice beef animals. The prices are on a live-weight basis from selected regions as obtained by market reporters. Over the past 60 years, the trend toward decentralization of marketing and pricing has made sampling commodity prices more difficult (Tomek). Also, since the farm price is a monthly average of weekly prices and the retail price is based on a once-a-month sample (but collected over varying days of the month), there is uncertainty about the degree which the prices can be treated as contemporaneous.

Finally, the adjustment factors, such as $g = 2.4$ for beef and 1.7 for pork, and the weights used to compute the composite average price may become dated. In any case, the constant proportions assumption may not be appropriate; at least, one can debate whether the assumption is reasonable or not (Wohlgenant and Haidacher). Economists often argue that changes in relative prices affect "g." Higher prices perhaps cause processors to be more economical in their use of the raw commodity (see appendix).

Basically, the issue of the quality of the price spread data boils down to the issue of level of resources to put into data collection. ERS must rely on others, especially BLS and AMS, for the raw data. If quality of price collection is to be improved, then ERS, BLS and/or AMS must have additional resources.

Interpretation of Spreads

If the spreads are accurately measured, they provide estimates of the aggregate costs, including profits, of all processing and marketing activities between the farm gate and the retail grocery store sale. That is, the spreads are estimates of a total margin for specific individual foods, and since the definition of each food item is held (approximately) constant through time, the changes in the spread should be related to the costs of processing and marketing the particular foods (for a discussion of margins and other performance measures, see Marion and Handy).

For example, the price spread for choice beef rose from 96.4 cents per pound in 1982-4 (the base period for indexes) to 146 cents per pound in 1995. This change reflects changes in wages, energy prices, profits, etc.; it also reflects any cost-reducing changes in technology that affect this particular good. When the 1995 margin for beef is divided by the Consumer Price Index for 1995, the "real margin" is 95.8 cents per pound. Thus, relative to retail prices, the marketing margin for beef declined slightly from 1982-4 to 1995.

As noted earlier, the index of price spreads for the aggregate market basket was 1.761 in 1995 (1982-4 = 1.0). When deflated, this index was 1.156 in 1995. Thus, the aggregate spread is estimated to have increased 15.6% in real terms. The marketing costs for a fixed market basket of foods has increased relative to the overall CPI. Without additional information, we do not know why the increase occurred. Hence, we cannot make judgments about whether these costs reflect excess profits or increased costs due to increased monopoly power or other imperfections in food markets, or whether they reflect changes in relative prices consistent with a well-functioning markets. That is, these data alone do not tell the observer whether or not marketing costs are "too large." Moreover, this statistic says nothing about total marketing costs for all foods.

The marketing chain from farmer to consumer is complex. Farm commodities are stored, transported, processed into many different products, packaged, subjected to various brokerage and wholesaling activities, and finally arrive at retail grocery stores (as well as other outlets). Costs are dependent on the prices of numerous inputs and are affected by changes in technology. The prices of inputs, like labor, materials, and energy, are themselves determined in a variety of markets; e.g., labor markets vary by region and level. There also is evidence that the degree of riskiness of input prices affects margins. Not surprisingly, explaining changes in marketing costs and profits is not easy. This, in turn, implies that alternative models of price spreads may provide equally plausible (but different) explanations of the historical record. Hence, scope for controversy exists.

We also should remember that price spreads are not intended to measure the welfare of farmers, the substitution of convenience foods for less process foods, or the addition of services to a food. As the economy grows and changes, consumers have more choices. As a consequence, the "basic" items included in the price spread data cover a decreasing part of the food sector. Over the years, some observers have interpreted the fact that farmers are receiving a smaller share of the consumer's food dollar as implying a decline in the economic welfare of farmers. But, the declining share, taken in isolation, says nothing about the well-being of farmers. A wheat grower consistently obtains a relatively small percent of the dollars spent on bread, and apple growers obtain a larger share than wheat producers of the consumers dollar. But this doesn't mean that Kansas wheat farmers are worse-off than New York State apple growers.

Economic theory does suggest that, other things being equal, increased marketing costs mean higher prices at retail and lower prices for farmers. One of the reasons that the Congress has funded research about processing and marketing foods has been to lower marketing costs (or at least reduce the rate of increase). It is perhaps fair to say, however, that much of this research has been about developing new products and new marketing services. This gives consumers more choices, but also

typically adds to the total marketing bill. Estimated marketing margins simply do not deal with total marketing costs; they are about measuring the costs of a fixed set of goods.

Another issue in interpretation relates to the short-run transmission of changes in commodity (and other input) prices to retail prices. If the monthly farm, wholesale, and retail prices are collected contemporaneously, then statistical analyses can be used to estimate the time lags in the price transmission process. As noted earlier, there is some uncertainty about whether prices at various market levels are collected at the same time, and it is possible that some of the estimated lags in price transmission are related to the timing of the data collection. The magnitude of this problem is difficult to judge. Certainly, to the degree that the monthly observations can be treated as contemporaneous, it is useful to evaluate the lags in price transmission. Lengthy lags and asymmetric responses to price increases and decreases may be signs of market imperfections, especially for fresh produce and meats.

Improving Price Spread Estimates

Marketing margins are intended to measure the spread between farm, wholesale, and retail prices for a precisely defined set of goods. In my judgment, the ERS USDA has done a good job of providing these estimates, given the constraints on resources to estimate the margins. Those of us using the resulting estimates must understand the limitations of the data. They should be interpreted as general economic indicators, i.e., as measures of total margins.

It is useful, however, to revisit two questions. What foods should be included in the market basket? What data and methods should be used to estimate the price spreads?[2] This short paper can't provide definitive answers for these questions, but I do amplify on the trade-offs.

This conference is about prices and price spreads for meats, but I think that it is important to encourage review of the items included in the price spread statistics. A general objective is to measure spreads for a consistent, fixed market basket of goods, but at the same time, these goods must have relevance to the modern economy. There should be a procedure to review the items to be included in the market basket on a regular basis, but spreads for meats will remain an important a component of the market basket. The margin for beef is currently computed using data for choice beef. Broadening the definition to estimate the margin for all fresh beef sales in foodstores would provide a more comprehensive measure. An all-fresh-beef retail price series is estimated by ERS (Duewer 1993), but is not used in the spread computations. An all-fresh-beef spread would require that comparable data be obtained at the wholesale and farm levels, including appropriate conversion factors from farm to retail weight.

In making changes, one must ask, is the benefit worth the added cost? A broader definition of beef would give a measure more closely related to consumer purchases of fresh beef in foodstores. My conjecture is that the two beef spreads would have similar long-run trends, because they would be influenced by similar costs. The prices of different grades of beef, however, are not perfectly

correlated, and consequently short-run fluctuations in spreads for different grades would probably differ. For example, the all-beef price dropped more rapidly and by a larger amount in the March-May 1996 period than did the choice-beef price. Thus, a price spread based on a broader definition of beef can have different short-run dynamics than one based on one grade of beef. We might find, for example, that beef prices in general adjust more rapidly than do prices of choice beef.[3] Ultimately, it is a matter of judgment whether such an insight, if true, is a sufficient benefit to justify the added costs of computing the broader measure.

An issue for any composite price series is the weights used to form the composite good's price. The choice-beef price series uses weights based on the average fabrication of a choice steer into retail cuts. An effort has been made to make these weights up-to-date (White, et al.). Nonetheless, it is likely that the actual fabrication varies through time and is influenced by relative prices. It obviously would be costly to obtain quantity weights that varied every month or even every year.

Another issue, which goes beyond the computations for individual meats, relates to the aggregation of the individual price spreads into indexes, including an index of farm-retail price spreads for a market basket of foods. Improvements in indexes must address not only what foods should be included, but how they should be weighted. These questions are similar to those faced by BLS in estimating the CPI.[4] The CPI probably over-states the rate of inflation, partly because of the fixed weights used to aggregate the individual prices (Calmes and Wessel). The index of the aggregate market basket of price spreads may also over-estimate the rate of increase in the farm-retail price spread for the aggregate market basket. This occurs to the extent that an increase in price spreads results in the substitution of lower priced items for the higher priced item. At a minimum, this emphasizes evaluating the index of price spreads relative to an index of the general price level.

There are benefits from improved data series. If the CPI is over-stating the inflation rate, this indirectly contributes to the federal budget deficit because of the "over-indexing" of welfare benefits, social security benefits, and government pensions. We have to entertain the possibility that some of the growth in the price spreads relates to measurement problems like fixed weights, and not to increases in marketing costs. If so, the aggregate price spreads under-estimate the efficiency of the food marketing system. While the costs of erroneous measures of spreads is less than the costs of erroneous measures of inflation, it still is desirable to have good measures of economic performance.

In considering margin revisions, the controversy among economists about the fixed proportions assumption (fixed "g") is separable from the issues about the prices collected. If reasonable measures of prices are available, they reflect actual market processes, and these prices can be used to **describe** what has happened. It is not necessary to multiple the farm price by a constant "g" in order to do descriptive analyses, although as noted above, we do need to be concerned about the weights used to obtain the average price of a good.

The controversy about fixed proportions has to do with **explaining** price changes: does a model that assumes a fixed rate of transformation of the farm commodity to the retail good, or a

model that assumes that this transformation varies with relative prices, best describe the observed price behavior? The answer to this question is an issue in estimating whether or not margins include "excess" profits related to monopoly over-charges. Thus, the controversy is about the appropriate way to model the observed prices; it is not about the prices themselves.

<u>Summary</u>

It is important to have good measures of the performance of the economy, but with the emphasis on lowering government expenditures, the Congress has tended to under-invest in economic data. Thus, while the economy grows more complex, we have poorer measures of what is happening. It is desirable to have broader, higher quality estimates of price spreads, but such measures require additional resources. This, in turn, requires additional funding from the Congress or a decision that other activities will be given up so that resources can be transferred to estimating price spreads. Consequently, while it is possible to identify ways to improve the estimates of price spreads, these improvements require better data, and it is not clear whether the benefits of the improved series justify the added costs.

It also should be noted in closing that the question of better data is largely separable from the issue of analyzing the data. As an academic economist, I support research to help explain why margins are changing. Considerable research has been done on trying to understand marketing margins (e.g., see Schwartz and Willett), but I am not confident that we have a good understanding of margin behavior. This understanding probably requires even more data and deeper insights into how markets work, and the possibility of obtaining the data and other resources necessary to do high quality analyses seems slim.

Appendix

This appendix formalizes the discussion of marketing margins when the farm commodity is used in fixed proportion to a unit of the final retail product. The processing and marketing functions are assumed to be performed by "n" identical firms, each maximizing profit.

$$\pi = PQ - FS - RX - TFC,$$

where P = retail price,
Q = quantity sold at retail,
F = farm-level price,
S = quantity of farm commodity (used to produce Q),
R = price of marketing input,
X = quantity of marketing input, and
TFC = total fixed cost.

Q is assumed to be produced in a fixed proportion of S, so that $Q = \gamma S$. For simplicity, let $\gamma = 1$, then Q = S, and the profit equation can be rewritten as

$$\pi = (P - F)\, Q - RX - TFC.$$

In this context, the margin between farm and retail prices depends on the assumption made about the nature of the short-run variable costs related to X, the "generic" marketing input. If these costs are assumed to be a linear function of Q, then RX = aQ. Substituting, the profit function becomes

$$\pi = (P - F)Q - aQ - TFC.$$

The first-order condition for profit maximization is:

$$\frac{\partial \pi}{\partial Q} = P - F - a = 0, \quad \text{or}$$

$$P - F = a.$$

This specification implies that the marketing margin is a constant, a, which is independent of the quantity of Q (=S) produced and sold.

If, instead, the variable costs related to the input X are a quadratic function of Q, then

$$RX = aQ + bQ^2.$$

The profit function now is

$$\pi = (P - F)Q - aQ - bQ^2 - TFC,$$

and the short-run profit maximization condition is

$$\frac{\partial \pi}{\partial Q} = P - F - a - 2bQ = 0, \text{ or}$$
$$P - F = a + 2bQ.$$

Technically this condition is for a single representative firm. Given "n" identical firms, total output is $Q^T = nQ$. Thus, an (inverse) supply equation for Q^T can be written as

$$P - F = a + 2b (Q^T/n), \text{ or}$$

$$P - F = a + c Q^T, \text{ where } c = 2b/n.$$

To complete a model, the aggregate retail-level demand equation is specified as

$$P = \alpha + \beta Q^T, \text{ where } \beta < 0.$$

The farm-level (derived) demand equation is obtained by subtracting the supply equation from the retail demand equation:

$$F = (\alpha - a) + (\beta - c)Q,^T \quad \beta < 0.$$

The margin in this model varies with $Q,^T$ which is shown in Figure 1. This illustrates that it is possible in an efficient, competitive market for the margin to widen as the supply of the farm commodity increases. The key issue is the nature of the cost function for the aggregate marketing input. In practice, this is an unknown.

In the USDA statistics, the constant proportion assumption is used, but of course $\gamma \neq 1$. This merely modifies the profit function.

$$\pi = PQ - F\frac{(Q)}{\gamma} - RX - TFC$$

$$= (P - \frac{1}{\gamma} F)Q - RX - TFC.$$

So the empirical margin is typically computed as

$$M = P - \frac{1}{\gamma} F = P - gF.$$

For choice beef, $M = P - 2.4F - r$, where r is a byproduct allowance. Assuming P, F, r, and γ are correct, then one can ask, what causes M to change? The answer depends on a correct specification of the cost function for marketing services (given the fixed proportions assumption).

In principle, food manufacturers may have some flexibility in substituting between the commodity input, S, and the marketing input, X, as relative prices change. If so, the fixed proportions assumption, used in the foregoing model, is not applicable. For example, if S decreased and its price, F, increased, an incentive to substitute X for S is created. This means, other things remaining the same, that the increase in F would be less than in the fixed proportions case. Consequently, margin behavior is influenced by whether or not the fixed proportion assumption is correct.

It should be noted, however, that empirical analyses are of prices generated by the market. The price collection process is not effected by the assumptions of alternative conceptual models. Rather, the issue is, what conceptual model best represents the true, but unknown, data generating process?
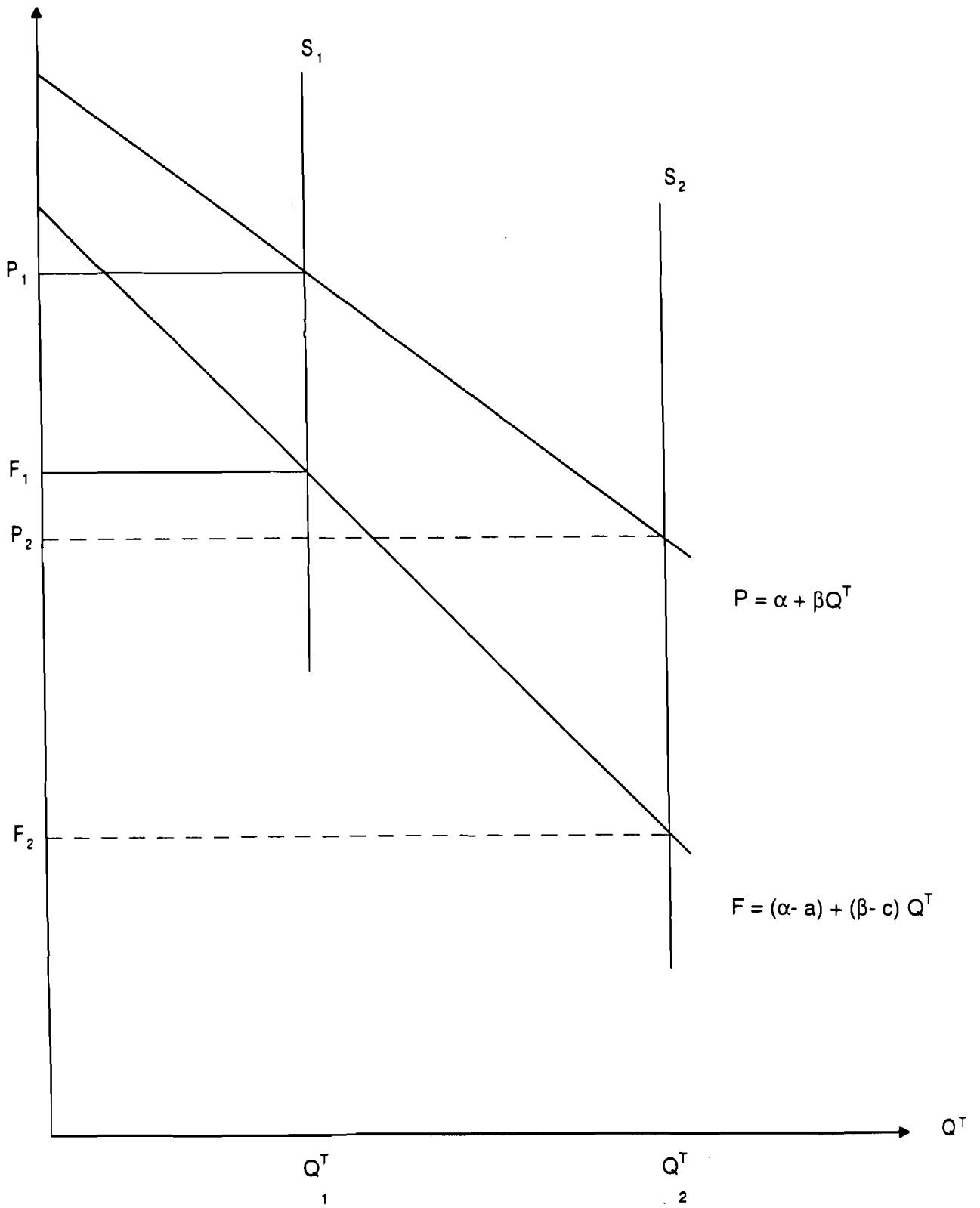
Figure 1.

End Notes

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[2] This question should include the issue of the extent to which the prices are observed contemporaneously. Since it is common for these data to be used to estimate possible lags in adjustment, it is important that each price series be observed at the same points in time.

[3] For the 12 months October 1995 through September 1996, the standard deviation of the choice price series was 3.56 cents per pound while the comparable number for the all beef price series was 4.55 cents per pound; the correlation coefficient was 0.62. Using annual observations for the six years 1990-95, the two price series have standard deviations that are more nearly alike, 4.45 cents for choice and 4.74 cents for all beef; the correlation coefficient was 0.79. An inspection of the data indicates, however, that 1995 is an outlier and that the two price series were very highly correlated through 1994 (r = .94); I do not know whether the 1995 observation reflects reality or is an artifact of the data collection and estimation process. In any case, these data do roughly support the hypothesis that the prices are more closely related on an annual basis than on a monthly basis.

[4] The analogy should not be carried too far. The CPI is intended to estimate an index of retail prices for a broad range of goods and services. The prices are for a fixed market basket, but items are added and dropped with the passage of time. A major problem in the CPI is that the quality of goods can change, e.g., the increased capabilities of personal computers. If quality improves while price remains the same, in effect price has decreased, but this may not be captured in the estimation process. In contrast, the price spread indexes cover a very limited set of food items, and although the quality of these items may change a little, it is feasible to use relatively stable definitions of the individual foods which are contained in the index.

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