Marketing Mix Team HW Group 15
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Interpretation of how the findings change across the columns in the results table:

1. Own National Trad Ads:

The felm regression results in the 1st column of the Own National Trad Ads show that perceived quality tends to **increase** with one-week lags of own ad spend. The 2nd column indicates that perceived quality also **increases** when the data are weighted by qua_vol. However, column 1 and column 2 don't have significant differences. When the brand fixed effects are replaced with brand-quarter fixed effects, perceived quality **increases** significantly compared to column 2, but there is no obvious trend over time. When the week-fixed effects are replaced with industry-week fixed effects, perceived quality also **increases**, but the data fluctuates around those of column 3. We can see that in Own National Trad Ads, fixing brand-quarter increases the accuracy of our results. In general, as we fix more variables, the increasing perceived quality is more obvious.

2. Comp National Trad Ads:

Compared to Own National Trad Ads, The felm regression results in the 1st column of the Comp National Trad Ads show that perceived quality tends to **decrease** with one-week lags of own ad spend. This is expected because as competitors spend more money on advertising the products, our own perceived quality tends to fall. The 2nd column shows a more **negative** correlation as we fix the when the data are weighted by qua_vol. The 3rd column shows a slightly **increasing** perceived quality, but the 4th column again shows a more **negative** perceived quality compared to previous columns. We can see that there is a decreasing perceived quality when we fix more variables. In general, as we fix more variables, the relationship is more precise.

3. Own Local Trad Ads:

The felm regression results in the first column of the second part of our final table show that perceived quality tends to **increase** with one-week lags of own local ad spend in traditional media. The second column indicates that perceived quality also **increase**s when the own local traditional ad spend are weighted by the number of quality survey respondents; The coefficients are similar, suggesting that weighting the data does not significantly change the relationship between ad spend and perceived quality. The third column reveals that perceived quality will also **increase** if we replace the brand fixed effect with brand-quarter fixed effect; however, the degree of increase is slightly different: the first two intervals increase less while the other intervals increase more. The final column informs us that the perceived quality is still **positively** correlated with the ad spend, while the overall performance after replacing the week-fixed effect with industry-week fixed effect is more volatile.

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4. Comp Local Trad Ads:

The felm regression results in the first column of the fourth part of our final table show that perceived quality tends to **increase** with one-week lags of competitor local ad spend in traditional media. The second column indicates that perceived quality also **increases** when the own local traditional ad spend are weighted by the number of quality survey respondents; The trend of change in coefficient are indifferent from the first column, suggesting that weighting the data does not significantly change the relationship between ad spend and perceived quality. The third column reveals that perceived quality will **increase** if we replace the brand fixed effect with brand-quarter fixed effect; however, the degree of change is slightly different. We cannot persuasively conclude the relationship between the perceived quality and ad spend after replacing the week-fixed effect with industry-week fixed effect based on the data of column 4 since the coefficients of different time period are pretty deviating from each other. Thus, the impact in this situation is **unclear**.

It's easy to understand that a brand's perceived quality tends to increase while the brand invests more in ads on local traditional media, because the ads on such media are highly reliable and could significantly increase the brand influence. Also, it certainly could be possible for a brand's perceived quality to increase if competitors increase their ads spend on local traditional media. If the audience learned a single brand through local media, it is very likely for them to do more research on other brands offering similar products before they make a buy decision.

5. Own Digital Ads:

The felm regression results in the 1st column of the Own Digital Ads show that there is **no specific trend** of perceived quality as it both **increases** and **decreases** with lagged advertising in digital ads. Same with the 2nd column. Data in 2nd column do not show a systematic change in perceived quality with the one-week lags of own ad spend; however, both columns do indicate the same type of correlations between perceived quality and digital ads expense in terms of its positive or negative value. Column 3 and 4 are showing a similar impact on perceived quality with same lagged advertising in digital ads. It seems like when the brand fixed effects are replaced with brand-quarter fixed effects or industry-week fixed effects, perceived quality will **increase**.

6. Comp Digital Ads:

The felm regression results in the 1st column of the Competitors' Digital Ads show that there is **no stable change** on perceived quality with lagged advertising in digital ads. Similarly, **no apparent trend** of its performance change based on data in 2nd column either. Like what was observed in flem and weighted regression in Own Digital Ads, the first two columns indicate same negative or positive correlations between perceived quality and digital ads as well, so it is hard to tell whether there are cross effects on each other's brand perceived quality.

Column 3 and 4 are showing a similar **increasing** impact on perceived quality when the brand fixed effects are replaced with brand-quarter fixed effects or industry-week fixed effects. This increasing effect can be seen in Own Digital Ads dataset as well. It looks conflicting when competitor's advertisements contribute to the own brand perceived quality, but it might be the case that competitor's digital ads draw consumers attention to the industry/products and so customers start to search for other incumbent suppliers and their products as well.

Findings & Summary:

We start by comparing fit statistics across models. The descriptive model explains the large majority of variation in the brand attitude data, with adjusted R-squared statistics of 0.957, which shows a high coefficient of determination between the variations and brand quality.

The second column represents the data when the number of survey respondents is added to the descriptive model. Under this circumstance, R-square increases from 0.957 to 0.958 while adjusted R-square stays approximately the same.

The third column displays the adjusted R-squared statistics when brand-quarter fixed effect is added to the second model. The Adjusted R-squared statistics increased to 0.962, which means that the proportion of unexplained variance falls from 0.043 to 0.038.

Similarly, the industry-week fixed effects reduce the proportion of unexplained variance from 0.038 (when in the model of only brand-quarter fixed effect) to 0.031 (when in the model of both brand-quarter fixed and industry-week fixed effects).

We then compare each of the four columns and find that R-squared tends to get slightly higher when adding extra fixed variances. Besides, we dig into statistics in all three types of advertising, noticing that the models are not necessarily meeting our perception. For instance, it is quite reasonable for us to think that the perceived quality will change in the same way as putting more ad spend on national and local media. But the results show that both the uncontrolled and the weight-controlled models demonstrate positive as well as negative results. Furthermore, adding a single-controlled variable will not alleviate the conflicts. For example, we tend to think that our own national traditional ad spend will strengthen the brand quality. However, the results surprisingly show that it is actually our competitors' ad spend aggrandize the brand quality. We realize that the only solution towards the problem is using the all-controlled model. Our finding also suggests that as the more controlled variables are being added in, the more the results are meeting our expectations of ad effects on perceived brand quality.

To summarize, simply by looking at the different results in a single column hardly can we interpret the correlations and the virtue behind. When combining the data in both descriptive and brand-quarter/industry-week controlled sets, however, we can easily deduce the fact that including proper control variables will produce patterns of effects that appear more consistent with expectations than the descriptive one.

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Ad Parameter Estimates for Brand Quality

	Dependent variable:			
	qua			
	Felm regression	Reg with Weights	Reg with Brand-Quarter Effect	Reg with Industry-Week Effect
	(1)	(2)	(3)	(4)
National Trad. Ads (own) (t=0)	0.00003461	0.00003571	0.00002355	0.00001440
	(0.00002226)	(0.00002219)	(0.00002285)	(0.00002199)
(t=1)	0.00010972***	0.00011681***	0.00012538***	0.00007919***
	(0.00002336)	(0.00002331)	(0.00002320)	(0.00002234)
(t=2)	-0.00002254	-0.00002324	0.00001329	0.00002636
	(0.00002331)	(0.00002328)	(0.00002309)	(0.00002224)
(t=3)	0.00002522	0.00002255	0.00005096**	0.00002869
	(0.00002332)	(0.00002326)	(0.00002303)	(0.00002220)
(t=4)	0.00004851**	0.00004469*	0.00008348***	0.00007143***
	(0.00002336)	(0.00002332)	(0.00002313)	(0.00002228)
(t=5)	-0.00003063	-0.00003416	0.00003794*	0.00004702**
	(0.00002224)	(0.00002219)	(0.00002280)	(0.00002195)
Local Trad. Ads (own) (t=0)	0.00004630*	0.00004752*	0.00002334	0.00003588
	(0.00002468)	(0.00002449)	(0.00002519)	(0.00002462)
(t=1)	0.00004389*	0.00004660*	0.00003943	0.00005534**
	(0.00002542)	(0.00002525)	(0.00002535)	(0.00002480)
(t=2)	0.00003454	0.00003360	0.00003826	-0.00000477
	(0.00002499)	(0.00002483)	(0.00002515)	(0.00002463)
(t=3)	0.00000978	0.00001320	0.00002186	0.00003869
	(0.00002498)	(0.00002481)	(0.00002510)	(0.00002460)
(t=4)	0.00001623	0.00001507	0.00003233	0.00002740
	(0.00002538)	(0.00002521)	(0.00002520)	(0.00002465)
(t=5)	-0.00000177	-0.00000273	0.00002602	0.00003457
	(0.00002466)	(0.00002449)	(0.00002510)	(0.00002454)
Digital Ads (own) (t=0)	0.00004788	0.00004651	0.00002324	0.00002631
	(0.00003988)	(0.00003940)	(0.00004085)	(0.00003968)
(t=1)	0.00000861	0.00001820	0.00003034	0.00006111
	(0.00004785)	(0.00004727)	(0.00004557)	(0.00004409)
(t=2)	-0.00001791	-0.00002744	-0.00002225	-0.00003362
	(0.00004791)	(0.00004734)	(0.00004547)	(0.00004400)
(t=3)	0.00004489	0.00003843	0.00005036	0.00004223
	(0.00004790)	(0.00004735)	(0.00004550)	(0.00004403)

(t=4)	-0.00001786	-0.00000363	0.00001707	-0.00000446
	(0.00004778)	(0.00004724)	(0.00004554)	(0.00004407)
(t=5)	-0.00004443	-0.00005838	-0.00000332	0.00001200
	(0.00003970)	(0.00003927)	(0.00004056)	(0.00003932)
National Trad. Ads (comp) (t=0)	0.00012269	0.00011319	-0.00002741	-0.00029932
	(0.00010535)	(0.00010385)	(0.00010489)	(0.00022739)
(t=1)	0.00021884*	0.00023962**	0.00022102**	-0.00045983**
	(0.00011242)	(0.00011119)	(0.00010888)	(0.00022890)
(t=2)	-0.00002800	-0.00004786	0.00000093	-0.00029340
	(0.00011090)	(0.00010937)	(0.00010821)	(0.00022658)
(t=3)	-0.00015879	-0.00018422*	-0.00014735	-0.00048160**
	(0.00011059)	(0.00010924)	(0.00010744)	(0.00022492)
(t=4)	0.00011242	0.00013585	0.00014665	-0.00032197
	(0.00011138)	(0.00011014)	(0.00010768)	(0.00022477)
(t=5)	-0.00001213	-0.00005398	0.00000523	0.00012397
	(0.00010417)	(0.00010314)	(0.00010643)	(0.00022530)
Local Trad. Ads (comp) (t=0)	0.00001208	0.00004050	0.00002758	0.00006342
	(0.00009007)	(0.00009008)	(0.00009211)	(0.00022675)
(t=1)	-0.00003356	-0.00005961	-0.00005601	0.00012186
	(0.00009256)	(0.00009257)	(0.00009253)	(0.00022936)
(t=2)	0.00023122**	0.00023404***	0.00021978**	-0.00061321***
	(0.00009078)	(0.00009073)	(0.00009170)	(0.00023072)
(t=3)	0.00004581	0.00005526	0.00007695	0.00019549
	(0.00009074)	(0.00009078)	(0.00009150)	(0.00022971)
(t=4)	0.00010523	0.00005464	0.00006972	-0.00005481
	(0.00009228)	(0.00009240)	(0.00009237)	(0.00022862)
(t=5)	-0.00009740	-0.00007470	-0.00005287	-0.00039548*
	(0.00009005)	(0.00009028)	(0.00009288)	(0.00022901)
Digital Ads (comp) (t=0)	0.00000754	0.00001877	-0.00010052	0.00015777
	(0.00012758)	(0.00012527)	(0.00012998)	(0.00032349)
(t=1)	0.00012734	0.00021747	0.00014848	0.00047091
	(0.00014641)	(0.00014386)	(0.00014006)	(0.00034054)
(t=2)	-0.00022592	-0.00029775**	-0.00037081***	-0.00041567
	(0.00014643)	(0.00014379)	(0.00013896)	(0.00033907)
(t=3)	0.00007578	0.00011151	0.00003753	0.00017118
	(0.00014595)	(0.00014338)	(0.00013873)	(0.00033960)
(t=4)	0.00034789**	0.00034135**	0.00034312**	-0.00001143

	(0.00014503)	(0.00014278)	(0.00013827)	(0.00033925)
(t=5)	-0.00036487***	-0.00041097***	-0.00037190***	-0.00083584***
	(0.00012508)	(0.00012316)	(0.00012805)	(0.00032115)
Observations	142,600	142,600	142,600	142,600
R^2	0.95688510	0.95766830	0.96474740	0.97314840
Adjusted R^2	0.95661240	0.95740060	0.96156090	0.96857600
Residual Std. Error	0.02601728 (df = 141703)	0.23909540 (df = 141703)	0.22712030 (df = 130778)	0.20535250 (df = 121850)

Note: *p<0.1; **p<0.05; ***p<0.01