Modeling Consumer Response to EDP Changes

Eric Schulman

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1 Introduction

In order to predict the effect of EDP changes on consumer choices, I propose an econometric model similar to the model in Winer's 1986 paper [**?**]. In this paper, Winer models the probability consumers buy from a brand as a function of previous quantity sold, consumer price expectations, competitors price and advertising spending. Winer used data directly from the point of sale, so my model is modified to take advantage of the syndicated data.

1.1 Relevant Literature

The most relevant areas of research to everyday price changes are research into brand loyalty, reference prices and their relationship with promotions. Reference prices are an expected price. Consumers get a higher utility from purchasing the good below their expected price. Brand loyalty is often represented the statistical odds that consumer will buy the same brand multiple times based on their attitudes.

Many economists have tried to create econometric models to predict consumers reactions to price changes during promotions due to reference prices and brand loyalty. The most notable model, which I will be modifying, is Winer's econometric model which models the probability consumers buy from a brand as a function of previous quantity sold, consumers price expectations, competitors' price and advertising spending. [**?**].

Another model worth mentioning is Krishnamurthi and Raj's econometric model which tries to predict the volume of the good purchased. They improve on Winer's model in their 1991 paper using an econometric technique called structural equations [**?**]. This techniques uses separate econometric equations to model brand loyalty and volume. It produces results that are considered more statistically sound. Also it reflects the intuition that consumers decide on both brand and quantity.

1.2 Winer's Model

My model borrows heavily from Winer's model. Formally, Winer's model describes the probability of purchasing brand i at time t and is given by

$$Pr_{it} = \alpha_0 + \alpha_1 Vol_{it} + \alpha_2 ADV_{it} + \alpha_3(\frac{P_{it}}{\sum_j P_{jt}} - \hat{P}_{it}) + \alpha_4 \frac{P_{it}}{\sum_j P_{jt}} + \epsilon_{it}$$

$$Pr_{it}$$

is a boolean variable representing whether or not the brand was purchased at time t before it is fit using the regression equation. This is a logistic regression. The data comes from the point of sale. If there are j brands then there $j-1$ more data points are generated for all the brands that were not purchased.

$$Vol_{it}$$

represents the volume at of brand i at time t.

$$ADV_{it}$$

is a boolean based on the advertising spending of brand i at time t. It is an aggregate metric that takes into account various types of promotional spending.

$$\frac{P_{it}}{\sum_j P_{jt}} - \hat{P}_{it}$$

is meant to capture a reaction in the reference price. In the model, P_{it} is the price charged by brand i at time t.

$$\hat{P}_{it}$$

represents the consumers expectation for the price at the current time period period. It involves estimating P_{it} as a function of P_{it-1}. This process is called 2 stage least squares. In 2 stage least squares, you look at the effect of one variable 'through' another variable. In this case we are looking on how past prices effect the current price 'through' the current price. You do this by running running a regression using a variable called an instrument (in this case, previous price) on another variable (in this case price). You use the predicted values from the first regression in a second regression. I plan to use this technique as well when estimating my model.

$$\alpha_4 \frac{P_{it}}{\sum_j P_{jt}}$$

represents the overall pricing environment. It is the current brand price at time t as a fraction of all the prices.

2 Model Description

My model emulates Winer's model by including previous quantity sold, consumer price expectations, product description and competitors price. It predicts changes in the volume sold by group i in CTA j at time t. Estimates for this model are included in the preliminary results section

$$\Delta Vol_{ijt} = \alpha_0 + \alpha_1 PRICE_{ijt} + \alpha_2 EDP_{ijt} + \alpha_3 DAIRY_j + \alpha_4 FLAVOR_j +$$

$$\alpha_5 CM_j + \alpha_6 DD_j + \alpha_7 ID_j + \alpha_8 PL_j + \alpha_9 SIZE32_j + \alpha_{10} SIZE64_{ij} + \alpha_{11} SIZE48_{ij} +$$

$$\alpha_{13} PRICE_{ijt-1} + \alpha_{13} PRICE_{ijt-2}$$
$$+ \alpha_{14} TOTALVOL_t + \alpha_{15} AVGPRICE_t$$

2.1 Description of the Variables

$$\delta Vol_{ijt}$$

is the weekly change in volume. I chose predict weekly change because previous volume dominates the other variables in terms of its ability to predict volume in the next week. Analyzing volume changes makes it easier to identify which variables have more explanatory power.

$$PRICE_{ijt}$$

is the price for CTA i in Group j at time t.

$$EDP_{ijt}$$

is the everyday price for CTA i in Group j at time t.

$$DAIRY_j$$

is a boolean variable that says whether group i contains dairy

$$FLAVOR_j$$

is a boolean variable that says whether group i is a flavored creamer

$$CM_j, DD_j, ID_j, PL_j$$

are boolean variable that represent the brand. If all 4 boolean variables are 0, then the brand is BA.

$$SIZE32_j, SIZE64_j, SIZE48_j$$

are boolean variables that represent the size of the product. If all 3 boolean variables are 0 then the product is 16 ounce units.

$$PRICE_{ijt-1}$$

represents the price for group j in CTA i at week $t-1$

$$PRICE_{ijt-2}$$

represents the price for group j in CTA i at week $t-2$. After experimenting with various models, I've chosen to include the previous price going back 2 weeks. Including previous prices essentially 'divides' the coefficient on prices. However, they repeatedly test for statistical significance beyond the 5 percent level, so it seemed prudent to include them.

$$TOTALVOL_t$$

represents aggregate volume across all of the CTA groups (i.e. sum of all volumes).

$$AVGPRICE_t$$

represents the average price across all of the CTA groups.

2.2 CTA and Week Dummy Variables

I estimated two additional models (included in the appendix). Each one of these includes various dummy variables.

The first model includes dummy variables that represent each of the CTAs

$$\sum_{i=1}^{30} \alpha_i CTA_i$$

are 30 boolean variables representing the 31 CTAs.

$$\alpha_{14} TOTALVOL_{it}, \alpha_{15} AVGPRICE_{it}$$

Additionally, total volume and average price needed to be adjusted to reflect average price and volume within the CTA. It is particularly important to adjust price to be restricted to the CTA. Without this adjustment, price looses its statistical significance within the model.

The second regression includes a boolean variable for the weeks.

$$\sum_{i=0}^{156} \alpha_i WEEK_i$$

are 156 boolean variables representing the 156 weeks to detect weekly patterns.

2.3 2 Stage Least Squares

Winer uses previous prices in his regression to do 2 stage least squares. This process involves estimating P_{it} as a function of P_{it-1}. In 2 stage least squares, you look at the effect of one variable 'through' another variable. In this case we are looking on how past prices effect the current price 'through' the current price.

By using this process we are assuming that the past prices can only relate to future volume changes 'through' consumers the current price. This assumption makes sense through the lense of the reference price literature. In the literature, past prices effect current purchasing decisions because its relationship to current prices. Consumers form expectations about prices and call these expectations reference prices. Theoretical models involving reference prices often involve an explicit assumption that previous prices only affect purchasing decisions through the reference price [**?**].

Using this technique involves running a regression using a variable called an instrument (in this case, previous price) on another variable (in this case price). You use the predicted values from the first regression in a second regression. I plan to use this technique as well when estimating my model. I plan to use

(1) Past price
(2) Past 2 prices
(3) EDP
(4) EDP, and Past 2 prices

As my instrumental variables to see which produces the best results.

3 Preliminary Results

3.1 Basic Model

Tables with results can be found in the appendix.

In the basic model, only the coefficients on $PRICE_{ijt}$, EDP_{ijt}, $TOTALVOL_t$, and $AVGPRICE_t$ are statistically significant coefficients at the 5 percent level. This means that the boolean variables relating to group have little explanatory power. Interestingly enough by removing EDP, the boolean variables regarding dairy, flavor and size become statistically significant the the 5 percent level. This suggests that EDP acts as a signal that transmits information about the product category. All but one of the brand coefficients is statistically significant at the 5 percent level.

3.2 CTA and Week Dummy Variables

All but 4 of the CTA dummy variables are statistically significant at the 5 percent levels. When using an F-test for join significance of these variables, they are significant at the 5 percent level. This means that these variables are related to volume changes and should not be taken lightly. Additionally, when

including the CTA dummies, total regional volume is no longer statistically significant.

The weekly dummy variables appear to be less important to the overall results. They pass an f-test for joint significant at the 5 percent, but considering the number of data points this is unsurprising. Most of the values do not pass individual t-tests.

References

[1] Daniel S. Putler. Incorporating reference price effects into a theory of consumer choice. *Marketing Science*, 11(3):287–309, 7 1992.

[2] Lakshman Krishnamurthi , S. P. Raj. An empirical analysis of the relationship between brand loyalty and consumer price elasticity. *Marketing Science*, 10(2):172–183, 3 1991.

[3] Hyun soo Ahn , Mehmet Gumus , Philip Kaminsky. Pricing and manufacturing decisions when demand is a function of prices in multiple periods. *Operations Research*, 55(6):1039–1057, 11 2007.

[4] Russell S. Winer. A reference price model of brand choice for frequently purchased products. *Journal of Consumer Research*, 13(2):250–256, 9 1986.

A Appendix Regression Tables

Dep. Variable:	y	**R-squared:**	0.263
Model:	GLS	**Adj. R-squared:**	0.263
Method:	Least Squares	**F-statistic:**	1491.
Date:	Thu, 24 Aug 2017	**Prob (F-statistic):**	0.00
Time:	23:05:06	**Log-Likelihood:**	-9.1863e+05
No. Observations:	62567	**AIC:**	1.837e+06
Df Residuals:	62551	**BIC:**	1.837e+06
Df Model:	15		

	coef	**std err**	**t**	**P>|t|**	**[0.025**	**0.975]**
const	1.059e+04	3.41e+04	0.311	0.756	-5.62e+04	7.74e+04
x1	-2.023e+06	1.64e+04	-123.541	0.000	-2.06e+06	-1.99e+06
x2	1.629e+05	2.17e+04	7.513	0.000	1.2e+05	2.05e+05
x3	1689.5385	7618.685	0.222	0.824	-1.32e+04	1.66e+04
x4	4567.2173	6859.456	0.666	0.506	-8877.330	1.8e+04
x5	2.226e+04	1.23e+04	1.809	0.070	-1856.427	4.64e+04
x6	9105.3157	1.21e+04	0.751	0.453	-1.47e+04	3.29e+04
x7	1.393e+04	1.28e+04	1.092	0.275	-1.11e+04	3.89e+04
x8	3.15e+04	1.2e+04	2.630	0.009	8023.628	5.5e+04
x9	-6344.7006	1.08e+04	-0.588	0.557	-2.75e+04	1.48e+04
x10	-2113.0252	1.3e+04	-0.162	0.871	-2.76e+04	2.34e+04
x11	2221.5663	1.78e+04	0.125	0.901	-3.26e+04	3.7e+04
x12	2.313e+06	1.82e+04	127.049	0.000	2.28e+06	2.35e+06
x13	-4.665e+05	1.62e+04	-28.823	0.000	-4.98e+05	-4.35e+05
x14	0.0009	7.51e-05	12.348	0.000	0.001	0.001
x15	-2.289e+05	2.3e+04	-9.932	0.000	-2.74e+05	-1.84e+05

Omnibus:	23468.865	**Durbin-Watson:**	2.813
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	16947552.135
Skew:	-0.135	**Prob(JB):**	0.00
Kurtosis:	83.628	**Cond. No.**	5.68e+09

Regression results in the basic model (with EDP and without dummy variables).x_1 is price, x_2 is EDP, x_3 is dairy, x_4 is flavor, $x_5 - x_8$ are boolean variables for brand, $x_9 - x_{11}$ are boolean variables for size, x_{12}, x_{13} are previous 2 prices. x_{14} is total volume and x_{15} is average price. $x_{16} - x_{46}$ are CTA boolean variables

Dep. Variable:	y	**R-squared:**	0.263
Model:	GLS	**Adj. R-squared:**	0.263
Method:	Least Squares	**F-statistic:**	1592.
Date:	Fri, 25 Aug 2017	**Prob (F-statistic):**	0.00
Time:	11:16:55	**Log-Likelihood:**	-9.1866e+05
No. Observations:	62567	**AIC:**	1.837e+06
Df Residuals:	62552	**BIC:**	1.837e+06
Df Model:	14		

	coef	std err	t	P>|t|	[0.025	0.975]
const	1.18e+05	3.1e+04	3.809	0.000	5.73e+04	1.79e+05
x1	-1.974e+06	1.5e+04	-131.701	0.000	-2e+06	-1.94e+06
x2	1.542e+04	7399.388	2.084	0.037	921.170	2.99e+04
x3	1.914e+04	6582.263	2.908	0.004	6242.632	3.2e+04
x4	2.774e+04	1.23e+04	2.257	0.024	3655.696	5.18e+04
x5	1.814e+04	1.21e+04	1.503	0.133	-5523.046	4.18e+04
x6	1.465e+04	1.28e+04	1.148	0.251	-1.04e+04	3.97e+04
x7	6345.2504	1.15e+04	0.552	0.581	-1.62e+04	2.89e+04
x8	-3.522e+04	1.01e+04	-3.491	0.000	-5.5e+04	-1.54e+04
x9	-4.581e+04	1.17e+04	-3.932	0.000	-6.87e+04	-2.3e+04
x10	-4.593e+04	1.66e+04	-2.771	0.006	-7.84e+04	-1.34e+04
x11	2.335e+06	1.8e+04	129.847	0.000	2.3e+06	2.37e+06
x12	-4.2e+05	1.5e+04	-28.073	0.000	-4.49e+05	-3.91e+05
x13	0.0010	7.5e-05	12.800	0.000	0.001	0.001
x14	-2.402e+05	2.3e+04	-10.440	0.000	-2.85e+05	-1.95e+05

Omnibus:	23316.818	**Durbin-Watson:**	2.812
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	17073360.850
Skew:	-0.041	**Prob(JB):**	0.00
Kurtosis:	83.927	**Cond. No.**	5.00e+09

Regression results without EDP and without dummy variables. x_1 is price, , x_2 is dairy, x_3 is flavor, $x_4 - x_7$ are boolean variables for brand, $x_8 - x_{10}$ are boolean variables for size, x_{11}, x_{12} are previous 2 prices. x_{13} is total volume and x_{14} is average price.

Dep. Variable:	y	**R-squared:**	0.268
Model:	GLS	**Adj. R-squared:**	0.267
Method:	Least Squares	**F-statistic:**	519.8
Date:	Thu, 24 Aug 2017	**Prob (F-statistic):**	0.00
Time:	23:05:48	**Log-Likelihood:**	-9.1844e+05
No. Observations:	62567	**AIC:**	1.837e+06
Df Residuals:	62522	**BIC:**	1.837e+06
Df Model:	44		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-1.027e+05	3.08e+04	-3.333	0.001	-1.63e+05	-4.23e+04
x1	-2.023e+06	1.63e+04	-123.850	0.000	-2.06e+06	-1.99e+06
x2	1.805e+05	2.23e+04	8.088	0.000	1.37e+05	2.24e+05
x3	6619.6916	7863.497	0.842	0.400	-8792.778	2.2e+04
x4	-6920.8994	7008.375	-0.988	0.323	-2.07e+04	6815.528
x5	1.922e+04	1.26e+04	1.531	0.126	-5381.617	4.38e+04
x6	-3632.1752	1.23e+04	-0.296	0.767	-2.77e+04	2.04e+04
x7	1.905e+04	1.28e+04	1.484	0.138	-6118.408	4.42e+04
x8	2.233e+04	1.2e+04	1.855	0.064	-1268.655	4.59e+04
x9	5435.1126	1.13e+04	0.480	0.631	-1.68e+04	2.76e+04
x10	1.676e+04	1.38e+04	1.218	0.223	-1.02e+04	4.37e+04
x11	5867.1182	1.84e+04	0.320	0.749	-3.01e+04	4.18e+04
x12	2.309e+06	1.82e+04	127.194	0.000	2.27e+06	2.34e+06
x13	-4.651e+05	1.62e+04	-28.792	0.000	-4.97e+05	-4.33e+05
x14	1.5966	37.332	0.043	0.966	-71.574	74.768
x15	0.0212	0.001	23.148	0.000	0.019	0.023
x16	1.5966	37.332	0.043	0.966	-71.574	74.768
x17	-1.263e+05	2.05e+04	-6.149	0.000	-1.67e+05	-8.61e+04
x18	-1.399e+05	1.94e+04	-7.203	0.000	-1.78e+05	-1.02e+05
x19	-1.905e+04	1.9e+04	-1.004	0.316	-5.62e+04	1.82e+04
x20	-1.528e+05	1.95e+04	-7.815	0.000	-1.91e+05	-1.14e+05
x21	3.635e+04	2.04e+04	1.782	0.075	-3639.935	7.63e+04
x22	-1.215e+05	1.91e+04	-6.368	0.000	-1.59e+05	-8.41e+04
x23	-9.211e+04	1.86e+04	-4.942	0.000	-1.29e+05	-5.56e+04
x24	-9.211e+04	1.86e+04	-4.950	0.000	-1.29e+05	-5.56e+04
x25	3.938e+04	1.91e+04	2.057	0.040	1857.042	7.69e+04
x26	-1.06e+05	2.01e+04	-5.274	0.000	-1.45e+05	-6.66e+04
x27	-1.334e+05	1.87e+04	-7.118	0.000	-1.7e+05	-9.66e+04
x28	-7.835e+04	1.8e+04	-4.363	0.000	-1.14e+05	-4.31e+04
x29	-9.473e+04	1.78e+04	-5.321	0.000	-1.3e+05	-5.98e+04
x30	-8.018e+04	1.78e+04	-4.510	0.000	-1.15e+05	-4.53e+04
x31	-2.813e+04	1.75e+04	-1.612	0.107	-6.23e+04	6072.631
x32	-3.801e+04	1.75e+04	-2.172	0.030	-7.23e+04	-3713.216
x33	-1.213e+05	1.79e+04	-6.778	0.000	-1.56e+05	-8.62e+04
x34	-6.505e+04	1.77e+04	-3.679	0.000	-9.97e+04	-3.04e+04
x35	-4.82e+04	1.75e+04	-2.752	0.006	-8.25e+04	-1.39e+04
x36	-1.556e+05	1.87e+04	-8.308	0.000	-1.92e+05	-1.19e+05
x37	-3.719e+04	1.73e+04	-2.152	0.031	-7.11e+04	-3318.805
x38	-5.482e+04	1.74e+04	-3.142	0.002	-8.9e+04	-2.06e+04
x39	-3.043e+05	2.12e+04	-14.336	0.000	-3.46e+05	-2.63e+05
x40	-3.887e+04	1.68e+04	-2.314	0.021	-7.18e+04	-5948.662
x41	-4.732e+05	2.64e+04	-17.958	0.000	-5.25e+05	-4.22e+05
x42	-5.503e+05	2.9e+04	-18.950	0.000	-6.07e+05	-4.93e+05
x43	-4.032e+05	2.39e+04	-16.872	0.000	-4.5e+05	-3.56e+05
x44	-3.063e+05	2.41e+04	-12.721	0.000	-3.54e+05	-2.59e+05
x45	-1.477e+05	2.13e+04	-6.929	0.000	-1.89e+05	-1.06e+05
x46	-7.507e+05	3.85e+04	-19.499	0.000	-8.26e+05	-6.75e+05

Omnibus:	23885.880	**Durbin-Watson:**	2.000
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	16303463.262
Skew:	-0.265	**Prob(JB):**	0.00
Kurtosis:	82.079	**Cond. No.**	8.63e+20

Regression results with the dummy variables for CTA. x_1 is price, x_2 is EDP, x_3 is dairy, x_4 is flavor, $x_5 - x_8$ are boolean variables for brand, $x_9 - x_{11}$ are boolean variables for size, x_{12}, x_{13} are previous 2 prices. x_{14} is total volume and x_{15} is average price. $x_{16} - x_{46}$ are CTA boolean variables

Dep. Variable:	y	**R-squared:**	0.277
Model:	GLS	**Adj. R-squared:**	0.275
Method:	Least Squares	**F-statistic:**	144.3
Date:	Thu, 24 Aug 2017	**Prob (F-statistic):**	0.00
Time:	23:05:29	**Log-Likelihood:**	-9.1803e+05
No. Observations:	62567	**AIC:**	1.836e+06
Df Residuals:	62400	**BIC:**	1.838e+06
Df Model:	166		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-2.842e+04	2.54e+04	-1.118	0.264	-7.82e+04	2.14e+04
x1	-2.076e+06	1.64e+04	-126.465	0.000	-2.11e+06	-2.04e+06
x2	1.798e+05	2.18e+04	8.259	0.000	1.37e+05	2.23e+05
x3	982.7676	7564.939	0.130	0.897	-1.38e+04	1.58e+04
x4	3841.8414	6826.161	0.563	0.574	-9537.448	1.72e+04
x5	2.359e+04	1.22e+04	1.931	0.053	-348.546	4.75e+04
x6	9164.6847	1.21e+04	0.760	0.447	-1.45e+04	3.28e+04
x7	1.498e+04	1.27e+04	1.183	0.237	-9827.336	3.98e+04
x8	3.407e+04	1.19e+04	2.865	0.004	1.08e+04	5.74e+04
x9	-7250.8479	1.07e+04	-0.675	0.500	-2.83e+04	1.38e+04
x10	-2693.4226	1.3e+04	-0.208	0.835	-2.81e+04	2.27e+04
x11	2680.7714	1.77e+04	0.152	0.879	-3.19e+04	3.73e+04
x12	2.355e+06	1.82e+04	129.263	0.000	2.32e+06	2.39e+06
x13	-4.733e+05	1.62e+04	-29.144	0.000	-5.05e+05	-4.41e+05
x14	0.0007	5.52e-05	12.230	0.000	0.001	0.001
x15	-1.424e+05	1.37e+04	-10.431	0.000	-1.69e+05	-1.16e+05
x16	-0.0040	0.001	-3.293	0.001	-0.006	-0.002
x17	-0.0097	0.003	-3.293	0.001	-0.015	-0.004
x18	-1.678e+04	3.17e+04	-0.530	0.596	-7.88e+04	4.53e+04
x19	-7.145e+04	3.15e+04	-2.272	0.023	-1.33e+05	-9801.599
x20	8.09e+04	3.15e+04	2.567	0.010	1.91e+04	1.43e+05
x21	8.875e+04	3.16e+04	2.809	0.005	2.68e+04	1.51e+05
x22	-2.119e+04	3.16e+04	-0.671	0.502	-8.31e+04	4.07e+04
x23	-1.701e+04	3.14e+04	-0.542	0.588	-7.86e+04	4.46e+04
x24	-2.339e+04	3.15e+04	-0.743	0.457	-8.51e+04	3.83e+04
x25	-1.992e+04	3.15e+04	-0.632	0.527	-8.17e+04	4.18e+04
x26	-8.124e+04	3.15e+04	-2.580	0.010	-1.43e+05	-1.95e+04
x27	5.284e+04	3.15e+04	1.680	0.093	-8824.492	1.15e+05
x28	2.873e+04	3.15e+04	0.914	0.361	-3.29e+04	9.04e+04
x29	2.014e+04	3.14e+04	0.641	0.522	-4.15e+04	8.18e+04
x30	5.559e+04	3.11e+04	1.787	0.074	-5367.222	1.17e+05
x31	-2.041e+05	3.14e+04	-6.493	0.000	-2.66e+05	-1.43e+05
x32	8.623e+04	3.15e+04	2.741	0.006	2.46e+04	1.48e+05
x33	-8.626e+04	3.14e+04	-2.745	0.006	-1.48e+05	-2.47e+04
x34	6.496e+04	3.12e+04	2.079	0.038	3726.996	1.26e+05
x35	5.79e+04	3.14e+04	1.844	0.065	-3626.620	1.19e+05
x36	9401.2755	3.14e+04	0.300	0.765	-5.21e+04	7.09e+04
x37	-4.575e+04	3.12e+04	-1.468	0.142	-1.07e+05	1.53e+04
x38	8.476e+04	3.12e+04	2.719	0.007	2.37e+04	1.46e+05
x39	-4210.0601	3.1e+04	-0.136	0.892	-6.49e+04	5.65e+04
x40	3.561e+04	3.12e+04	1.142	0.253	-2.55e+04	9.67e+04
x41	-9075.6092	3.13e+04	-0.290	0.772	-7.04e+04	5.22e+04
x42	-4.72e+04	3.12e+04	-1.513	0.130	-1.08e+05	1.39e+04
x43	3.936e+04	3.12e+04	1.260	0.208	-2.19e+04	1.01e+05
x44	9.03e+04	3.12e+04	2.891	0.004	2.91e+04	1.52e+05
x45	1.964e+04	3.14e+04	0.625	0.532	-4.19e+04	8.12e+04
x46	4.341e+04	3.13e+04	1.386	0.166	-1.8e+04	1.05e+05
x47	2.492e+04	3.14e+04	0.795	0.427	-3.66e+04	8.64e+04
x48	5662.9355	3.13e+04	0.181	0.857	-5.57e+04	6.71e+04
x49	8.08e+04	3.13e+04	2.581	0.010	1.95e+04	1.42e+05
x50	-3.391e+04	3.12e+04	-1.085	0.278	-9.51e+04	2.73e+04
x51	-118.5516	3.12e+04	-0.004	0.997	-6.13e+04	6.1e+04
x52	-7.701e+04	3.12e+04	-2.467	0.014	-1.38e+05	-1.58e+04
x53	-1.507e+04	3.12e+04	-0.483	0.629	-7.63e+04	4.61e+04
x54	5.888e+04	3.12e+04	1.889	0.059	-2203.746	1.2e+05

Omnibus:	23255.762	**Durbin-Watson:**	2.818
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	16391777.699
Skew:	-0.077	**Prob(JB):**	0.00
Kurtosis:	82.295	**Cond. No.**	1.96e+26

Regression results with dummy variables for week. x_1 is price, x_2 is EDP, x_3 is dairy, x_4 is flavor, $x_5 - x_8$ are boolean variables for brand, $x_9 - x_{11}$ are boolean variables for size, x_{12}, x_{13} are previous 2 prices. x_{14} is total volume and x_{15} is average price. $x_{16} - x_{171}$ are week boolean variables