

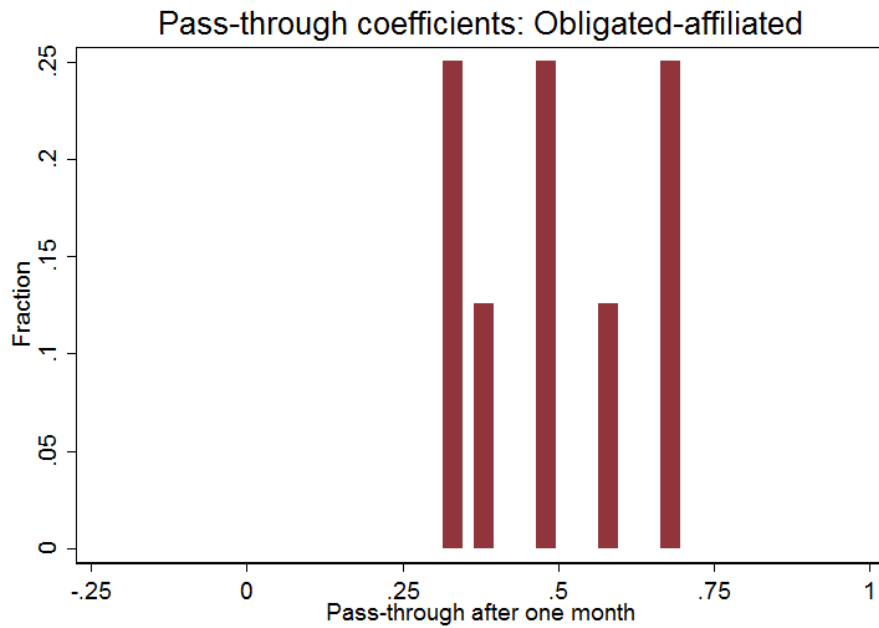
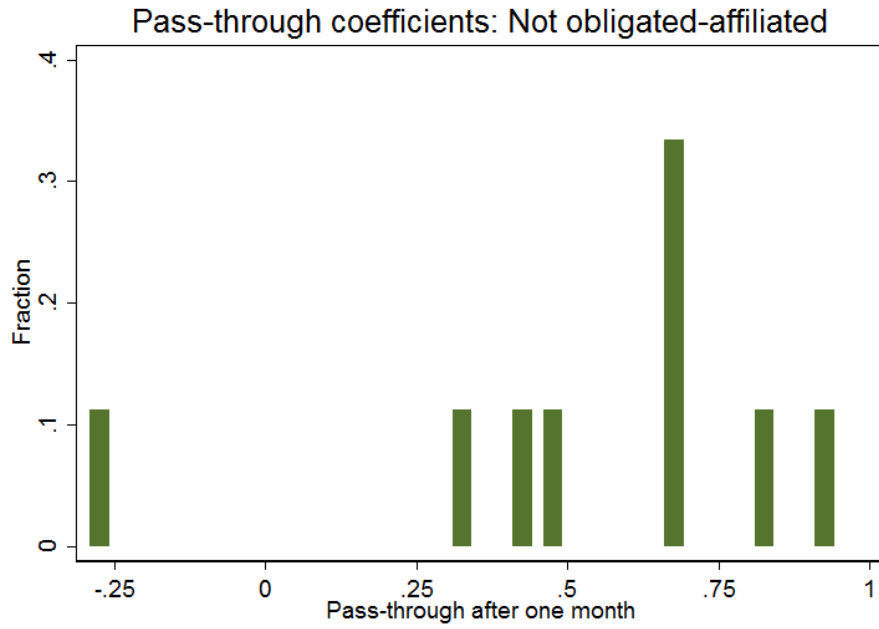
November 18, 2018

**Supplemental Appendix for  
Cost Pass-Through to Higher Ethanol Blends at the Pump:  
Evidence from Minnesota Gas Station Data**

**Jing Li, MIT**

**James H. Stock, Harvard University and NBER**

This supplemental appendix contains additional tables and figures referred to in the text. Appendix Figure 1 breaks down the station-level pass-through coefficients by whether the station is affiliated or not with an obligated party. The tables provide sensitivity analyses to varying the choices made for the results presented in the paper. The sensitivity check particulars are given in the table titles.



Notes: E85-E10 dataset. Pass-through coefficients are estimated at the brand level (brand interactions), with station-level fixed effects and monthly seasonals. The panel separate out stations affiliated, or not affiliated, with an entity that is obligated under the RFS (i.e. is affiliated with a refiner or importer of petroleum fuels).

Appendix Figure 1. Histogram of pass-through by station affiliation

Appendix Table I. Station-level pass-through regressions with additional monthly lag

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Dependent variable</b>	Retail E10	Retail E85	Retail E85	Retail E85-E10 Spread	Retail E10	Retail E85	Retail E85	Retail E85-E10 Spread
<b>Sample</b>	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10
<b>Dates</b>	2007m1- 2011m12	2007m1- 2011m12	2007m1- 2011m12	2007m1- 2011m12	2012m1- 2015m3	2012m1- 22015m3	2012m1- 2015m3	2012m1- 2015m3
<b>Cumulative pass-through</b>								
Wholesale E10, lag 0	0.889 (0.00894)		0.735 (0.0232)		0.846 (0.00851)		0.668 (0.0314)	
Wholesale E10, lag 1	1.040 (0.00422)		0.871 (0.0155)		1.036 (0.00731)		0.908 (0.0193)	
Wholesale E10, lag 2	1.029 (0.00240)		0.926 (0.00840)		0.960 (0.00431)		1.034 (0.0160)	
Wholesale E85, lag 0		0.699 (0.0171)				0.626 (0.0272)		
Wholesale E85, lag 1		0.874 (0.0149)				0.805 (0.0253)		
Wholesale E85, lag 2		0.942 (0.00948)				0.984 (0.0194)		
Wholesale E85-E10 spread, lag 0			0.147 (0.0149)	0.215 (0.0235)			0.255 (0.0358)	0.179 (0.0317)
Wholesale E85-E10 spread, lag 1			0.251 (0.0201)	0.387 (0.0355)			0.446 (0.0443)	0.432 (0.0409)
Wholesale E85-E10 spread, lag 2			0.408 (0.0251)	0.502 (0.0279)			0.561 (0.0527)	0.544 (0.0514)
N	5,469	5,278	5,278	5,278	4,288	4,247	4,247	4,247
Number of stations	215	215	215	215	175	175	175	175
Monthly seasonals?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: See the notes to Table IV.

Appendix Table II. Station-level pass-through regressions: No seasonals

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Dependent variable</b>	Retail E10	Retail E85	Retail E85	Retail E85-E10 Spread	Retail E10	Retail E85	Retail E85	Retail E85-E10 Spread
<b>Sample</b>	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10
<b>Dates</b>	2007m1- 2011m12	2007m1- 2011m12	2007m1- 2011m12	2007m1- 2011m12	2012m1- 2015m3	2012m1- 2015m3	2012m1- 2015m3	2012m1- 2015m3
<b>Cumulative pass-through</b>								
Wholesale E10, lag 0	0.885 (0.00781)		0.760 (0.0248)		0.836 (0.00849)		0.720 (0.0358)	
Wholesale E10, lag 1	1.035 (0.00216)		0.914 (0.00818)		1.006 (0.00275)		0.965 (0.0126)	
Wholesale E85, lag 0		0.843 (0.0238)				0.639 (0.0231)		
Wholesale E85, lag 1		0.951 (0.00928)				0.934 (0.0148)		
Wholesale E85-E10 spread, lag 0			0.137 (0.0152)	0.189 (0.0224)			0.325 (0.0322)	0.373 (0.0233)
Wholesale E85-E10 spread, lag 1			0.311 (0.0224)	0.456 (0.0262)			0.612 (0.0426)	0.658 (0.0359)
N	5,521	5,424	5,424	5,424	4,288	4,277	4,277	4,277
Number of stations	215	215	215	215	175	175	175	175
Monthly seasonals?	No	No	No	No	No	No	No	No

Notes: See the notes to Table IV.

Appendix Table III. Station-level pass-through regressions: Different data samples

	(1)	(2)	(3)	(4)	(5)	(6)
<b>Dependent variable</b>	Retail E10	Retail E85	Retail E10	Retail E85	Retail E10	Retail E85
<b>Sample</b>	E10	E85	E10	E85	E10	E85
<b>Dates</b>	2007m1- 2011m12	2007m1- 2011m12	2012m1- 2015m3	2012m1- 2015m3	2007m1- 2015m3	2007m1- 2015m3
<b>Cumulative pass-through</b>						
Wholesale E10, lag 0	0.885 (0.0117)		0.852 (0.00833)		0.852 (0.00908)	
Wholesale E10, lag 1	1.027 (0.00226)		0.983 (0.00228)		1.051 (0.00308)	
Wholesale E85, lag 0		0.656 (0.0169)		0.516 (0.0296)		0.529 (0.0137)
Wholesale E85, lag 1		0.938 (0.0103)		0.841 (0.0167)		0.923 (0.0101)
N	133,865	8,835	95,251	6,480	229,116	15,315
Number of stations	2,904	351	2,724	282	3,093	395
Monthly seasonals?	Yes	Yes	Yes	Yes	Yes	Yes

Notes: See the notes to Table IV.

Appendix Table IV. Station-level pass-through regressions: Including year effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<b>Dependent variable</b>	Retail E10	Retail E85	Retail E85	Retail E85-E10 Spread	Retail E10	Retail E85	Retail E85	Retail E85-E10 Spread	Retail E10
<b>Sample</b>	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10	E85-E10
<b>Dates</b>	2007m1- 2011m12	2007m1- 2011m12	2007m1- 2011m12	2007m1- 2011m12	2012m1- 2015m3	2012m1- 2015m3	2012m1- 2015m3	2012m1- 2015m3	2007m1- 2015m3
<b>Cumulative pass-through</b>									
Wholesale E10, lag 0	0.860 (0.00856)		0.678 (0.0276)		0.808 (0.00929)		0.669 (0.0367)		0.856 (0.00729)
Wholesale E10, lag 1	1.011 (0.00282)		0.911 (0.0119)		0.910 (0.0108)		0.970 (0.0387)		1.003 (0.00310)
Wholesale E85, lag 0		0.682 (0.0217)				0.428 (0.0372)			
Wholesale E85, lag 1		0.947 (0.0122)				0.669 (0.0374)			
Wholesale E85-E10 spread, lag 0			0.119 (0.0162)	0.250 (0.0201)			0.232 (0.0366)	0.180 (0.0305)	
Wholesale E85-E10 spread, lag 1			0.319 (0.0198)	0.410 (0.0290)			0.470 (0.0556)	0.433 (0.0522)	
N	5,521	5,424	5,424	5,424	4,288	4,277	4,277	4,277	9,921
Number of stations	215	215	215	215	175	175	175	175	247
Monthly seasonals?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The specifications and data are the same as in Table IV, except that all specifications include year effects. See the notes to Table IV.

Appendix Table V. Station-level pass-through regressions: replacing the OPIS E85 rack price for blended fuel with the “blend-your-own” price

	(1)	(2)	(3)	(4)
<b>Dependent variable</b>	Retail E85	Retail E85-E10 Spread	Retail E85	Retail E85-E10 Spread
<b>Sample</b>	E85-E10	E85-E10	E85-E10	E85-E10
<b>Dates</b>	2007m1- 2011m12	2007m1- 2011m12	2012m1- 2015m3	2012m1- 2015m3
<b>Cumulative pass-through</b>				
Wholesale E10, lag 0	0.683 (0.0293)		0.557 (0.0306)	
Wholesale E10, lag 1	0.939 (0.00765)		1.014 (0.0152)	
Wholesale E85-E10 spread, lag 0	0.169 (0.0176)	0.342 (0.0256)	0.0281 (0.0299)	0.0273 (0.0258)
Wholesale E85-E10 spread, lag 1	0.429 (0.0270)	0.537 (0.0286)	0.403 (0.0427)	0.392 (0.0475)
N	5,521	5,521	4,288	4,288
Number of stations	215	215	175	175
Monthly seasonals?	Yes	Yes	Yes	Yes

Notes: The regressions and data are the same as in Table IV, except that wholesale E85 price is using OPIS E85 rack price data. See the notes to Table IV.

Appendix Table VI. Table IV using double-cluster (county-time) standard errors

Dependent variable	Retail E10		Retail E85				Retail E85-E10 Spread
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dates	2007m1-2011m12	2012m1-2015m3	2007m1-2011m12	2012m1-2015m3	2007m1-2011m12	2012m1-2015m3	2012m1-2015m3
Wholesale E10, lag 0	0.860	0.808			0.678	0.669	
	(0.00856)	(0.00929)			(0.0276)	(0.0367)	
	[0.0260]	[0.0460]			[0.0606]	[0.0693]	
Wholesale E10, lag 1	1.011	0.910			0.911	0.970	
	(0.00282)	(0.00108)			(0.0119)	(0.0387)	
	[0.0935]	[0.0145]			[0.0137]	[0.0220]	
Wholesale E85, lag 0			0.682	0.428			
			(0.0217)	(0.0372)			
			[0.124]	[0.0744]			
Wholesale E85, lag 1			0.947	0.669			
			(0.0122)	(0.0374)			
			[0.0335]	[0.0337]			
Wholesale E85-E10 spread, lag 0					0.119	0.232	0.180
					(0.0162)	(0.0366)	(0.0305)
					[0.0535]	[0.0726]	[0.0724]
Wholesale E85-E10 spread, lag 1					0.319	0.470	0.433
					(0.0198)	(0.0556)	(0.0522)
					[0.0376]	[0.0681]	[0.0716]
N	5,521	4,288	5,424	4,277	5,424	4,277	4,277
Number of stations	215	175	215	175	215	175	175
Monthly seasonals?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Specifications are identical to text Table IV, except that standard errors are computed using the Cameron et al. (2011) double-cluster formula, where double clustering is at the county and time level. To simplify comparisons, the original (county-cluster) SEs are in parentheses, the double-cluster SEs are in brackets.



Appendix Table VII. Pass-through, rack-to-retail, if retailer splash-blends fuel and sells RIN:  
No seasonals

Dependent variable: retail E85-E10 spread  
Sample period: January 2012 – March 2015

Regional subset	(1) all	(2) Twin Cities	(3) outside Twin Cities
<b>Cumulative pass-through:</b>			
Splash blend wholesale E85- E10 spread, lag 0	0.400 (0.026)	0.420 (0.010)	0.394 (0.029)
Splash blend wholesale E85- E10 spread, lag 1	0.662 (0.036)	0.819 (0.023)	0.639 (0.037)
Splash blend RIN value, lag 0	-0.169 (0.033)	-0.005 (0.060)	-0.182 (0.035)
Splash blend RIN value, lag 1	0.429 (0.037)	0.753 (0.053)	0.392 (0.032)
<i>F</i> statistic testing equality of cumulative coefficient on spread and RIN value ( <i>p</i> -value)	29.75 <0.0001	0.770 0.541	29.04 <0.0001
N	4,288	441	3,847
Number of stations	175	16	159
Standard errors clustered at:	county	station	county
Monthly seasonals?	No	No	No

Notes: The reported coefficients are the cumulative pass-through. The splash blend wholesale spread is the difference between the splash-blend wet-fuel wholesale price of E85 and the rack price of E10, where E85 is produced by splash blending E10 with E100 with a RIN at the appropriate seasonal blending rate. The splash blend RIN value is  $-\left((\omega - .1) / .9\right) P_t^{D6}$ , where  $\omega$  is the seasonal blend rate for E85. All regressions have station fixed effects, with standard errors clustered as indicated. Results are for the E85-E10 dataset over the period January 2012 – March 2015.

Appendix Table VIII. Comparisons of station-level pass-through by binary station characteristics

	(1) $\mathbb{1}_Z = 1$ (Std. Err.)	(2) $\mathbb{1}_Z = 0$ (Std. Err.)	(3) t-test (p-val)
Z = Pre-2012	0.337 (0.017)	0.561 (0.022)	-7.743 (0.000)
Z = Twin Cities	0.712 (0.044)	0.510 (0.015)	-5.483 (0.000)
Z = Obligated Party	0.513 (0.031)	0.591 (0.034)	1.566 (0.123)

Notes:

- Column (1) gives the mean and standard error of station-level pass-through estimates after 1 month for the data sample that are in the category defined on the left of each row.
- Column (2) gives the mean and standard error of station-level pass-through estimates after 1 month for the data sample that are not in the category on the left of each row.
- Column (3) presents the two-sample t-test statistic, with p-values for the two-tailed hypothesis test against the null hypothesis that data split by the binary variable have equal sample means.
- Row 1 splits the data into a 2007-2011 period (Column 1) and 2012-2015 period (Column 2). The t-test is a paired t-test.
- Row 2 restricts the data to 2012 – 2015 sample, and it splits the data into stations that are in the Twin Cities region (Column 1) and stations that are in the Greater Minnesota area (Column 2). The t-test in Column (3) allows unequal variances and rejects the null that the two samples have equal means. This is consistent with the results in Section 5.
- Row 3 restricts the data to 2012 – 2015 sample, and it splits the data into stations that are Obligated Parties under the RFS (Column 1), and those that are not (Column 2). The t-test in Column (3) allows unequal variances and fails to reject the null that the two samples have equal means. This is consistent with the results in Section 5.