For Web Publication Only: Appendix

Supplemental Materials for Hausman, Catherine, 'Shock Value: Bill Smoothing and Energy Price Pass-Through,' *The Journal of Industrial Economics*

This appendix provides additional tables and figures.

Pass-Through from Henry Hub to Citygate

Another form of price smoothing is via hedging, including physical storage of gas, signing long-term contracts, or the use of financial instruments. To get a sense of how this impacts the purchasing price that utilities report, I regress purchasing cost on the Henry Hub price. Across various specifications (Table A1), pass-through is estimated to be at most 0.9, suggestive of some form of hedging. Column 1 shows the immediate pass-through (0.76). Column 2 shows that much of this comes with one-month lag. Column 3 shows that the pass-through after one year is 0.87; Column 4 includes additional time-series controls and shows a one-year pass-through of 0.79. Column 5 shows that, with an AR(1) process, the long-run pass-through is estimated to be 0.91 (calculated as 0.26 / (1-0.72)). Column 6 shows that instrumenting for the Henry Hub price does not change the results; the instrument, in the spirit of Hausman and Kellogg (2015), is the national average heating degree days over twelve months. Across these six specifications, the largest estimated long-run pass-through is 0.91 (Column 5). All specifications except the long-run pass-through in Column 5 are statistically different from one. This delayed (and possibly incomplete) pass-through is consistent with some hedging on the part of utilities.

Allowing for Price Endogeneity

Table A2 presents IV results for the residential fixed fee smoothing using the survey data on fixed fees. All three columns instrument for the citygate price with the average price at the Census region level. Results are essentially unchanged from the OLS results shown in Table 1.

Price Data Collection

While no comprehensive dataset on utility retail prices exists, some price documentation is publicly available online or by request from utilities and commissions. I searched for a time-series of rate documents for the largest utilities in the US.[1] Information was collected

[1]Largest according to the number of residential customers in 2013, the last year for which I have SNL data.

via a combination of web searches for utility and commission websites, contacting utilities directly, and the Internet Archive (archive.org). I searched for data on fixed charges for the 40 largest utilities, finding both current and historical information for 30, and current or spotty information only for an additional 9. I additionally searched for data on variable mark-ups and on gas cost recovery charges. I found historical mark-up data for 28 utilities and current or spotty data for an additional 7; and historical gas cost recovery data for 20 utilities and current or spotty data for an additional 4.

The typical utility or commission provides two types of documentation: a table of changes in gas commodity charges over time, and a "tariff book" in pdf form detailing the other components of the prices, which tend to change less often. For instance, Con Edison (New York) provides the information for March 2017 displayed in Figure A1. The left image shows the "gas cost factors," or volumetric commodity charge, for Con Edison, which change monthly. The right image shows the "minimum charge (per month)" (in practice, akin to a fixed charge) and "base rate... per therm" (volumetric mark-up), which tend to change every 1-3 years. Other utilities tend to show comparable documentation.

The Con Edison documentation also shows some of the complications that arise when collecting price data. The right panel of Figure A1 shows the pricing for "Service Classification No. 3: Residential and Religious - Heating Firm Sales Service." Numerous other price plans are available, including "general firm sales service," "residential and religious firm sales service," "seasonal off-peak firm sales service," "interruptible" rates, etc. Moreover, a comprehensive dataset would also need to account for additional fees and charges (frequently called "riders"), including the "merchant function charge," "revenue decoupling mechanism," "system benefits charge," and "temporary state assessment surcharge," each of which carries its own time series of changes. These additional charges are widespread across utilities, and they can appear as either volumetric or fixed charges. Finally, for the case of Con Edison (and some other utilities), what is loosely described here as a two-part tariff with a fixed and a volumetric charge is actually a minimum charge with an increasing block pricing structure: that is, there is a fixed charge, then zero mark-up (but a commodity charge) for the first three units sold, and a volumetric charge (both commodity cost and a mark-up) for additional units rising with usage. In practice, the typical customer is likely to use between 3 and 87 units, so I have elided the non-linear aspect of the volumetric fee.

Additional complications that arise include multiple service territories (in general, I collected pricing data for the largest service territory) and additional service classifications (e.g. low-income pricing).

A comprehensive dataset would require tracking, for all utilities, changes in (1) fixed charges, (2) volumetric mark-ups, (3) commodity costs, (4) additional temporary fixed and

volumetric surcharges, (5) non-linear volumetric prices—these would need to be tracked for each service classification and each service territory, and one would need data on the number of customers subject to each service classification. Each of these components could be structured and reported differently across utilities, and across time within a utility.

In general, I have collected data on the standard or default residential plan; low-income or other residential pricing plans are not included in the data. In some cases, I have collected both a "heating" rate and a "non-heating rate." Where it was clear what the main service territory was, I have collected data only for that geographic region. If it was unclear, I have included both regions as two separate cross-sectional units. Where possible, I have included riders, but for several utilities these were not clearly available.

Estimating Price Structures

Table A3 provides full results for the tests of potential threats to identification, using residential sector data (matching the condensed results presented in Table 4). Tables A4 and A5 provide additional robustness checks. Tables A6 through A8 provide comparable estimates for the commercial sector. Descriptions are given in the main text.

Expenditures

Table A10 provides summary statistics for the firm-level panel used in the capital expenditures regression. While the data are annual, quantity and expenditure variables have been divided by 12, to be comparable with the monthly summary statistics in Table 2.[2] Summary statistics are displayed for the 229 companies in the raw data; the regressions results in the main text use fewer companies because of missing data.

Tables A11 shows the robustness of the expenditures and input cost results to alternative specifications: alternative controls (Columns 1-3), using the region-level price as an instrument (Column 4), and weighting (Column 5). The results are sensitive to the time series controls (Columns 2 and 3); the coefficient is approximately zero if a quadratic trend is used, but the coefficient is larger in absolute value when year effects are used. Results are qualitatively similar when instrumenting for the citygate price (Column 4), but statistical significance is lost.

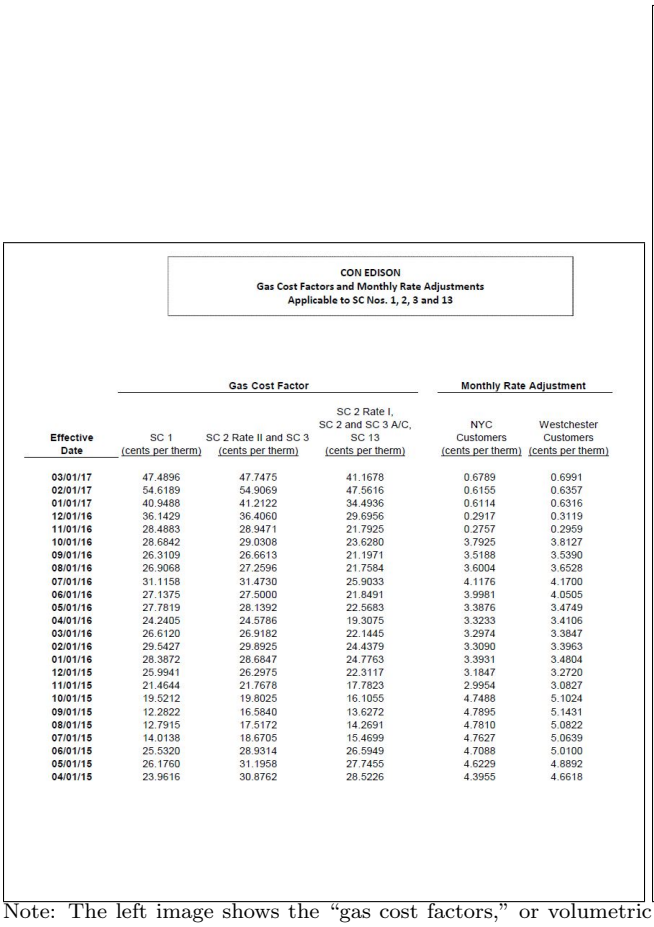
Table A12 shows the same specification as in Table 7, but with alternative expenditures categories. The expenditures data are broken out into multiple categories: distribution oper-

[2]The only variable not directly comparable with Table 2 is the customer count variable; in the state-by-month panel, this is a count of customers per state, whereas in the utility-by-year panel, it is a count of customers per utility.

ations and maintenance (O&M); customer accounts, sales, and information; administrative expenses; and capital. Distribution O&M includes, for instance, repairs at citygate stations, repairs to customer meters, etc. Customer accounts, sales, and information includes such spending as meter reading, customer accounts maintenance, uncollectible expenses, low-income assistance, etc. I subtract uncollectible accounts from this category, since its value is mechanically linked to the citygate price. As a result, this category has missing values—data on uncollectible accounts contain missing values. Administrative expenses include salaries, office supplies, etc. While negative impacts are estimated for capital, impacts for distribution expenditures; customer accounts, information, and sales; and administrative expenditures are small and not statistically different from zero.

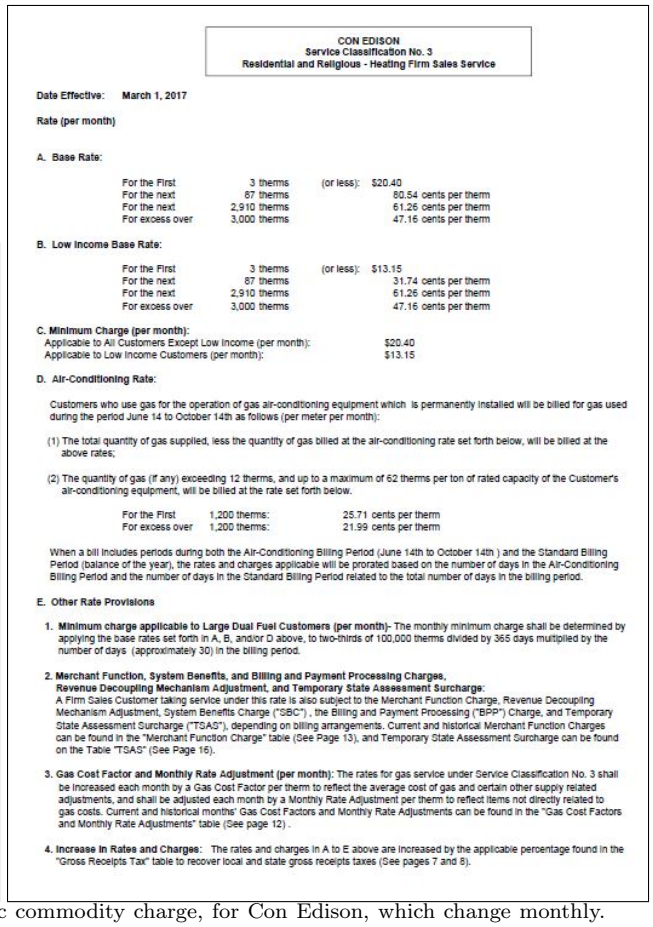
Note that control coefficients (not displayed in the main text's Table 7) are also displayed in this table, in Column 2. The positive coefficients on quantity consumed, although not statistically significant, are consistent with two possibilities: (1) service territory expansions increase the number of customers and require capital expenditures; (2) a positive mark-up means that additional sales will lead to additional revenue, which can then be used for capital expenditures. The negative coefficient on heating degree days is also consistent with two possibilities: (1) cold weather might inhibit pipeline repair; (2) "weather normalization" clauses in some jurisdictions are designed to undo the quantity/revenue tie previously mentioned. In these jurisdictions, additional HDDs would lead to additional consumption and therefore additional revenue, but some of this additional revenue would be removed via the normalization clause. To the extent these revenue changes impact capital expenditures, it would imply a positive coefficient on quantity but a negative coefficient on HDDs.

Figure A1: Sample Price Documentation, Con Edison (NY)



CON EDISON
Gas Cost Factors and Monthly Rate Adjustments
Applicable to SC Nos. 1, 2, 3 and 13

	Gas Cost Factor			Monthly Rate Adjustment	
Effective Date	SC 1 (cents per therm)	SC 2 Rate II and SC 3 (cents per therm)	SC 2 Rate I, SC 2 and SC 3 A/C, SC 13 (cents per therm)	NYC Customers (cents per therm)	Westchester Customers (cents per therm)
03/01/17	47.4896	47.7475	41.1678	0.6789	0.6991
02/01/17	54.6189	54.9069	47.5616	0.6155	0.6357
01/01/17	40.9488	41.2122	34.4936	0.6114	0.6316
12/01/16	36.1429	36.4060	29.6956	0.2917	0.3119
11/01/16	28.4883	28.9471	21.7925	0.2757	0.2959
10/01/16	28.6842	29.0308	23.6280	3.7925	3.8127
09/01/16	26.3109	26.6613	21.1971	3.5188	3.5390
08/01/16	26.9068	27.2596	21.7584	3.6004	3.6528
07/01/16	31.1158	31.4730	25.9033	4.1176	4.1700
06/01/16	27.1375	27.5000	21.8491	3.9981	4.0505
05/01/16	27.7819	28.1392	22.5683	3.3876	3.4749
04/01/16	24.2405	24.5786	19.3075	3.3233	3.4106
03/01/16	26.6120	26.9182	22.1445	3.2974	3.3847
02/01/16	29.5427	29.8925	24.4379	3.3090	3.3963
01/01/16	28.3872	28.6847	24.7763	3.3931	3.4804
12/01/15	25.9941	26.2975	22.3117	3.1847	3.2720
11/01/15	21.4644	21.7678	17.7823	2.9954	3.0827
10/01/15	19.5212	19.8025	16.1055	4.7488	5.1024
09/01/15	12.2822	16.5840	13.6272	4.7895	5.1431
08/01/15	12.7915	17.5172	14.2691	4.7810	5.0822
07/01/15	14.0138	18.6705	15.4699	4.7627	5.0639
06/01/15	25.5320	28.9314	26.5949	4.7088	5.0100
05/01/15	26.1760	31.1958	27.7455	4.6229	4.8892
04/01/15	23.9616	30.8762	28.5226	4.3955	4.6618



CON EDISON
Service Classification No. 3
Residential and Religious - Heating Firm Sales Service

Date Effective: **March 1, 2017**

Rate (per month)

A. Base Rate:

For the First	3 therms	(or less):	$20.40
For the next	87 therms		80.54 cents per therm
For the next	2,910 therms		61.26 cents per therm
For excess over	3,000 therms		47.16 cents per therm

B. Low Income Base Rate:

For the First	3 therms	(or less):	$13.15
For the next	87 therms		31.74 cents per therm
For the next	2,910 therms		61.26 cents per therm
For excess over	3,000 therms		47.16 cents per therm

C. Minimum Charge (per month):
Applicable to All Customers Except Low Income (per month): $20.40
Applicable to Low Income Customers (per month): $13.15

D. Air-Conditioning Rate:

Customers who use gas for the operation of gas air-conditioning equipment which is permanently installed will be billed for gas used during the period June 14 to October 14th as follows (per meter per month):

(1) The total quantity of gas supplied, less the quantity of gas billed at the air-conditioning rate set forth below, will be billed at the above rates;

(2) The quantity of gas (if any) exceeding 12 therms, and up to a maximum of 62 therms per ton of rated capacity of the Customer's air-conditioning equipment, will be billed at the rate set forth below.

For the First	1,200 therms:	25.71 cents per therm
For excess over	1,200 therms:	21.99 cents per therm

When a bill includes periods during both the Air-Conditioning Billing Period (June 14th to October 14th) and the Standard Billing Period (balance of the year), the rates and charges applicable will be prorated based on the number of days in the Air-Conditioning Billing Period and the number of days in the Standard Billing Period related to the total number of days in the billing period.

E. Other Rate Provisions

1. **Minimum charge applicable to Large Dual Fuel Customers (per month)**- The monthly minimum charge shall be determined by applying the base rates set forth in A, B, and/or D above, to two-thirds of 100,000 therms divided by 365 days multiplied by the number of days (approximately 30) in the billing period.

2. **Merchant Function, System Benefits, and Billing and Payment Processing Charges, Revenue Decoupling Mechanism Adjustment, and Temporary State Assessment Surcharge**:
A Firm Sales Customer taking service under this rate is also subject to the Merchant Function Charge, Revenue Decoupling Mechanism Adjustment, System Benefits Charge ("SBC") , the Billing and Payment Processing ("BPP") Charge, and Temporary State Assessment Surcharge ("TSAS"), depending on billing arrangements. Current and historical Merchant Function Charges can be found in the "Merchant Function Charge" table (See Page 13), and Temporary State Assessment Surcharge can be found on the Table "TSAS" (See Page 16).

3. **Gas Cost Factor and Monthly Rate Adjustment (per month)**: The rates for gas service under Service Classification No. 3 shall be increased each month by a Gas Cost Factor per therm to reflect the average cost of gas and certain other supply related adjustments, and shall be adjusted each month by a Monthly Rate Adjustment per therm to reflect items not directly related to gas costs. Current and historical months' Gas Cost Factors and Monthly Rate Adjustments can be found in the "Gas Cost Factors and Monthly Rate Adjustments" table (See page 12) .

4. **Increase in Rates and Charges:** The rates and charges in A to E above are increased by the applicable percentage found in the "Gross Receipts Tax" table to recover local and state gross receipts taxes (See pages 7 and 8).

Note: The left image shows the "gas cost factors," or volumetric commodity charge, for Con Edison, which change monthly. The right image shows the "minimum charge (per month)" (in practice, akin to a fixed charge) and "base rate... per therm" (volumetric mark-up), which tend to change every 1-3 years.

Table A1: Pass-Through of Henry Hub to Citygate

	(1)	(2)	(3)	(4)	(5)	(6)
Henry Hub price	0.76***	0.26***	0.25***	0.24***	0.26***	0.71***
	(0.03)	(0.05)	(0.04)	(0.03)	(0.02)	(0.15)
Henry Hub, lag 1		0.48***	0.48***	0.48***		
		(0.07)	(0.05)	(0.05)		
Henry Hub, lag 2		0.06	-0.05	-0.05*		
		(0.04)	(0.05)	(0.03)		
Henry Hub, lag 3			0.01	-0.00		
			(0.04)	(0.03)		
Henry Hub, lag 4			0.02	0.04		
			(0.03)	(0.03)		
Henry Hub, lag 5			-0.02	-0.03*		
			(0.02)	(0.02)		
Henry Hub, lag 6			0.06**	0.05**		
			(0.02)	(0.02)		
Henry Hub, lag 7			0.02	-0.01		
			(0.03)	(0.02)		
Henry Hub, lag 8			0.04	0.04*		
			(0.03)	(0.02)		
Henry Hub, lag 9			-0.03	-0.04		
			(0.03)	(0.03)		
Henry Hub, lag 10			-0.02	0.00		
			(0.04)	(0.04)		
Henry Hub, lag 11			0.07	0.07		
			(0.04)	(0.04)		
Henry Hub, lag 12			0.03	0.01		
			(0.03)	(0.03)		
Citygate price, lag 1					0.72***	
					(0.02)	
Linear trend	Yes	Yes	Yes	Yes	Yes	Yes
Quadratic trend	No	No	No	Yes	No	No
State by month effects	No	No	No	Yes	No	No
Observations	10,943	10,847	10,367	10,367	10,942	10,943
R^2	0.59	0.63	0.64	0.80	0.84	0.59
F-stat						6.29

Notes: This table regresses citygate purchasing costs reported by utilities on the Henry Hub price. The Henry Hub price, originally reported in dollars per mmBtu, has been rescaled to dollars per mcf using a conversion factor of 1.037. Column 6 instruments for the Henry Hub price using the national average heating degree days over 12 months. Standard errors are clustered by sample month. *** Statistically significant at the 1% level; ** 5% level; * 10% level.

Table A2: Residential Bill Smoothing, IV Specifications

	(1) Fixed Fee	(2) Fixed Fee	(3) Fixed Fee	(4) Volumetric mark-up	(5) Volumetric gas cost
Citygate price, $/mcf	-0.43*	-0.41	-0.17**	-0.10*	1.04***
	(0.22)	(0.27)	(0.07)	(0.05)	(0.05)
Fixed effects	Yes	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	Yes	Yes	Yes
Observations	27	337	5,410	4,549	3,219
Within R^2	0.63	0.08	0.16	0.04	0.75
F-stat	245.90	221.17	1580.36	1630.69	1434.11

Notes: Column 1 uses observations at the level of a Census division (n=9), covering the years 2006, 2010, and 2015; the data source is AGA surveys. Column 2 uses an unbalanced panel of utility-level observations for 48 cities in the US for the years 2007 and 2009-2016; the data source is a survey conducted annually by Memphis Light Gas and Water. Columns 3, 4, and 5 use an unbalanced panel of utility-level monthly observations for the approximately 40 largest utilities in the US for the years 1994 to 2017; the data source is tariff sheets collected by the author. Most utilities are represented by just one rate; a few have, for instance, both a "heating" and a "non-heating" rate. Standard errors are two-way clustered by state and year in Columns 2 through 5. The citygate price is instrumented with the Census region level (West, Midwest, Northeast, and South) average price. All prices are in 2015 dollars. *** Statistically significant at the 1% level; ** 5% level; * 10% level.

Table A3: Estimating Residential Rate Structures, Alternative Specifications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cost, $MC_{it}Q_{it}$, in $	0.42***	0.44***	0.42***	0.38***	0.47***	0.42***	0.43***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)
$MC_{i,t-1}Q_{it}$	0.24***	0.24***	0.24***	0.23***	0.24***	0.24***	0.24***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)
$MC_{i,t-2}Q_{it}$	0.12***	0.12***	0.11***	0.11***	0.12***	0.12***	0.12***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
$MC_{i,t-3}Q_{it}$	0.07***	0.07***	0.07***	0.10***	0.03	0.07***	0.07***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
Quantity	3.03***	3.14***	2.98***	3.59***	2.35***	3.10***	3.06***
	(0.26)	(0.26)	(0.29)	(0.37)	(0.26)	(0.74)	(0.26)
Citygate price	-0.37**	-0.62***	-0.38**	-0.33**	-0.47*	-0.38**	-0.33**
	(0.16)	(0.18)	(0.16)	(0.16)	(0.24)	(0.16)	(0.16)
CDD			-0.04				
			(0.05)				
HDD			0.04				
			(0.10)				
Quantity, quadratic						-0.00	
						(0.06)	
Quantity, cubic						0.00	
						(0.00)	
Rising citygate indicator							-0.63*
							(0.32)
Citygate, lag 1							
Citygate, lag 2							
Observations	14,942	14,942	14,942	8,411	6,531	14,942	14,942
Within R^2	0.85	0.85	0.85	0.84	0.86	0.85	0.85

Notes: This table is identical to Table 3 in the main text, with the following exceptions. Additional lags (4-12) on cost are included as controls, as in Table 3, but are not shown here for space. All columns use fixed effects and a linear trend with the following exceptions. Column 1 uses a quadratic trend. Column 2 uses a cubic trend. Column 3 controls for cooling degree days and heating degree days. Column 4 restricts the sample to states with less than 50 percent of homes using natural gas for heating. Column 5 restricts to states with more than 50 percent of homes using natural gas for heating. Column 6 controls for third-order polynomials for the quantity variables. Column 7 adds an asymmetric citygate effect (see text for details). *** Statistically significant at the 1% level; ** 5% level; * 10% level.

Table A4: Estimating Residential Rate Structures, Alternative Specifications

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Cost, $MC_{it}Q_{it}$, in $	0.46***	0.47***	0.47***	0.42***	0.43***	0.42***	0.43***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
$MC_{i,t-1}Q_{it}$	0.23***	0.23***	0.23***	0.24***	0.24***	0.27***	0.26***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
$MC_{i,t-2}Q_{it}$	0.10***	0.10***	0.11***	0.11***	0.12***	0.13***	0.13***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$MC_{i,t-3}Q_{it}$	0.08***	0.08***	0.06**	0.07***	0.07***	0.05**	0.06**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Quantity	2.44***	2.62***	3.21***	3.13***	3.08***	2.85***	2.94***
	(0.24)	(0.23)	(0.30)	(0.26)	(0.26)	(0.33)	(0.30)
Citygate price	-0.89***	-1.05***	-1.18***	-0.33**	-0.51***	-0.37*	-0.23
	(0.29)	(0.28)	(0.24)	(0.15)	(0.16)	(0.21)	(0.18)
CDD							
HDD							
Quantity, quadratic							
Quantity, cubic							
Rising citygate indicator							
Citygate, lag 1							
Citygate, lag 2							
Observations	14,942	14,942	14,942	14,942	14,942	14,942	14,942
Within R^2	0.96	0.96	0.80	0.87	0.85	0.85	0.86

Notes: This table is identical to Table 3 in the main text, with the following exceptions. Additional lags (4-12) on cost are included as controls, as in Table 3, but are not shown here for space. All columns use fixed effects and a linear trend with the following exceptions. Column 8 has only state fixed effects as controls. Column 9 has no seasonal controls. Column 10 uses year effects. Column 11 uses state-specific linear trends. Column 12 controls for GDP growth and for PHMSA safety regulations. Column 13 weights by customer count (time-invariant). Column 14 weights by volume sold (time-invariant). *** Statistically significant at the 1% level; ** 5% level; * 10% level.

Table A5: Estimating Residential Rate Structures, Alternative Specifications

	(15)	(16)	(17)	(18)	(19)	(20)
Cost, $MC_{it}Q_{it}$, in $	0.43***	0.45***	0.45***	0.42***		
	(0.03)	(0.04)	(0.04)	(0.03)		
$MC_{i,t-1}Q_{it}$	0.23***	0.22***	0.26***	0.25***		
	(0.02)	(0.02)	(0.03)	(0.03)		
$MC_{i,t-2}Q_{it}$	0.12***	0.10***	0.11***	0.10***		
	(0.02)	(0.02)	(0.02)	(0.03)		
$MC_{i,t-3}Q_{it}$	0.06**	0.07**	0.05*	0.07***		
	(0.02)	(0.03)	(0.03)	(0.02)		
Quantity	3.02***	3.11***	3.31***	3.04***		
	(0.26)	(0.41)	(0.44)	(0.26)		
Citygate price	-0.32**	-0.86***	-0.60**	-0.37*	-0.33**	-0.64***
	(0.14)	(0.18)	(0.26)	(0.18)	(0.13)	(0.20)
CDD						
HDD						
Quantity, quadratic						
Quantity, cubic						
Rising citygate indicator						
Citygate, lag 1				-0.13		
				(0.23)		
Citygate, lag 2				0.13		
				(0.16)		
Observations	14,011	8,606	6,336	14,942	14,942	14,891
Within R^2	0.86	0.80	0.91	0.85	0.87	0.82

Notes: This table is identical to Table 3 in the main text, with the following exceptions. Additional lags (4-12) on cost are included as controls, as in Table 3, but are not shown here for space. All columns use fixed effects and a linear trend with the following exceptions. Column 15 drops the three states with active and well-subscribed retail choice programs: Georgia, New York, and Ohio. Column 16 is restricted to 1990 through 2004. Column 17 is restricted to 2005 through 2015. Column 18 uses additional lags on the citygate variable. Column 19 allows the markup and pass-through coefficients to vary by state and by five-year periods. Column 20 uses first-differences of all variables. *** Statistically significant at the 1% level; ** 5% level; * 10% level.

Table A6: Estimating Commercial Rate Structures, Alternative Specifications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cost, $MC_{it}Q_{it}$, in $	0.45***	0.46***	0.45***	0.40***	0.50***	0.45***	0.45***
	(0.03)	(0.03)	(0.03)	(0.04)	(0.05)	(0.03)	(0.03)
$MC_{i,t-1}Q_{it}$	0.22***	0.22***	0.22***	0.22***	0.21***	0.22***	0.22***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
$MC_{i,t-2}Q_{it}$	0.11***	0.11***	0.11***	0.10***	0.13***	0.11***	0.11***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)
$MC_{i,t-3}Q_{it}$	0.06***	0.05***	0.06***	0.06**	0.05**	0.06***	0.06***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Quantity	2.73***	2.90***	2.63***	3.11***	1.99***	0.63	2.74***
	(0.38)	(0.40)	(0.44)	(0.49)	(0.27)	(1.29)	(0.36)
Citygate price	-2.14	-3.96**	-1.90	-1.95	-1.53	-2.31*	-1.59
	(1.40)	(1.57)	(1.31)	(1.76)	(1.73)	(1.19)	(1.38)
CDD			-0.15				
			(0.66)				
HDD			0.68				
			(0.96)				
Quantity, quadratic						0.02	
						(0.02)	
Quantity, cubic						-0.00	
						(0.00)	
Rising citygate indicator							-4.20*
							(2.18)
Citygate, lag 1							
Citygate, lag 2							
Observations	14,931	14,931	14,931	8,411	6,520	14,931	14,931
Within R^2	0.83	0.83	0.83	0.84	0.83	0.83	0.83

Notes: This table is identical to Table 3 in the main text, with the following exceptions. Additional lags (4-12) on cost are included as controls, as in Table 3, but are not shown here for space. All columns use fixed effects and a linear trend with the following exceptions. Column 1 uses a quadratic trend. Column 2 uses a cubic trend. Column 3 controls for cooling degree days and heating degree days. Column 4 restricts the sample to states with less than 50 percent of homes using natural gas for heating. Column 5 restricts to states with more than 50 percent of homes using natural gas for heating. Column 6 controls for third-order polynomials for the quantity variables. Column 7 adds an asymmetric citygate effect (see text for details). *** Statistically significant at the 1% level; ** 5% level; * 10% level.

Table A7: Estimating Commercial Rate Structures, Alternative Specifications

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Cost, $MC_{it}Q_{it}$, in $	0.48***	0.50***	0.51***	0.45***	0.46***	0.46***	0.46***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)
$MC_{i,t-1}Q_{it}$	0.21***	0.21***	0.20***	0.22***	0.21***	0.24***	0.24***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
$MC_{i,t-2}Q_{it}$	0.10***	0.10***	0.10***	0.11***	0.11***	0.14***	0.14***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$MC_{i,t-3}Q_{it}$	0.06***	0.06***	0.04**	0.05***	0.06***	0.06***	0.06***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)
Quantity	2.32***	2.44***	3.13***	2.48***	2.83***	2.70***	2.80***
	(0.28)	(0.28)	(0.43)	(0.32)	(0.38)	(0.36)	(0.38)
Citygate price	-5.12**	-6.05***	-8.88***	-1.97	-3.48**	-1.01	-0.75
	(2.07)	(1.98)	(2.02)	(1.38)	(1.42)	(1.66)	(1.51)
CDD							
HDD							
Quantity, quadratic							
Quantity, cubic							
Rising citygate indicator							
Citygate, lag 1							
Citygate, lag 2							
Observations	14,931	14,931	14,931	14,931	14,931	14,931	14,931
Within R^2	0.94	0.94	0.77	0.85	0.83	0.82	0.83

Notes: This table is identical to Table 3 in the main text, with the following exceptions. Additional lags (4-12) on cost are included as controls, as in Table 3, but are not shown here for space. All columns use fixed effects and a linear trend with the following exceptions. Column 8 has only state fixed effects as controls. Column 9 has no seasonal controls. Column 10 uses year effects. Column 11 uses state-specific linear trends. Column 12 controls for GDP growth and for PHMSA safety regulations. Column 13 weights by customer count (time-invariant). Column 14 weights by volume sold (time-invariant). *** Statistically significant at the 1% level; ** 5% level; * 10% level.

Table A8: Estimating Commercial Rate Structures, Alternative Specifications

	(15)	(16)	(17)	(18)	(19)	(20)
Cost, $MC_{it}Q_{it}$, in $	0.45***	0.46***	0.51***	0.46***		
	(0.03)	(0.05)	(0.04)	(0.04)		
$MC_{i,t-1}Q_{it}$	0.22***	0.19***	0.23***	0.22***		
	(0.02)	(0.03)	(0.03)	(0.04)		
$MC_{i,t-2}Q_{it}$	0.09***	0.10***	0.10***	0.08*		
	(0.02)	(0.02)	(0.02)	(0.05)		
$MC_{i,t-3}Q_{it}$	0.06***	0.05**	0.05	0.06***		
	(0.02)	(0.02)	(0.03)	(0.02)		
Quantity	2.74***	2.21***	2.78***	2.74***		
	(0.39)	(0.40)	(0.61)	(0.38)		
Citygate price	-1.96	-4.75***	-5.81*	-2.84	-1.86*	-3.52***
	(1.27)	(1.57)	(2.78)	(1.92)	(1.02)	(0.95)
CDD						
HDD						
Quantity, quadratic						
Quantity, cubic						
Rising citygate indicator						
Citygate, lag 1				-0.43		
				(1.33)		
Citygate, lag 2				1.62		
				(1.81)		
Observations	14,007	8,595	6,336	14,931	14,931	14,879
Within R^2	0.83	0.76	0.87	0.83	0.85	0.74

Notes: This table is identical to Table 3 in the main text, with the following exceptions. Additional lags (4-12) on cost are included as controls, as in Table 3, but are not shown here for space. All columns use fixed effects and a linear trend with the following exceptions. Column 15 drops the three states with active and well-subscribed retail choice programs: Georgia, New York, and Ohio. Column 16 is restricted to 1990 through 2004. Column 17 is restricted to 2005 through 2015. Column 18 uses additional lags on the citygate variable. Column 19 allows the markup and pass-through coefficients to vary by state and by five-year periods. Column 20 uses first-differences of all variables. *** Statistically significant at the 1% level; ** 5% level; * 10% level.

Table A9: Forecasting the Future Rolling Average Citygate Price

	Rolling (Lags 11 to 0) Average Citygate Price
L12.Citygate price	0.44***
	(0.01)
L13.Citygate price	0.07***
	(0.01)
L14.Citygate price	0.04***
	(0.01)
L15.Citygate price	0.00
	(0.01)
L16.Citygate price	0.02*
	(0.01)
L17.Citygate price	0.04***
	(0.01)
L18.Citygate price	0.03*
	(0.01)
L19.Citygate price	0.02*
	(0.01)
L20.Citygate price	0.04***
	(0.01)
L21.Citygate price	0.04***
	(0.01)
L22.Citygate price	0.01
	(0.01)
L23.Citygate price	0.04***
	(0.01)
State by month effects	Yes
Observations	14,397
Within R^2	0.66

Notes: This table displays the coefficients on lagged citygate prices used for forecasting. Specifically, a rolling-average citygate price (using up to 11 lags) was generated, using seasonal quantity weights. This was then regressed on the previous year's 12 months of prices. These coefficients are then used to predict the following year's rolling average price. See text for details. *** Statistically significant at the 1% level; ** 5% level; * 10% level.

Table A10: Summary Statistics, Utility by Year Panel

	Mean	Std. Dev.	N
Citygate price	7.58	2.38	2,666
Retail price			
Residential	13.30	3.79	2,629
Commercial	11.40	3.11	2,625
Industrial	9.76	3.54	2,371
Quantity			
Residential	6.49	1.84	2,666
Commercial	47.58	26.35	2,666
Industrial	5,778.13	11,683.51	2,666
Power Plant	111,957.71	320,432.13	2,666
Customers			
Residential	308,180.56	583,831.14	2,666
Commercial	24,624.75	34,062.64	2,666
Industrial	988.86	2,897.76	2,666
Power Plant	8.14	53.79	2,666
Expenditures			
Distribution O&M	6.90	3.21	2,578
Customer accounts, info, and sales	4.22	2.24	1,898
Administrative	10.50	7.26	2,577
Capital	10.30	10.44	2,440

Notes: A unit of observation is a utility in a year. For comparison with Table 2, the quantity and expenditure variables have been divided by 12 and thus are monthly amounts per customer. The sample covers 1998 through 2013. The subset of firms included is 229 large investor-owned utilities; see text for details. Prices are in $ per thousand cubic feet (mcf). Revenue is in $ per customer per month. Quantity is in mcf per customer per month. Expenditures are in $ per customer per month. Prices and revenue are listed in 2015 dollars.

Table A11: The Impact of Gas Input Prices on Capital Expenditures, Alternative Specifications

	(1)	(2)	(3)	(4)	(5)
Citygate price	-0.19***	0.01	-0.41*	-0.12	-0.14*
	(0.06)	(0.10)	(0.22)	(0.08)	(0.07)
Quantity					
Residential		1.08*	1.01	1.12*	0.40
		(0.60)	(0.65)	(0.60)	(0.62)
Commercial		0.04	0.04	0.04	0.01
		(0.02)	(0.03)	(0.03)	(0.01)
Industrial		0.00	0.00	0.00	0.00*
		(0.00)	(0.00)	(0.00)	(0.00)
Power Plant		0.00	0.00	0.00	-0.00
		(0.00)	(0.00)	(0.00)	(0.00)
Heating degree days	-0.26	-0.70**	-0.78**	-0.77**	-0.34
	(0.17)	(0.33)	(0.33)	(0.33)	(0.29)
Utility effects	Yes	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	No	Yes	Yes
Year effects	No	No	Yes	No	No
Observations	2,434	2,434	2,434	2,434	2,434
Within R^2	0.02	0.04	0.02	0.04	0.06

Notes: Expenditures are per-customer and in 2015 dollars. Observations are weighted by the number of customers. Standard errors are clustered by state. Table is identical to Table 7 in the main text, with the following exceptions. Column 1 uses no controls other than utility effects and a linear trend. Column 2 uses a quadratic trend. Column 3 uses year effects. Column 4 uses the region-level average price as an instrument for the state-level price. Column 5 weights by customer count. *** Statistically significant at the 1% level; ** 5% level; * 10% level.

Table A12: The Impact of Gas Input Prices on Various Categories of Expenditures

	(1)	(2)	(3)	(4)
	Distribution	Capital	Customer Accounts, Info, and Sales	Adminis-trative
Citygate price	-0.04	-0.13**	-0.00	0.02
	(0.03)	(0.06)	(0.02)	(0.03)
Quantity				
Residential	0.24	1.11*	0.19*	-0.30
	(0.27)	(0.59)	(0.10)	(0.21)
Commercial	0.01*	0.04	0.01***	0.02***
	(0.00)	(0.03)	(0.00)	(0.00)
Industrial	-0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Power Plant	-0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Heating degree days	-0.15	-0.76**	-0.11*	0.11
	(0.13)	(0.32)	(0.06)	(0.11)
Utility effects	Yes	Yes	Yes	Yes
Linear trend	Yes	Yes	Yes	Yes
Observations	2,574	2,434	1,891	2,573
Within R^2	0.03	0.04	0.04	0.02

Notes: Expenditures are per-customer and in 2015 dollars. Upper one percent expenditure outliers have been winsorized. Standard errors are clustered by state. *** Statistically significant at the 1% level; ** 5% level; * 10% level.