EXPECTATIONS, FUTURES PRICES, AND FEEDLOT OPERATOR BEHAVIOR

by

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Introduction

This paper attempts to explain placement and marketing decisions in cattle feeding, with decisions modeled using future prices as measures of price expectations. The main idea is to avoid the problem of ambiguity in the effects of cash prices on the marketing of fed cattle. The observed correlation between a rise in cash price and current marketings could be either positive or negative. The reason is that when the cash price rises, returns from current sales encourage increased marketings; yet if the price is expected to remain high it may pay to feed cattle longer, holding them back from current marketing. By considering cash and futures prices simultaneously we hope to separate these two effects.

Previous Research[1]

Hayenga and Hacklander (1970), Tryflos (1974), Nelson and Spreen (1978), and Ospina and Shumway (1979) made notable attempts to disentangle the effects of current and expected cattle prices on marketings. Hayenga and Hacklander estimated supply and demand functions for cattle and hogs using the change in cattle prices as a proxy for price expectations along with feed prices as regressors in their model estimates. A positive price change coefficient was estimated for the beef cattle regression. These results would lead one to conclude that when the change in the beef price is positive, e.g., when the June live beef spot price is higher than the May live beef spot price, cattle producers will increase marketings in June. When the change is negative, marketings decrease.

Tryflos stated that prior to 1974 it was felt that livestock supply was a function of past cattle prices and feed costs, rather than current prices.

He believed however, that

> ...a case can be made that current inventory should appear as an explanatory variable in short-run functions... Alternatively, current prices and costs may replace current inventory in the supply functions; the expected sign of current price is negative and of current feed positive" (Tryflos, p. 114).

He notes that if we assume current prices are signals of expected prices, then an increase in the current price would bring about a decrease in cattle supplied. This is an explanation for the negative supply elasticities found in studies such as Myers, Havlicek, and Henderson (1970) and Brester and Marsh (1983).

Nelson and Spreen developed a model of marketed cattle supply in which the capital asset value and current market value of fed cattle are compared to determine the marketing decision. The capital value of fed cattle was the expected price multiplied by the expected selling weight less the expected cost of feeding the cattle longer. The market value was simply the actual price multiplied by the actual cattle weight. The model itself was not estimated due to the lack of a suitable measure of price expectations. Instead they focused on the price formation mechanism. They developed a proxy for the expected price that was based on a function of the current month's price and the price movements for the previous three months. One of their conclusions was that there was "strong evidence for the existence of accelerated or delayed marketing in response to the pattern of recent prices," (Nelson and Spreen, p. 124).

Futures prices were used as a measure of expectations by Hurt and Garcia (1982) in their model of sow farrowings, with results indicating promise for this approach in livestock-sector modeling. Ospina and Shumway (1979) considered the use of futures prices to measure expectations but did not do so because the futures markets did not provide a time series of price data long enough and because futures prices were not quoted far enough into the future to be useful for their breeding herd inventory equation (Ospina and Shumway, p. 50). The former problem is lessened for our purposes because another decade of futures price data is available. The latter problem is avoided in the present context by looking at short-run decisions in monthly data, and not estimating a breeding herd equation. Instead we concentrate on the placement and marketing of fed cattle.

Two potential problems limit the prospects for the use of futures prices as price expectations. The first is the issue of whether futures prices are in fact unbiased estimates of subsequent cash prices. A substantial literature in grains led to the conclusion of Tomek and Gray (1970) that there was no bias. In livestock, Helmuth (1981) and Koppenhaver (1984) found a downward bias but Palme and Graham (1981) did not. Kolb and Gay (1983) provide the most systematic evidence available to date, finding no systematic downward bias. Overall the evidence appears inconclusive. Even if there is bias, changes over time in futures price will measure the change in expected price if the bias is constant. Variability in bias is equivalent to variability in the basis between the price of a cash contract and the futures contract at time of delivery. It creates an errors-in-variables problem that could bias the estimated price coefficient downward. Empirical work by Gardner (1976) on crops and Hurt and Garcia (1982) on hogs suggests that futures prices appear to yield slightly better fits and larger coefficients than lagged-price specifications in supply relationships, suggesting that the potential problems may not be damaging in practice.

The Placement Decision

With these considerations in mind, our placement behavioral function is

$$(1) \qquad q_t = f(P^*_{t+6,t}, C_t, D, \bar{Q}, q^m_t)$$

where q_t is placements in month t. These cattle, net of normal mortality losses, are expected to be marketed in month t + 6. $P^*_{t+6,t}$ is the expected selling prices at time t of fed steers at the expected date of sale. C_t is a vector of input prices, D is a vector of monthly dummy variables, $\bar{Q}$ is a feedlot capacity constraint, and q^m_t is fed cattle marketings. $\bar{Q}$ is in essence a stock concept. q^m_t on the other hand measures the flow of cattle out of feedlots. Capacity is unobservable but, assuming it is fixed in the short run, we can obtain a proxy for short-term availability of feed lot space, A_t, by the use of the month's beginning inventory of cattle on feed, I_t. This observed inventory is assumed always to be less than or equal to true capacity $I_t \leq \bar{Q}$. Then $A_t = \bar{Q} - I_t$ is always positive. Solving for I_t, we have $I_t = \bar{Q} - A_t$. Since $\bar{Q}$ is constant, I_t is proportional to (the negative of) availability, i.e., the larger is I_t the closer we are to capacity, and other things equal, the less placements will be. $\bar{Q}$ and q^m are hoped to account for some of the dynamics of cattle placements.

This paper does not attempt to derive equation (1) or the marketings equation to follow in the context of a complete behavioral model of the livestock sector, but we follow the general specifications of Ospina and Shumway (1979), Brester and Marsh (1983), and Nelson and Spreen (1978). The input prices are reduced to three which serve as proxies for broader input categories: the spot and the nearby futures contract price of corn to represent feed costs, the price of feeder calves at the time the placement decision is made, and a short-term interest rate to measure the cost of funds tied up during the six-month feeding period.

The Marketing Decision

From January 1973 through October 1987 the average weight of cattle slaughtered in the U.S. (48 states) ranged between 972 and 1121 pounds, with a mean value of 1058 pounds. With the simplifying assumptions that 1) slaughter weight is 4% less than the initial marketing weight due to shrinkage that cattle experience during shipping, 2) their placement weight is usually about 550 lbs., and 3) they average a 2.8 pound per day weight gain, it can be inferred that the average feedlot operator markets cattle about six months after the placement date. However, feedlot operators can readily market or hold cattle three to four weeks before or after the expected six month time horizon, which suggests that feedlot operators adjust marketings as new information (such as deviations from initially expected fed cattle prices) becomes available to them. Once the fed cattle have reached the minimum weight associated with fed cattle classification (i.e. greater than 900-950 pounds) feedlot operators begin making marketing decisions. They can decide to market the cattle now (i.e. in time t) or feed the cattle more and market them at a higher weight in time t+i, where i is the number of days beyond t. The decision to sell the cattle is the marketing decision, and the behavior of aggregate sales constitutes the supply function of marketed cattle.

As discussed earlier, the key analytical problem encountered when assessing price effects on marketings is that producers are reacting to both the actual price, and the near term expected price when making marketing decisions. If the sale price of cattle marketed today exceeds their discounted present value when held for another month (the smallest decision interval in the monthly data available), then the cattle will be sold. Otherwise they are held. The conditions for current sale of a steer can be expressed as:

(2) $$P^*_{t+1} \; W^*_{t+1} - C_t \, X_t \leq P_t \, W_t$$

where P^*_{t+1} is next month's expected price, W^*_{t+1} is next month's expected weight, $C_t \, X_t$ is the cost of inputs for one month's feeding, and P_t and W_t are current price and weight. If the inequality is reversed the steer is held off the market another month.

Inequality (2) can be re-written as

(3) $$P^*_{t+1} \, W^*_{t+1} - P_t \, W_t \leq C_t \, X_t,$$

which is analogous to the condition for selling inventories of a stored commodity such as grain, with the important difference that for grain $W^*_{t+1} \leq W_t$. For steers we expect $W^*_{t+1} > W_t$ -- the cattle keep growing. This has the important implication that the marketing decision does not depend only on the expected price change, and indeed if cattle are gaining fast enough it pays to keep them on feed even if $P^*_{t+1} < P_t$.

At the aggregate market level a given level of P^*_{t+1} relative to P_t is consistent with some producers selling fed cattle and others holding at a given t because: (i) different lots of cattle are at different weights, and the rate of gain, dw/dt, slows at heavier weights; thus inequality (3) can hold for some lots and not others even when P^*_{t+1} and P_t are the same for all. (ii) Feedlots vary in capacity constraints and prior commitments, for example to bring in a new lot of feeder calves, so that despite a rise in P^*_{t+1} relative to P_t some producers sell to make room for new feeder cattle. (iii) Risk aversion could cause an individual to split sales between t and t+1 to reduce the variance of receipts regardless of the direction of inequality in (3). Then as P^*_{t+1} rose relative to P_t, the individual would increase the share of cattle held off the market in t, but would not reduce it to zero. (iv) It is likely that different producers have different price expectations so that one person's P^*_{t+1} implies selling while an otherwise identical individual with higher P^*_{t+1} holds.

In the spirit of using futures prices as an indicator of P^*_{t+1}, points (iii) and (iv) are not emphasized in this paper. As shown in Holthausen (1979) and Feder, Just, and Schmitz (1980), with respect to (iv), when a futures market is available utility maximization implies commodity market behavior as if the futures price was the expected price (with an individual's disagreement with the futures price causing futures transactions only). And if futures markets are available, risk aversion implies hedging so if inequality (3) says to hold, the producer holds all the cattle and hedges rather than selling some now as "insurance". Transactions costs, the size of contracts available, and output risk, may not make full hedging or speculation based on personal expectations using futures the optimal choice. However, if these factors are important, items (iii) and (iv) will play a more important role.

At the competitive market level an aggregate set of expected profit maximizing feedlots would tend to turn equations (2) and (3) into equalities. Inequality (3) would cause sales of fed cattle such that P_t fell and P^*_t rose, with equality being the market equilibrium condition. Although risk aversion or imperfect information might prevent full equilibrium from being reached, it seems apparent that P_t and P^*_{t+1} will be closely related in aggregate data, creating colinearity which is likely to cause problems in estimating their separate influences.

The empirical supply equation of marketed cattle is

(4) $$q^m_t = h(R^*_{t+1}, R_t, C2_t, C3_t, C4_t, q_t, D_t)$$

where R^*_{t+1} expected revenue per steer sold next period, $P^*_{t+1} W^*_{t+1}$, and R_t is revenue per steer sold currently, $P_t W_t$. Feeder cattle placements are q_t, and monthly dummy variables, $D_t = \{D1,....,D11\}$. Costs of feeding the cattle another period are represented by the spot price of corn, $C2_t$ the nearest futures contract price of corn, $C3_t$, and the returns on 6 month treasury bills, $C4_t$, as in the placement equation.

Estimation

The data used to estimate equations (1) and (4), linearized, are described in table 1. The observations are monthly, from January 1973 through October 1987. In equation (1) we assume that feeder cattle prices, expected future selling prices (i.e. the spot or futures price of fed cattle) of fed cattle and total marketings are endogenous. In equation (4) it is assumed that total placements of feeder cattle, and the capital and expected investment value of the marketable fed cattle are endogenous. The truncated two stage least squares estimation procedure is employed to estimate equations (1) and (4). To identify these equations we use the fact that the demand for feeder cattle is a derived demand, and the demand for fattened cattle is a derived demand from the wholesale demand of beef. We do not attempt to identify the entire structural system of related demands, but simply use determinants of demand at both the feeder and wholesale levels. The exogenous variables in this system are the spot and nearest futures prices of corn, the returns on 6 month treasury bills, the beginning month's inventory of total cattle on feed, the beginning month's inventory of beef in cold storage, feeder cattle placements lagged 1 to 6 months, fed cattle marketings lagged 1 to 3 months, the wholesale price of beef, the wholesale price of pork, an index of beef byproduct values, and monthly dummy variables for January through November.

Placement Results

Equation (1) was estimated using Truncated Two Stage Least Squares (T2SLS) under four different specifications. As noted earlier the endogenous variables are the expected selling price, the price of feeder cattle, and total marketings. The specifications differ only in how the expected future selling prices of fed cattle were proxied. We used the spot price of fed cattle and the nearest three futures prices of fed cattle as these measures. In the discussion of the results we will refer to the spot price specification as the SP model, the nearest futures price model as the F1 model, (or specification) the second nearest futures price model as the F2 model and the third nearest futures price model as the F3 model. The estimation results are included in Table 2. Two comments must be made with respect to the statistical results in Table 2: First, under T2SLS estimation it is well known that the t-ratios of estimators do not lend themselves to the same inferences as OLS estimators. We follow the convention that a coefficient is "significant" whenever its t-ratio is greater than two. Second, we use the correlation coefficient between the actual and the estimated value of placements or marketings as a measure of the explanatory power of equation (1) or equation (4).

The explanatory power of equation (1) under the four different specifications is either 0.88 or 0.89. Although there does not seem to be any significant difference between the specifications, we compared specifications by using Davidson and MacKinnon's (1983) J test of model specification. The J test in this case simply amounts to regressing placements on any combination of two of the expected prices (e.g., the fed cattle spot price and the nearest fed cattle futures price). See Davidson and MacKinnon for details of the testing procedure. The result of the model comparisons (not reported) was that the nearest futures contract price is the best of the four specifications.

Placements are decreasing in feeder cattle prices, but significant only in the F1 model. Placements are increasing in the expected selling price and significant in all but the F3 model. In addition placements are decreasing in corn prices and T-bill rates, and the respective coefficients are significant in all models except the F3 model's corn price coefficient. As the number of cattle on feed in the prior month increases, placements decrease, and as the number of marketings increase the placements increase. The total cattle on feed and marketing coefficients are significant in all specifications. The dummy variable coefficients indicate that placements have seasonal fluctuations with the highest placements occurring in the fall.

The elasticity of placements with respect to the expected prices ranged from 0.236 for the farthest futures contract price to 0.978 for the nearest futures contract price (see Table 3). All elasticities associated with a significant expected price coefficient are larger than the elasticity estimated by Brewster and Marsh, 0.32, yet smaller than the elasticity estimated by Shonkwiler and Hinkley (1985), 1.221. The elasticity of placements with respect to the feeder cattle price ranged from -0.135 for the farthest futures contract price to -0.385 for the nearest futures contract price, all of which are less than the Shonkwiler and Hinkley estimate, -0.909. The further into the future the expected price went the less negative this elasticity became. One interpretation of this result is that cattle feeders pay less attention to more distant futures prices. Also given that the reaction to the nearest futures price is stronger than the reaction to the spot price, one could assume that cattle feeders do not form expectations in a naive fashion, but use information about future expectations as reflected in the nearest futures contract price.

Next we tested the F1 model out of sample and examined its ability to forecast turning points. The model used data from January 1973 to December 1980 as its in sample series, and generated a series of one step ahead forecasts for the time period including January 1981 through October 1987 (81 observations). The model performed reasonably well. Out of 45 turning points found in the data, 35 (78%) of them were forecasted by the model. Of the turning points that were forecasted by the model (45), 10 or 22% were incorrect, meaning that a turning point was predicted when one actually did not occur.

Marketing Results

Equation (4) was estimated using T2SLS. The endogenous variables are expected revenue, current revenue, and total placements. The overall explanatory power as indicated by the correlation coefficient between the actual and estimated value of total marketings are rather low at 0.46.

All coefficients are of the expected signs. The coefficients on current and expected revenues, and placements are significant. Total marketings are increasing in current revenues and decreasing in expected revenues. Consistent with the placement results, total marketings increase as placements increase. The elasticity of marketings with respect to expected revenues and current revenues is -2.051 and 2.035 respectively. Although the elasticities appear somewhat high, they do appear to measure the separate effects of actual and expected market forces. When making marketing decisions, cattle feeders are reacting to both actual market conditions and to their expectations on the market conditions to obtain in the near future. The respective elasticities measure responses to actual guaranteed revenues if selling today and to expected revenues if holding the cattle longer. These results lend some insight into the causes underlying the negative elasticities estimated in studies mentioned earlier. Both spot and expected prices move very closely together (correlation coefficient = 0.91). Apparently using only one price to capture the effects of prices (revenues) on marketings confounds the effects and measures only the dominant effect, in this case the response to expected revenues. Corn prices and T-bill rates are insignificant. The seasonal dummy variables' coefficients exhibit a seasonal pattern with the highest marketings occurring in January and the lowest occurring in the fall.

Next we tested the cattle marketing model out of sample and examined its ability to forecast turning points. As with the F1 model, we used data from January 1973 to December 1980 as its in sample series, and generated a series of one step ahead forecasts for the time period including January 1981 through October 1987 (81 observations). Of the 50 turning points found in the data, 36 of them were forecasted by the model. The model forecast 53 turning points. Seventeen (32%) of these were incorrect, i.e., a turning point was predicted when one actually did not occur. See figure 2 and table 5 in appendix.

Summary

Two major topics have been explored in this paper. First, a model of the feedlot operator's placement decision was estimated using four different model specifications. One specification assumed that fed cattle spot prices were measures of the feedlot operator's expected selling price. The other three specifications used the prices of the three nearest futures contracts as measures of the expected price. Using Davidson and MacKinnon's "J" test of model specification it was weakly concluded that the nearest fed cattle futures price model was the better of the four specifications. Next, the short-run live beef marketing function was estimated. Prior studies had not found an adequate way of handling the effects of expectations on cattle marketings. Tryflos, Hayenga and Hacklander, and Nelson and Spreen have devised methods which tried to capture the effects of expectations on marketing decisions, but none of the results gave empirical results which clearly addressed the response to actual market conditions. This study introduced a market-based measure by using fed cattle futures prices. Coefficients on the expected future value and current market values of fed cattle were estimated and found to have the expected signs and acceptable standard errors.

Table 1. Cattle Placement and Marketing

Variable	Definition	Source
q_t	monthly cattle placements seven-state survey	USDA (1983, 1988)
q_t^m	total head of cattle marketed in thousands	USDA (1983, 1988)
I_t	previous months inventory (end of month) of total cattle on feed in thousands	USDA (1983, 1988)
W_t	average weight of cattle marketed	USDA (1983, 1988)
R_t	market value of fed cattle dollars/head	calculated using W_t and Wall Street Journal mid-month Omaha steer price
$\tilde{R}_t$	capital or investment value of fed cattle, dollars/head	calculated using Wall Street Journal futures price at mid-month
$C1_t$	feeder cattle spot price dollars/cwt.	Wall Street Journal (1978-1987), Chicago Mercantile Exchange Yearbook (1973-1977)
$C2_t$	spot price of corn cents/bushel	Wall Street Journal
$C3_t$	interest rate on short term (6 month) treasury notes	"
$\bar{Q}_t^m$	six months lagged cattle placed on feed	USDA (1983, 1988)
Instrumental variables:		
Nearest futures price of corn		Wall Street Journal (1978-1987), Chicago Mercantile Exchange Yearbook (1973-1977)
Inventory of beef in cold storage		USDA (1983, 1988)
Wholesale price of beef		"
Wholesale price of pork		"
Beef byproduct value index		"

Table 2: Results of T2SLS Estimations

Variables	Cattle marketing	Cattle placement			
		SP	F1	F2	F3
Constant	979.87 (3.58)	275.73 (0.54)	-35.66 (-0.07)	882.27 (1.91)	1462.05 (3.81)
Expected price	-- --	46.60 (3.08)	64.44 (3.72)	57.48 (2.24)	15.61 (0.40)
Expected revenue	-12.05 (-2.21)	-- --	-- --	-- --	-- --
Current revenue	12.43 (2.26)	-- --	-- --	-- --	-- --
Feeder cattle price	-- --	-12.24 (-1.21)	-23.50 (-2.06)	-16.12 (-1.07)	8.26 (0.39)
Corn price	-0.29 (-0.51)	2.51 (-4.41)	-3.11 (-4.99)	-3.99 (-3.49)	-2.41 (-1.27)
T-bill rates	-3.59 (-0.61)	-13.88 (-2.27)	-12.18 (-2.02)	-18.89 (-3.39)	-20.59 (-3.50)
Cattle marketings	-- --	1.51 (3.92)	1.67 (4.40)	1.22 (3.44)	0.83 (2.17)
Cattle placements	0.33 (2.24)	-- --	-- --	-- --	-- --
Total cattle on feed	-- --	-0.15 (-3.33)	-0.16 (-3.45)	-0.17 (-3.60)	-0.15 (-2.60)
January dummy	243.15 (4.31)	-345.99 (-3.53)	-371.25 (-3.89)	-295.37 (-3.16)	-214.16 (-2.11)
February dummy	156.90 (2.20)	-387.25 (-5.46)	-384.75 (-5.57)	-374.20 (-5.49)	-363.28 (-4.92)
March dummy	186.44 (3.38)	-261.67 (-2.92)	-300.93 (-3.35)	-246.94 (-2.75)	-167.09 (-1.83)
April dummy	129.09 (2.19)	-295.77 (-3.55)	-337.62 (-4.01)	-300.38 (-3.47)	-217.69 (-2.50)
May dummy	87.43 (1.53)	-131.62 (-1.45)	-159.16 (-1.78)	-81.14 (-0.96)	-14.58 (-0.18)
June dummy	158.65 (2.59)	-427.81 (-4.58)	-463.68 (-4.99)	-370.26 (-4.29)	-315.08 (-3.64)
July dummy	185.80 (2.55)	-512.68 (-5.92)	-487.98 (-6.02)	-432.98 (-5.56)	-420.89 (-5.01)
August dummy	184.36 (3.19)	-363.53 (-3.33)	-380.49 (-3.60)	-284.96 (-2.87)	239.53 (-2.23)
September dummy	-19.99 (-0.27)	58.53 (0.58)	76.53 (0.80)	79.58 (0.82)	127.42 (1.17)
October dummy	-111.91 (-0.85)	427.83 (3.54)	404.34 (3.43)	440.60 (3.60)	540.77 (3.91)
November dummy	-46.67 (-0.75)	104.60 (1.35)	81.26 (1.06)	71.28 (0.92)	100.84 (1.16)
Correlation coef	0.46	0.88	0.88	0.89	0.88
Durbin Watson	1.48	1.74	1.66	1.41	1.46

Table 3: Elasticities

Variables	Cattle marketing	Cattle placement			
		SP	F1	F2	F3
Expected price	--	0.697	0.978	0.871	0.236
Expected revenue	-2.051	--	--	--	--
Current revenue	2.035	--	--	--	--
Feeder cattle price	--	-0.200	-0.385	-0.264	-0.135

<u>Footnote</u>

1. For readers interested in the mechanics of the beef cattle industry see Van Arsdall and Nelson (1983).
2. We regressed corn price, t-bill returns, fed cattle marketings, feeder cattle price, and the January through November dummies, along with combinations of the four expected prices taken two at a time. When combining the nearest futures price (F1) with any other expected price, F1 was always significant, and the other expected price was insignificant.

APPENDIX

TABLE 4: PLACEMENT DATA, ACTUAL VS. FORECASTED VALUES

DATE	PLC	PLCFORE	PLCERR	ERRSQR
81.01	1277	1471	-204	41528
81.02	1190	1248	132	17518
81.03	1383	1547	-26	677
81.04	1721	1489	-63	3908
81.05	1619	1630	-121	14687
81.06	1323	1550	183	33634
81.07	1082	1343	132	17428
81.08	1419	1847	102	10456
81.09	1845	2013	142	20072
81.10	2072	2419	-21	428
81.11	1637	1961	26	672
81.12	1301	1621	85	7243
82.01	1457	1570	-18	328
82.02	1320	1243	21	442
82.03	1798	1546	201	40372
82.04	1565	1487	59	3446
82.05	1853	1732	153	23388
82.06	1420	1523	275	75449
82.07	1205	1301	58	3361
82.08	1731	1569	143	20353
82.09	1994	2012	59	3527
82.10	2600	2363	-121	14735
82.11	1775	1776	-7	49
82.12	1533	1647	-121	14683
83.01	1494	1571	-111	12324
83.02	1164	1449	-39	1538
83.03	1404	1519	20	412
83.04	1566	1451	39	1484
83.05	1838	1668	199	39656
83.06	1595	1383	181	32868
83.07	1174	1359	61	3695
83.08	1582	1646	193	37295
83.09	2000	1820	173	29862
83.10	2460	2452	-86	7406
83.11	1711	1922	-59	3445
83.12	1756	1648	32	1043
84.01	1566	1725	10	101
84.02	1301	1254	95	9091
84.03	1764	1348	-28	787
84.04	1515	1460	-15	230
84.05	1798	1707	150	22510
84.06	1445	1452	-67	4502
84.07	1323	1500	104	10811
84.08	1680	1655	152	23216
84.09	2265	2062	20	412
84.10	2546	2541	-22	478

Table 4 (continued)

DATE	PLC	PLCFORE	PLCERR	ERRSQR
84.11	1945	1930	-46	2153
84.12	1657	1746	-122	14953
85.01	1449	1712	-18	323
85.02	1341	1211	-83	6927
85.03	1592	1547	-72	5117
85.04	1416	1631	-9	77
85.05	1676	1800	422	178218
85.06	1271	1585	42	1743
85.07	1078	1671	69	4719
85.08	1510	1887	52	2690
85.09	1988	2315	209	43702
85.10	2779	2632	124	15287
85.11	1766	2020	-105	11096
85.12	1540	1898	61	3749
86.01	1581	1927	8	63
86.02	1220	1443	-189	35627
86.03	1650	1720	-43	1829
86.04	1565	1781	44	1956
86.05	1756	1778	4	13
86.06	1162	1843	-34	1178
86.07	1544	1644	118	14020
86.08	1802	1836	24	577
86.09	2103	2204	142	20061
86.10	2403	2620	-15	239
86.11	1814	1448	-1	0
86.12	1435	1445	69	4755
87.01	1591	1797	6	33
87.02	1442	1547	-74	5479
87.03	1719	1602	-16	270
87.04	1681	1555	26	678
87.05	1984	1655	-131	17203
87.06	1422	1510	192	36770
87.07	1274	1722	-28	809
87.08	1915	1576	124	15257
87.09	2429	1617	19	376

				1017594

TABLE 5: MARKETING DATA, ACTUAL VS. FORECASTED VALUES

DATE	TMAR	TMARFORE	TMARERR	ERRSQR
81	1525	1688	-204	41528
81	1440	1601	132	17518
81	1553	1656	-26	677
81	1386	1613	-63	3908
81	1400	1543	-121	14687
81	1449	1329	183	33634
81	1412	1392	132	17428
81	1526	1688	102	10456
81	1452	1491	142	20072
81	1470	1793	-21	428
81	1315	1403	26	672
81	1340	1419	85	7243
82	1522	1685	-18	328
82	1413	1443	21	442
82	1547	1490	201	40372
82	1414	1536	59	3446
82	1413	1484	153	23388
82	1510	1453	275	75449
82	1482	1294	58	3361
82	1689	1510	143	20353
82	1575	1518	59	3527
82	1527	1751	-121	14735
82	1475	1370	-7	49
82	1430	1455	-121	14683
83	1628	1654	-111	12324
83	1491	1582	-39	1538
83	1603	1816	20	412
83	1470	1575	39	1484
83	1578	1508	199	39656
83	1570	1549	181	32868
83	1497	1421	61	3695
83	1651	1546	193	37295
83	1682	1617	173	29862
83	1626	1719	-86	7406
83	1459	1591	-59	3445
83	1445	1483	32	1043
84	1569	1676	10	101
84	1621	1555	95	9091
84	1594	1544	-28	787
84	1523	1465	-15	230
84	1637	1138	150	22510
84	1544	1327	-67	4502
84	1553	1321	104	10811
84	1683	1497	152	23216
84	1489	1365	20	412
84	1657	1706	-22	478
84	1501	1432	-46	2153
84	1429	1325	-122	14953
85	1782	1660	-18	323

Table 5 (continued)

DATE	TMAR	TMARFORE	TMARERR	ERRSQR
85	1540	1513	-83	6927
85	1559	1597	-72	5117
85	1603	1495	-9	77
85	1604	1566	422	178218
85	1577	1306	42	1743
85	1670	1542	69	4719
85	1697	1708	52	2690
85	1603	1615	209	43702
85	1573	1573	124	15287
85	1380	1341	-105	11096
85	1401	1175	61	3749
86	1750	1710	8	63
86	1470	1541	-189	35627
86	1593	1643	-43	1829
86	1631	1609	44	1956
86	1635	1742	4	13
86	1648	1381	-34	1178
86	1692	1469	118	14020
86	1659	1635	24	577
86	1637	1771	142	20061
86	1587	1759	-15	239
86	1447	1448	-1	0
86	1514	1445	69	4755
87	1803	1797	6	33
87	1473	1547	-74	5479
87	1586	1602	-16	270
87	1581	1555	26	678
87	1524	1655	-131	17203
87	1702	1510	192	36770
87	1694	1722	-28	809
87	1700	1576	124	15257
87	1636	1617	19	376

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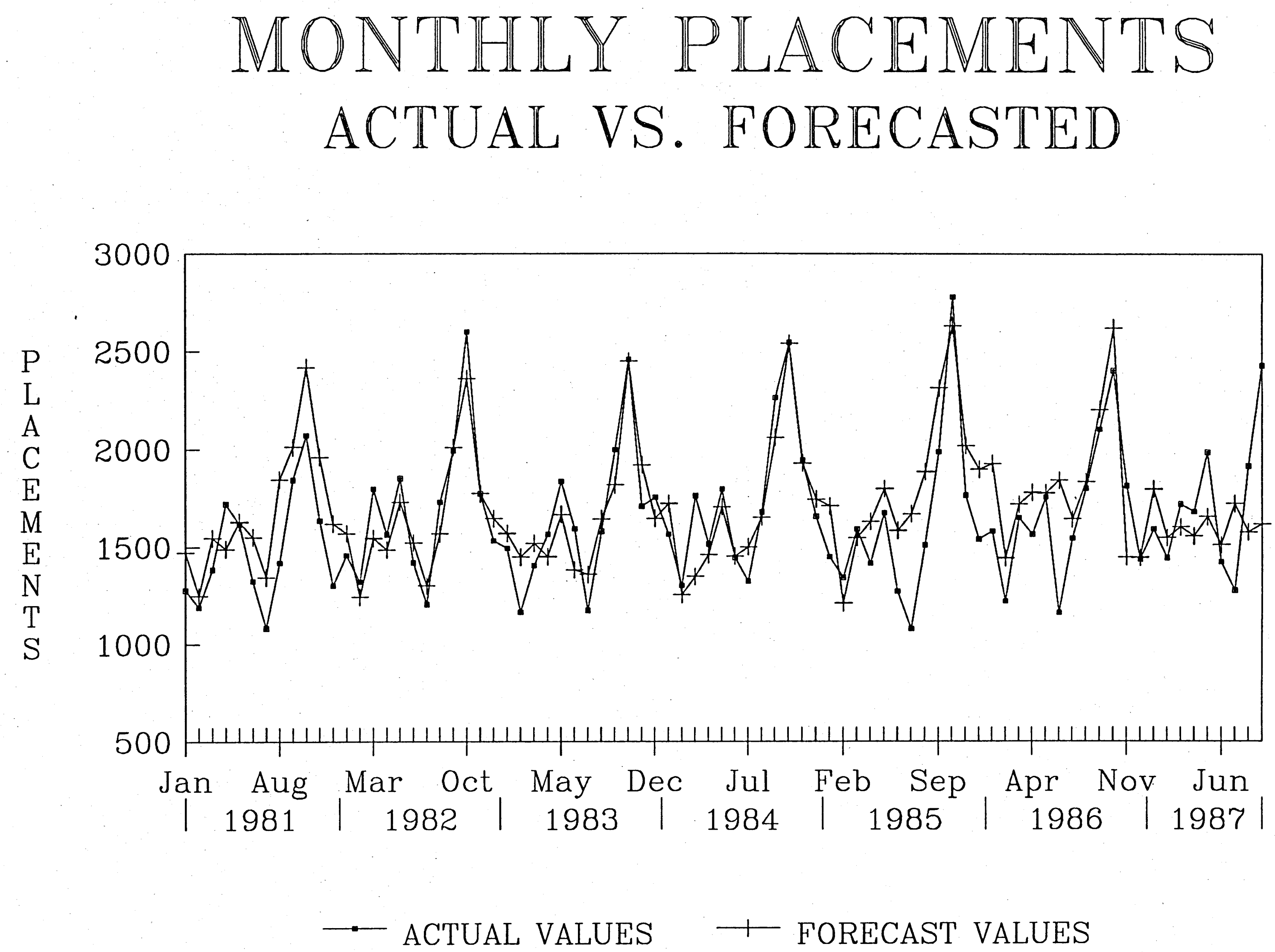
MONTHLY PLACEMENTS
ACTUAL VS. FORECASTED
PLACEMENTS
3000
2500
2000
1500
1000
500
Jan
Aug
Mar
Oct
May
Dec
Jul
Feb
Sep
Apr
Nov
Jun
1981
1982
1983
1984
1985
1986
1987
ACTUAL VALUES
FORECAST VALUES

FIGURE 1

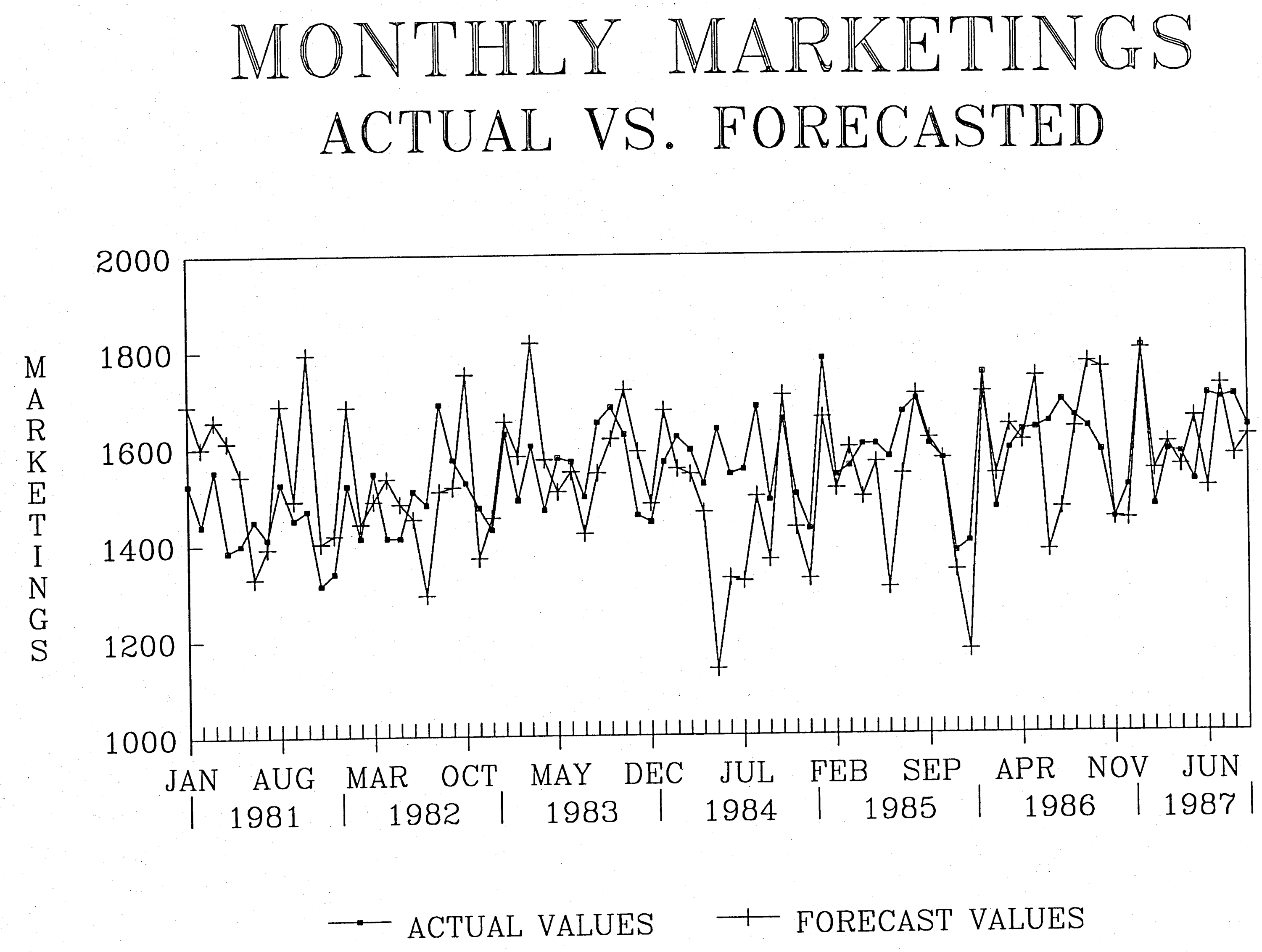
MONTHLY MARKETINGS
ACTUAL VS. FORECASTED
MARKETINGS
2000
1800
1600
1400
1200
1000
JAN AUG MAR OCT MAY DEC JUL FEB SEP APR NOV JUN
1981 1982 1983 1984 1985 1986 1987
ACTUAL VALUES
FORECAST VALUES

FIGURE 2

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