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THE EFFECT OF PRICE ON COUPON REDEMPTION: A CASE STUDY OF FLORIDA ORANGE JUICE INDUSTRY COUPON PROGRAMS

Jonq-Ying Lee

The distribution of coupons offering customers a reduction in the regular purchase price has become an important element of the marketing strategy for many consumer package goods and services. The distribution of manufacturers' cents-off coupons has increased from an estimated 35.7 billion coupons in 1975, to 90.6 billion coupons in 1980, representing an increase of more than 150 percent. In addition, there has been an upward trend in percent of households using coupons, from 65 percent in 1975, to 76 percent in 1980. More than 95 percent of the coupon users bought food items with them in 1980 (A. C. Nielsen Company).

According to a Nielsen Company survey, 67 percent of coupon users indicate that the face value of a coupon influences their decisions about whether or not to use the coupon (p. 14). The threshold value that determines whether or not a consumer uses a coupon may depend on the relative weight of the face value of a coupon as compared to the retail price of the product, i.e., the ratio of the face value of a coupon to retail price. For instance, a one-dollar coupon toward the purchase of a ten-thousand-dollar automobile would probably never be redeemed, but a 25-cent coupon for the purchase of a one-dollar product would be expected to have a high redemption rate.

Ward and Davis (1978b, p. 398) found that coupons have a declining marginal rate of return within the price range used in their study. Telser points out that advertising programs, such as those with coupons, draw consumers to the point of purchase, yet if the retail price is extremely high, the marginal response to a level of advertising effort may be less than with a lower price, since for the same amount of product purchased the consumer's expenditure would be greater for the higher price (p. 90). The implication of Telser's argument is that, for a given number of coupons distributed, one would expect a higher redemption rate when the price is low and a lower rate when the price is extremely high.

There has been increased price uncertainty in

the orange juice market in recent years, which is spawned in part by the effect of freezing weather on supplies, foreign competition from Brazil, and a turbulent money market, which directly affects orange juice storage costs. The retail price of frozen concentrated orange juice has increased from less than 20 cents per six ounces in 1973, to more than 39 cents in 1980 (Marketing Research Corporation of America). The performance of cents-off coupons in a market where retail price has almost doubled in less than eight years is of concern to the Florida orange juice industry.

This paper presents a case study of Florida's orange juice coupon programs with special emphasis on the impact of price on coupon redemption. The results and methods should have implication for other food items.

AN ECONOMETRIC MODEL

In previous studies, coupon redemption has been identified to be influenced by (Bowman; Ward and Davis, 1978a): (1) face value or savings versus retail price; (2) media used for distribution; (3) the size of coupon drop or effort;¹ (4) amount and timing of other advertising; (5) creative factor, i.e., prominence of coupon; (6) retail distribution of the commodity of interest and its substitutes; (7) current competitive activity; (8) demographic and geographic differences in consumers; (9) product consumption cycle; and (10) seasonal sales differences.

Several of these factors are controllable, and adjustments can be made in advance (such as factors 1 through 5). Many factors are only partially controllable or not at all controllable (factors 6 through 10), but they nevertheless should be used as guidelines when estimating the relationship between coupon redemption and changes in consumption. For a given product, factors 6 through 8 tend to remain constant and are not considered causal factors of variation in coupon redemption for the product.

Based on the foregoing factors, Ward and

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¹ Effort or drop are defined here as the total number of coupons distributed for a promotional program.

Davis (1978a, p. 52) proposed the following model:

$$(1) \quad CR_{ijt} = C_{ijt}^A \exp(\beta_0 + \beta_1 T^{-1})$$

where $A = (\sum_{j=1}^r \alpha_j M_{ij}) + \alpha_{r+1} FV_{ij}$, and,

CR_{ijt} = total coupon redemption at time t for program i using medium j ,

C_{ij} = total coupon drop or coupon effort for program i using medium j ,

M_{ij} = zero-one variable to indicate the medium (j) for program i ,

FV_{ij} = face value of coupon for program i using medium j ,

T_{ijt} = the age of program i using medium j at time t , and α 's and β 's are parameters to be estimated.

In their study, Ward and Davis (1978a) assumed that the level of redemption should increase with increased volume. Yet the rate of increase in redemption may decline as total effort is increased. A declining rate of redemption depicts the frequently observed phenomenon of diminishing returns to advertising and/or promotion efforts. It may further suggest that larger coupon distributions reach marginal consumers and, hence, it is more difficult to achieve a redemption response among that group of consumers. In addition, for a sufficiently long time span the redemption level will approach some upper limits, i.e., redemption of a particular coupon program will not continue indefinitely.

The model developed by Ward and Davis (1978a) did not allow for the impact of the face value of the coupon, size of distribution, and age of the program on coupon redemption to vary for different types of coupon programs.² Their model allowed only for shifts in the intercept of equation (1). In addition, Telser's hypothesis could not be tested with equation (1).

In order to estimate the impact of price on the level of coupon redemption, and relax the constraints on the impact of the face value of the coupon,³ size of distribution, and age of the program on coupon redemption, equation (1) was modified and presented as follows,

$$(2) \quad CR_{it} = C_i^B \exp(\beta_0 + \beta_1 T_{it}^{-1}),$$

where $B = \beta_2 FV_i / P_t + \beta_3$, and P_t = retail orange juice price at time t . And one equation was estimated for each type of coupon program.

According to Telser's hypothesis and results from the Ward and Davis study (1978a), the sign of β_2 is expected to be positive, i.e.,

$$\frac{\partial CR_{it}}{\partial P_t} < 0 \text{ and } \frac{\partial CR_{it}}{\partial FV_i} > 0.$$

For comparison purposes, the following revised Ward and Davis model was also estimated,

$$(3) \quad CR_{it} = C_i^{A'} \exp(\beta_0 + \beta_1 T_{it}^{-1}),$$

where $A' = \beta_2 FV_i + \beta_3$.

DATA SOURCES AND RESULTS

Florida Department of Citrus (FDOC) coupon program data were obtained from the FDOC's accounting department. The time period studied is from April, 1973, through January, 1981. The most recent coupon program included in this study originated in October, 1977. There are at least three years of data available on each coupon program. All coupon programs were classified into four major categories according to the distribution media used, i.e., magazine, newspaper, direct mail, and in-pack or on-pack. In general, FDOC's coupons do not have an expiration date, thus redemption may continue indefinitely. Retail orange juice price data were obtained from Marketing Research Corporation of America and NPD Research, Inc., for periods from April, 1973, through November, 1977, and December, 1977, through January, 1981, respectively. The prices used in the study were the weighted average retail prices of frozen concentrated orange juice and chilled orange juice expressed in cents per 24 ounces of single strength equivalent (SSE) orange juice. Prices ranged from 22 cents to 43 cents during the sample period.

The empirical estimates for equations (2) and (3) for each distribution method using ordinary least squares⁴ are as hypothesized with respect

² Defined by the distribution method used.

³ Both face value of coupon and price variables should be deflated. The special functional form used in equation (2), i.e., the ratio of these two variables, makes the use of a deflator unnecessary.

⁴ There have been two approaches to combining cross-section with time series data. First, the method of dummy variables has been suggested to account for constant effects associated with both the time direction and cross-sectional units, but is not readily attributable to identifiable causal variables (Hoch; Mundlak; Johnson). The second approach is to account for possible correlations among the error terms of the model in order to increase the asymptotic efficiency of the estimates of the causal parameters (Wallace and Hussian; Maddala; Fuller and Battese). Because the number of active coupon programs at a specific time is not fixed, a method similar to the dummy variable approach is used, where variables FV , C , and T are used to account for cross-section variations and retail prices are used to account for time series variation. Durbin-Watson test cannot be applied in this case. Multicollinearity problem is not serious. The sample correlation coefficients between $\phi_n C^* FV/P$ and $\phi_n C$ and the ones between $\phi_n C^* FV$ and $\phi_n C$ are:

	$\phi_n C^* FV/P$ and $\phi_n C$	$\phi_n C^* FV$ and $\phi_n C$
Magazine	.6156	.5980
Newspaper	.6930	.7124
Direct Mail	.6639	.7472
In/On Pack	-.2563	-.2354

The correlations between T^{-1} and other independent variables are smaller than the ones presented above.

to effort, value, price and time parameters, except for in/on pack coupons which estimates a negative sign for β_2 (Table 1) and the sign for the estimate of β_2 in equation (3) for magazine coupons. The estimated standard error for β_2 is also large relative to the estimate of β_2 for direct mail coupons. Other statistics also are included in Table 1, where, specifically, the R^2 's show that more than 80 percent of the variation in redemption is explained by the equations, except for in/on pack coupons, equation (2).

The negative sign of parameter β_2 in equation (3) for magazine coupons indicates that 15-cent coupons had lower redemption than 10-cent coupons. There were 26 magazine programs. Of these 26 programs, 8 programs occurred before 1975, of which 5 programs used 10-cent coupons and 3 used 15-cent coupons. Between March and October, 1975, the FDOC had 7 programs, and all of them used 10-cent coupons. The last 11 programs occurred in the fall of 1976, and all of these programs used 15-cent coupons. If one examines the face values of magazine coupons during the study period, one finds that the negative sign of β_2 would indicate that the programs in 1976 were less effective than the programs before 1976. This result suggests the possible downward influence of price, i.e., when price increases, redemption level decreases. The results in equation (2) for magazine coupons support this hypothesis.

The results of equations (2) and (3) for in/on pack coupons indicate that price may not be a relevant variable in explaining coupon redemption, because the inclusion of a price variable in the model caused R^2 to decrease and the estimated parameter β_2 is estimated with large standard error and unexpected sign.

One of the major differences between this study and the Ward and Davis (1978a) study is that the revised model allows the impacts of the face value of the coupon, size of distribution, and age of the program on coupon redemption to vary for different types of coupon programs. In other words, the hypothesis is that the four separate regression equations for the four media do not have the same structure, i.e., the same parameter estimates as Ward and Davis have hypothesized. Since these four regression equations are identically specified, Chow's F-ratio is used to test the equality among the coefficients for these four types of coupons and the results are presented in Table 2.

Chow's test is developed to determine whether two sets of observations come from the same relation, e.g., whether the observations on newspaper coupons and those on magazine coupon have the same relationship. With four types of

TABLE 2. Chow's F-ratio for Tests of Equality Between Coefficients in Two Relations^a

Medium	Magazine	Newspaper	Direct Mail
Equation (2)			
Newspaper	58.9659		
Direct Mail	673.5617	199.0565	
In/On Pack	104.6160	54.6015	192.7001
Equation (3)			
Newspaper	100.0901		
Direct Mail	261.9550	218.8326	
In/On Pack	39.4467	9.8889	104.0882

^a If Chow's F-ratio is greater than 3.48 ($F_{0.01,4,120}$), one would reject the equality hypothesis.

TABLE 1. OLS Estimates of Coupon Redemption Model (see equations (2) and (3))^a

Independent Variable	Magazine		Newspaper		Direct Mail		In/On Pack	
	(2)	(3)	(2)	(3)	(2)	(3)	(2)	(3)
Intercept (β_0)	5.4601 (.0909)	5.5065 (.0906)	3.4241 (.2975)	2.9778 (.2913)	6.1479 (.0869)	6.1018 (.0945)	5.1522 (.8713)	-9.2649 (.7288)
T^{-1} (β_1)	-5.3190 (.1043)	-5.1690 (.0969)	-7.2638 (.2403)	-6.5718 (.2400)	-5.3142 (.1318)	-5.2364 (.1296)	-8.2861 (.5822)	-8.7192 (.3019)
$\ln C * FV/P$ (β_2)	.0912 (.0188)	--	.4895 (.0316)	--	.0552 (.0217)	--	-.0198 (.0377)	--
$\ln C * FV$ (β_2)	--	-.0050 (.0007)	--	.0185 (.0013)	--	.0001 (.0010)	--	.1285 (.0057)
$\ln C$ (β_3)	.7996 (.0132)	.8954 (.0131)	.8571 (.0384)	.8625 (.0399)	.9126 (.0151)	.9484 (.0204)	.8936 (.0661)	.9866 (.0374)
R^2	.8788	.8810	.8273	.8214	.9697	.9691	.6473	.8813
F-Ratio	3116.89	3182.22	1120.97	1076.30	3462.69	3392.96	158.43	640.72
d.f.	1289	1289	702	702	325	325	259	259

^a The numbers in parentheses are estimated standard errors of parameters.

coupons included in this study, six possible pairs of relationship could be found, i.e., magazine coupons versus newspaper coupons, magazine coupons versus direct mail coupons, and so on. The Chow F-ratios of these six possible pairs for equation (2) are presented in Table 2, and those for equation (3) are presented at the bottom of the same table. The results suggest that, in all cases, the equality hypothesis is rejected at 0.01 level. In other words, the relaxation of the assumption of equal impacts of face value of the coupon, size of distribution, and age of the program on coupon redemption for different types of coupon programs should provide better parameter estimates than those reported by Ward and Davis.

ANALYSIS

Couponing Effort

Redemption models estimated in Table 1 implicitly assume that the redemption response or elasticity of coupon redemption is conditional on the media, coupon value, and juice price. For given media, coupon value, and juice price, the redemption elasticity (μ) is fixed, i.e., a 1-percent change in couponing effort will lead to a fixed percentage change in redemption where:

- (4) $\mu = \beta_2 * FV/P + \beta_3$ for equation (2), and
 (5) $\mu = \beta_2 * FV + \beta_3$ for equation (3),

where “*” indicates multiplication.

Estimated elasticities of coupon redemption by method of distribution are given in Table 3. These estimates are higher, and the rankings are different from those estimated by Ward and Davis.

The results in Table 3 show that the estimated elasticities from both equations (2) and (3) for magazine and direct mail coupons are statistically less than 1.0, which suggests that any increase in couponing effort using magazines or direct mail would result in reduced rates of redemption.⁵

The estimated elasticity from both equations for 10-cent newspaper coupons are not statistically different from 1.0, which indicates that doubling 10-cent newspaper couponing effort would also double the level of redemption, i.e., the rate of redemption remains constant. For 15-cent newspaper coupons, the estimated elasticities are statistically greater than 1.0, which implies that any increase in couponing effort would increase the rate of redemption.

The results from equations (2) and (3) for in/on pack coupons are not consistent. The estimates from equation (2) show that the elasticities are not statistically different from 1.0, while those

TABLE 3. Estimated Redemption Elasticities^a

Face Value	Magazine	Newspaper	Direct Mail	In/On Pack
Equation (2)				
10-cent	.8272 (.0107)	1.0054 (.0323)	.9383 (.0111)	.8876 (.0864)
15-cent	.8410 (.0104)	1.0796 (.0299)	.9467 (.0102)	.8846 (.1016)
Equation (3)				
10-cent	.8454 (.0104)	1.0473 (.0318)	.9495 (.0125)	2.2719 (.0713)
15-cent	.8204 (.0107)	1.1397 (.0291)	.9500 (.0104)	2.9145 (.0968)

^a The numbers in parentheses are estimated standard errors of elasticities. The following formula was used in computation (Kmenta, p. 372).

$$\text{var}(a x + b y) = a^2 \text{var}(x) + b^2 \text{var}(y) + 2 a b \text{Cov}(x, y)$$

estimates from equation (3) indicate that the elasticities are greater than 2.0. The estimates obtained using equation (3) appear to be far too large, therefore only equation (2) for in/on pack coupons will be used in the following discussion.

The point in time when the maximum redemption rate occurs can be estimated by setting the second derivatives of equation (2) with respect to variable T equal to zero and solving for T, i.e.,

$$(6) \quad \frac{\partial^2 CR}{\partial T^2} = \frac{\beta_1 CR}{T^3} \left[2 + \frac{\beta_1}{T} \right] = 0$$

which results in

$$(7) \quad T = -\beta_1/2$$

Using these results and the estimates in Table 1, one finds that the maximum redemption rate occurs during the third month for magazine and direct mail coupons, during the fourth month for newspaper coupons, and during the fifth month for in/on pack coupons.

Price Effect⁶

Another major difference between this study and the Ward and Davis study is that the price effect on coupon redemption can be studied with the revised model specification presented in equation (2). The empirical results in Table 1 showed the significance of price on the level of redemption for magazine, newspaper, and direct mail coupons. Using equation (2), the changes in the level of redemption resulting from juice price changes can be estimated as

$$(8) \quad \frac{\partial CR}{\partial P} = -\beta_2 * CR * \rho_n C * FV/P^2$$

where all variables are as previously defined.

⁵ At 0.05 level. This same level was used in the discussion of elasticities.

⁶ In the previous section, we fail to establish a relationship between juice price and the level of redemption for in/on pack coupons, therefore, no discussion will be given to in/on pack coupons in this section.

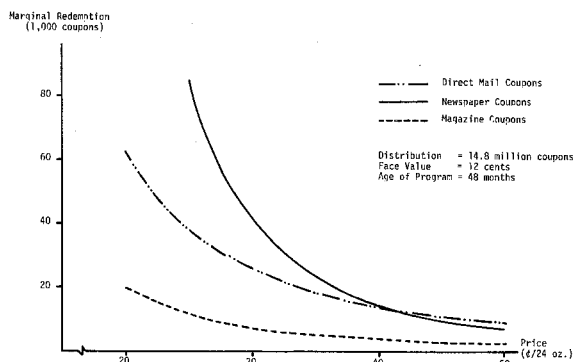


FIGURE 1. Marginal Rate of Redemption of Price by Media

Figure 1 illustrates the marginal rate of redemption (equation (8)) assuming a distribution of 14.8 million 12-cent⁷ coupons and with redemption levels computed at price levels and at the end of the fourth year ($T=48$).

As shown in Figure 1, price has the most significant effect on the redemption of newspaper coupons. For example, a one-cent increase in juice price from 33 cents per 24 ounces of orange juice to 34 cents would reduce newspaper coupon redemption by 28,325 coupons (based on a distribution of 14.8 million 12-cent coupons), while the same price change would reduce magazine coupon redemption by only 6,029 coupons and direct mail coupon redemption by 20,695 coupons. This negative marginal effect of price on the level of redemption decreases as price rises.

Figure 2 shows the couponing efforts required to have 400,000 coupons redeemed within 12 months at different price levels. The results indicate that (1) in order to have the same level (400,000 coupons) of redemption within a given time period, 10-cent coupons require larger distribution than 15-cent coupons. (2) At lower juice price levels, newspaper coupons have a higher redemption rate than magazine coupons. However, with higher juice prices, magazine coupons are more effective than newspaper coupons. (3) Juice price has little effect on the level of redemption of direct mail coupons but has a significant effect on the redemption of newspaper coupons.⁸ Figure 2 also shows that at a juice price of 35 cents per 24 ounces using newspaper as the method of distribution, 24.6 million 10-cent coupons or 12.7 million 15-cent coupons are required to have 400,000 coupons redeemed in 12 months.

Figure 3 illustrates the time required to have 400,000 coupons redeemed with a distribution of 20 million coupons at different price levels. The results are similar to those shown in Figure 2,

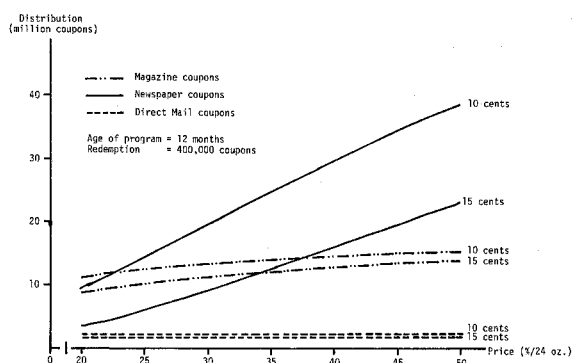


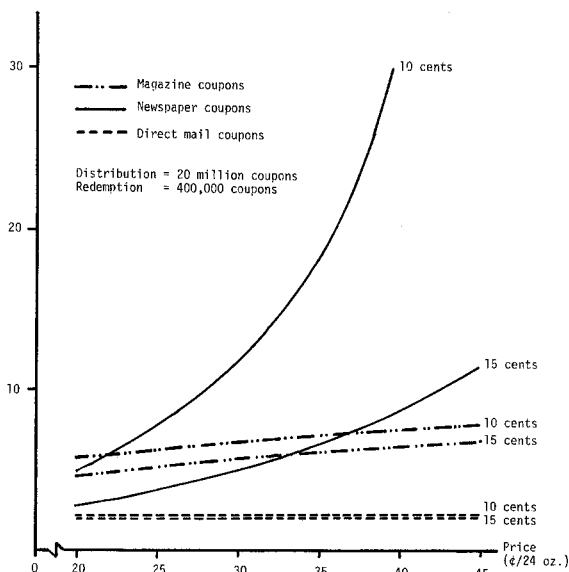
FIGURE 2. Relationship Between Coupon Effort and Juice Price

i.e., (1) at lower price levels, newspaper coupons require less time to have 400,000 coupons redeemed than magazine coupons, however, at higher prices, magazine coupons require less time to reach 2 percent redemption (400,000 coupons) than newspaper coupons; (2) 10-cent coupons were redeemed at a slower pace than 15-cent coupons, and this difference is especially evident for newspaper coupons; and (3) juice price has little effect on the redemption speed of direct mail coupons.⁹

CONCLUDING REMARKS

The empirical section verifies what this study postulates—that parameter estimates are differ-

FIGURE 3. Relationship Between Juice Price and the Age of Program



⁷ The overall average face value of FDOC coupons.

⁸ Because of the high redemption rate of direct mail coupons and the low redemption used in this example, the price effect is not evident for direct mail coupons.

⁹ Because of the high redemption rate of direct mail coupons and the low redemption level used in this example, the time or age effect is not evident for direct mail coupons.

ent for different types of coupons, and that there is a decreasing rate of coupon redemption as orange juice price increases. The analysis shows that the redemption level varies with coupon effort, face value of coupon, age of program, and orange juice price.

Orange juice price plays an important role in coupon redemption, and the price effect is most significant in newspaper coupon redemption and

least important in magazine coupon redemption. The study failed to establish a relationship between orange juice price and in-pack or on-pack coupon redemption. The benefits and costs of coupon promotional programs to Florida's orange juice industry and the advertising effects of couponing programs on the consumption of orange juice will be explored as evaluation of FDOC advertising programs continues.

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