Columbia Gas of Kentucky

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PUBLIC SERVICE COMMISSION

June 16, 2009

Mr. Jeff Derouen
Executive Director
Public Service Commission
Commonwealth of Kentucky
211 Sower Boulevard
P. O. Box 615
Frankfort, KY 40602

RE: Case No. 2009-00141

Dear Mr. Derouen,

Enclosed for docketing with the Commission is an original and ten copies of Columbia Gas of Kentucky, Inc.'s responses to the AARP's First Set of Requests. Should you have any questions about this filing, please contact me at 614-460-4648. Thank you!

Sincerely,

Stephen B. Seiple
Assistant General Counsel

Enclosures

cc: All Parties of Record
Hon. Richard S. Taylor

CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing responses of Columbia Gas of Kentucky, Inc., were served upon all parties of record by regular U. S. mail this 16th day of June, 2009.

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PSC Case No. 2009-00141
AARP DR Set 1-001
Respondent(s): Mark Balmert

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 001:

Please provide the earned rate of return, and the return allowed in the most recent rate case, for each period shown on Exhibit MPB-9.

Response:

Please refer to response to AG DR Set 1-193.

**COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP**

Data Request 002:

(a) Please provide the cross-price-elasticity of natural gas for each class of Columbia Gas of Kentucky customers, versus electricity.

(b) If such elasticities are available only for a larger set of customers (e.g. all Columbia Gas customers, all natural gas customers in various regions of the United States, etc.), please provide the elasticities most applicable to the customers of Columbia Gas of Kentucky.

(c) If such elasticities have changed over the last 10 years, please explain the changes.

(d) To the extent possible, please break out such elasticities for the residential class by the income levels of the customers (e.g. under 50% of federal poverty guidelines, under 100%, under 125%, under 150%, under 200%, or percentages of median income, or some similar yardstick).

Response:

(a) We have not estimated cross-price elasticities versus electricity.
(b) We are not aware of any estimates of cross-price elasticities.
(c) See response to (b).
(d) See response to (b).

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 003:

Please provide the average usage per gas-using appliance (e.g. furnace, space heater, refrigerator) for each of the last 10 years. To the extent available, please break out customers' average usage per gas-consuming appliance by income, age, and disability of the customer.

Response:

Columbia does not maintain data of this nature.

**COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP**

Data Request 004:

Please provide the average usage per customer and the annual total usage for each class for the last 10 years.

Response:

See attachment AARP DR Set 1-004 Attachment A.

Columbia Gas of Kentucky

	Annual MCF/Customer			Annual MCF		
	Res	Com	Ind	Res	Com	Ind
1999	84	519	173,390	10,550,472	7,409,840	21,847,090
2000	86	531	156,328	10,974,416	7,711,572	20,009,949
2001	83	513	123,987	10,560,781	7,452,087	15,498,340
2002	81	519	144,731	10,408,274	7,574,892	17,801,921
2003	84	532	119,317	10,793,016	7,805,323	14,675,962
2004	78	524	149,887	9,969,714	7,697,747	17,686,674
2005	77	528	142,669	9,749,004	7,784,901	17,120,274
2006	68	491	147,156	8,597,475	7,147,627	17,658,720
2007	70	502	141,548	8,740,362	7,279,191	16,844,217
2008	75	540	163,173	9,362,930	7,770,735	18,601,759

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

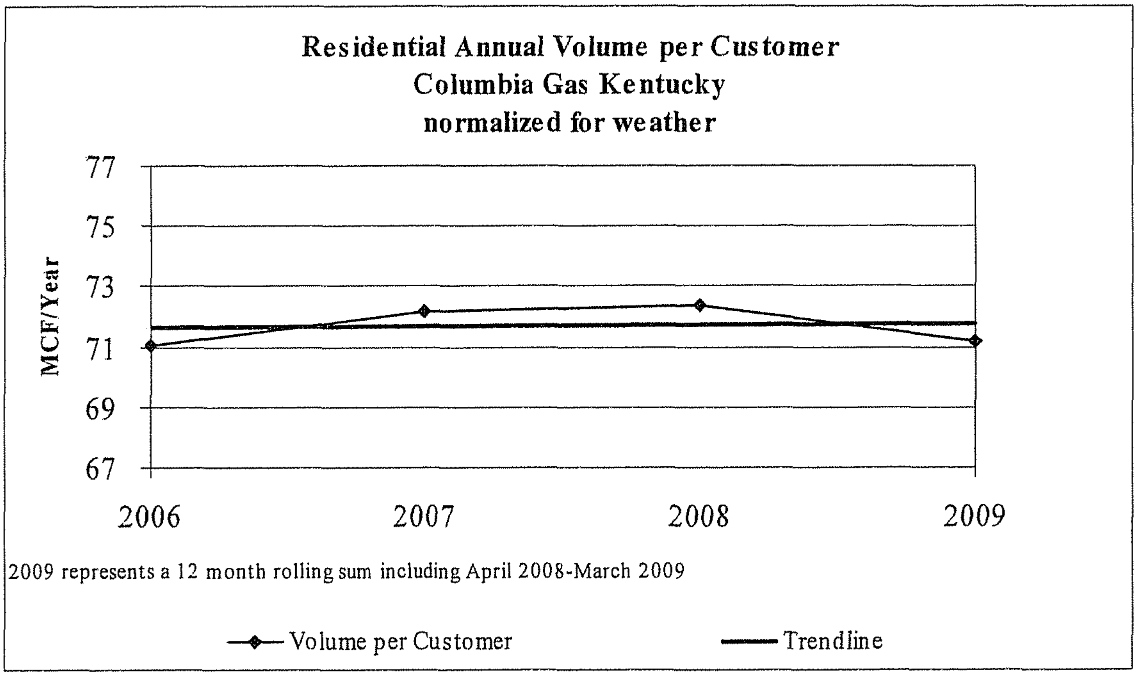
Data Request 005:

(a) Please provide the chart on p. 6 of Ms. Efland's testimony, using only the data points 2006, 2007, 2008 and 2009.

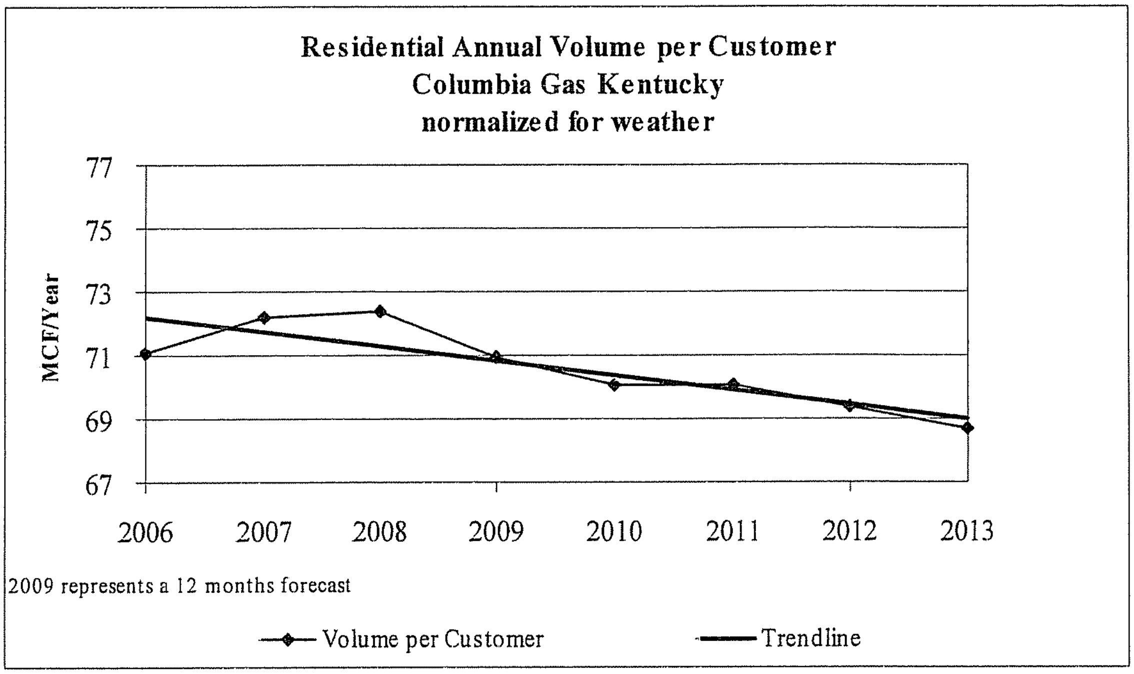
(b) Please provide the chart on p. 6 of Ms. Efland's testimony, using the historical data for 2006, 2007, 2008 and 2009, and the company's forecast residential annual volume per customer, Columbia Gas Kentucky, normalized for weather, for each of the next 5 years. Please provide copies of all forecasts of such volumes per customer for the next 5 years.

Response:

(a)



(b)



	CKY Forecast MCF/Customer
2009	71
2010	70
2011	70
2012	69
2013	69

PSC Case No. 2009-00141
AARP DR Set 1-006
Respondent(s): Amy Efland

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 006:

Please provide all studies, memoranda, data or other material on which Ms. Efland bases her conclusions on p. 7 that "the downward trend in consumption per customer will continue."

Response:

The conclusion is supported by Columbia's residential use per customer data. As indicated on pages 5 and 6 of my testimony, the data shows a long term trend of declining use. The most current 2009 data point follows this trend and indicates that the slight increase in use in 2007 and 2008 is not indicative of a change in usage trends. The March 2007 American Gas Association (AGA) study "An Economic Analysis of Consumer Response to Natural Gas Prices " states on page 7 that, "From a planning and policy perspective, even if gas prices do not increase in a given year, there will still be approximately a 1 percent fall in gas usage per household in the following year. This is driven by the historical forces related to the natural turnover of old appliances to the more efficient appliances that are available on the market each year." Please refer to AARP Set 1 Data Request No. 6 Attachment for a copy of the AGA study. This, in concert with recent national policy conservation initiatives, results in a conclusion that the downward trend in use per customer will continue.

An Economic Analysis of Consumer Response to Natural Gas Prices

Frederick Joutz and Robert P. Trost

Prepared for the American Gas Association
March, 2007

American Gas Association

An Economic Analysis of Consumer Response to Natural Gas Prices

Frederick Joutz and Robert P. Trost[1]

Prepared for the American Gas Association
March, 2007

Published by
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Washington, DC 20001
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[1] Professors of Economics, George Washington University. Contact information: fred.joutz@gmail.com and trost@gwu.edu. We are grateful for the support from the AGA, especially the helpful comments from Bruce McDowell, David Shin, and Paul Wilkinson. We are responsible for any remaining errors.

Table of Contents

Executive Summary

Introduction and Key Findings

The consumption of natural gas per household has been declining, on a weather-normalized basis, since about 1980. Over time, natural gas consumers have been tightening their homes, purchasing more efficient appliances and turning down their thermostats. Given the significant increase in natural gas prices since 2000, the American Gas Association (AGA) decided to examine whether or not the trend in declining use has changed in this higher-priced environment. The results of this study are based on monthly data submitted by 46 local natural gas distribution companies that serve nearly 30 percent of all residential natural gas customers throughout the U.S. Some companies submitted data as far back as the early 1980's. The key findings of the study are as follows.

- A trend in declining use per residential natural gas customer of 1 percent annually has been documented[2] back to 1980. This decline rate has accelerated since the year 2000.
  - Weather-adjusted use per residential customer fell by 13.1 percent from 2000 through 2006.
  - The annual rate of decline in this 2000 to 2006 timeframe more than doubled relative to the pre-2000 period, increasing to 2.2 percent annually.
  - Further acceleration was witnessed in the 2004 to 2006 period, as evidenced by a 4.9 percent annual rate of decline.
  - The decline in use per customer has accelerated since 2000 in all 9 geographic regions analyzed.

- No appreciable changes in the price elasticity of demand were observed post-2000. Price elasticity of demand refers to the percentage change in demand for a good relative to a percentage change in price. Although the elasticity has not changed over time, it should be noted that natural gas is an essential product that provides heat, hot water and cooking. Despite the essential nature of natural gas, consumers have continued to reduce their consumption at a relatively constant rate with respect to changing prices. Therefore, the large price increases post-2000 have resulted in the large consumption declines noted above.
  - This study found a short-run price elasticity of –0.09 and a long-run price elasticity of -0.18. (Long-run elasticity refers to a period of time long enough for consumers to change the capital stock of their energy consuming equipment and the shell efficiency of their homes.)

[2] 2004 AGA Energy Analysis: Patterns in Residential Natural Gas Consumption, 1980-2001.

- These price elasticity estimates are relatively consistent with previous works on this subject.
- The econometric analysis presented in this study predicts a decline of 13.9 percent between 2000 and 2006; the actual decline was 13.1 percent. The decline is attributable to a price effect and the longer-run trend towards tighter homes and more efficient appliances. The price elasticity effect is 7.9 percent - equal to the elasticity estimate of -0.18 times the 44 percent real price increase. The remaining 6.0 percent is explained by the longer-run trend towards tighter homes and more efficient appliances.
- As a general rule of thumb, at the national level we would expect a 10 percent increase in the price of natural gas to result in nearly a 3 percent decline in the average residential use per customer 12 months later – 1 percent attributable to more conservation with existing appliances, 1 percent attributable to the price-induced purchase of more efficient appliances, and 1 percent attributable to the natural turnover of equipment that occurs annually.

<u>Background</u>

Residential natural gas consumption is strongly influenced by three factors: seasonal heating needs; response to price change; and the efficiency changes in appliances and home shells caused by a natural turnover rate to more efficient homes and gas appliances. On a weather-adjusted basis, the price and the long run conservation effects are key determinants of changes in residential natural gas consumption. The price effects can be further decomposed into short-term and long-term effects. Short term effects are decisions made by consumers with the current capital stock. Residential customers "turning down the thermostat" would be considered a short term effect. Long term effects are distinguished from short term effects by the inclusion of the decision to purchase more efficient energy consuming appliances and prematurely retiring less efficient ones. The price elasticity in the long-run is the sum of (1) the short-run demand and (2) the additional changes that occur to quantity demanded one year later because of natural gas price effects on the efficiency of the appliance capital stock and on the shell efficiency of homes[3]. While the separate efficiency and conservation effects due to appliance and housing shell turnover are difficult to disentangle in the current sample, they do appear to be discernable from the long term price effects.

To address these issues, AGA commissioned a study to document changes in use per residential customer on a weather normalized basis, particularly since the year 2000, and to identify the reasons for these changes. Other objectives of this study were: to obtain updated elasticity estimates for all nine US Census Regions and for the US; to test for an increase in

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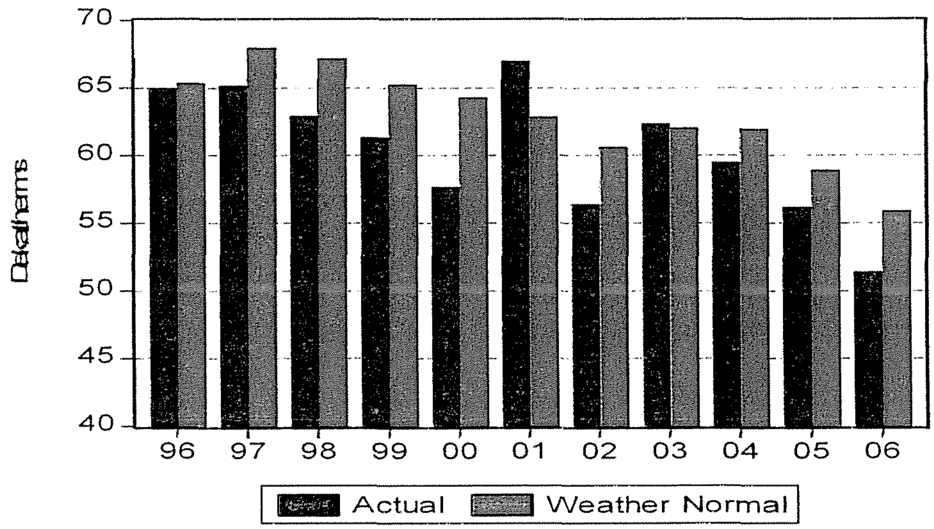
[3] It should be noted that if natural gas prices decrease, consumers will not replace recently purchased efficient equipment with less efficient equipment. So there maybe asymmetry with respect to the impact of natural gas prices on appliance and shell efficiency. The efficiency gains in appliance equipment that have occurred in the last several years will not disappear if natural gas prices go down. However, declining prices may lead consumers turning up thermostats to increase comfort levels (in the short-run). In the very long-run, a decline in prices could lead to an increase in burner tips per customer.

the price elasticity of demand for natural gas since the year 2000; and to estimate a natural rate of decline in use per customer due to technology-induced gains in appliance and shell efficiency and a change in conservation attitudes that would occur even in an environment of constant real natural gas prices.

Decline in Use per Customer

Demand for natural gas per residential customer has been declining since the 1980's, and in recent years this decline has accelerated. Between 1980 and 2001, weather adjusted natural gas use per consumer in the US declined almost 1 percent on an annual basis. Since 2000, however, the decline for winter only use has accelerated, decreasing 13.1 percent nationally between 2000 and 2006 for the sample of companies analyzed in this report. Figure ES1 below shows the winter season use per customer in actual and weather normal dekatherms from 1996-2006 using the data collected by AGA.[4] It is clear that actual and weather normalized use per customer has been declining since 1997 and this decline has accelerated since 2004.

Figure ES1
US Annual Winter Use per Customer



[4] The data was collected from 46 Local Distribution Companies (LDCs) in 29 states, representing 28 percent of all residential customers. An LDC is a gas utility that serves a specific rate jurisdiction. Some of the companies in this sample have multiple jurisdictions in their corporate structure. The winter season for this report is defined as the sum of the monthly consumption between October and March.

Table ES1 disaggregates the national winter season weather normal use per residential customer across the nine US Census Regions and for the US. The decline in weather normal use per customer has occurred across all US Census regions. The decline ranges from 5.7 dekatherms per customer for the West South Central region to 10.9 dekatherms for the East North Central region. The percentage decline in use per customer ranged from 9.2 percent for the Middle Atlantic Region to 14.8 percent for the Pacific Region.

Table ES1
Annual Winter Season Weather Normal
Natural Gas Use per Residential Customer,
By Region and for the U.S.
(Dekatherms per Customer)

Census Region	2000	2001	2002	2003	2004	2005	2006	Percent Change
National	64.3	62.8	60.6	62.0	61.9	58.9	55.9	-13.1%
East North Central	81.1	79.2	80.1	77.8	76.1	73.1	70.2	-13.4%
East South Central	64.9	64.2	61.3	62.2	60.8	58.7	55.9	-13.9%
Middle Atlantic	93.7	95.0	91.2	93.5	92.8	88.3	85.1	-9.2%
Mountain	80.6	77.9	75.8	76.4	71.8	72.0	70.5	-12.5%
New England	80.7	79.8	75.3	82.3	80.3	75.9	72.4	-10.3%
Pacific	43.8	40.9	40.0	41.8	40.6	40.4	37.3	-14.8%
South Atlantic	71.7	69.4	63.8	69.1	62.0	62.5	62.5	-12.8%
West North Central	80.1	79.5	79.8	80.4	78.3	75.9	70.2	-12.4%
West South Central	46.3	46.4	40.2	44.1	54.1	41.7	40.6	-12.3%

Source: An Economic Analysis of Consumer Response to Natural Gas Prices, AGA, 2007.

Price Elasticity and "Natural" Conservation Estimates

This study found that neither a practical nor statistically significant change in the price elasticity of residential natural gas consumption occurred in the post year 2000 period. The price elasticity of residential natural gas demand appears to have remained relatively constant since the 1990s. This implies the large percentage price increase since 2000 accounted for the decline in natural gas use, rather than an increased sensitivity or greater response by households to a given price change. The study also found that independent of natural gas price increases, the naturally occurring decline due to the technology driven gain in appliance and home thermal shell efficiency, as well as changes in conservation attitudes was 1 percent per year.

Table ES2 illustrates that for the sample of companies in the study, the short run price elasticity of demand averaged -0.09, while the long run estimated averaged -0.18. Therefore, given a 10 percent increase in the price of natural gas, consumption would decline 2.8 percent; 1.8 percent for price response, added to 1.0 percent decline due to the normal turnover of appliances and other "natural" conservation measures. There is very little regional variation in the total impact of a 10 percent increase in real prices on use per customer. The impact in all regions was close to the national estimate of 2.8 percent, with the Mountain region being the lowest at 1.9 percent and the South Atlantic region being the highest at 3.7 percent.

The study also found that the elasticity estimates calculated using the sample data were generally consistent with the elasticity estimates found in the energy economics literature.[5]

Table ES2
Summary of National and Regional
Natural Gas Price Elasticity Estimates*

Region	Short-run elasticity	Long-run elasticity**	Annual Time Trend	Total Response to a 10% Price Increase***
National	-0.09	-0.18	-1.0%	-2.8%
East North Central	-0.08	-0.22	-1.0%	-3.2%
East South Central	0.01	-0.01	-2.0%	-2.1%
Middle Atlantic	-0.10	-0.20	-1.3%	-3.3%
Mountain	-0.07	-0.10	-0.9%	-1.9%
New England	-0.08	-0.25	-0.4%	-2.9%
Pacific	-0.07	-0.12	-0.8%	-2.0%
South Atlantic	-0.12	-0.29	-0.8%	-3.7%
West North Central	-0.09	-0.15	-1.1 %	-2.6%
West South Central	-0.13	-0.16	-1.6%	-3.2%

* Estimates obtained from the "fixed effects" pooled regression
** Cumulative: includes impacts of short-run elasticities
*** The total response to a 10% price increase is the sum of the long-run elasticity and the annual time trend effect.

Implications

These price elasticity estimates and the natural conservation trends are able to explain the post 2000 winter consumption per household per customer actual experience.

Between 2000 and 2006, real natural gas prices for the sample companies in this study rose 44 percent, which according to our analysis would lead to approximately a 7.9 percent (0.18 x 44 percent) decline in use per customer by the year 2006. In addition to this 7.9 percent price induced decline in weather normal use per household, there would be an additional 6.0 percent (6 x 1.0 percent) decline because of the natural annual rate of turnover of old gas appliances to

[5] See Appendix C of the main report for a summary of the elasticity estimates found in the energy economics literature.

newer more efficient appliances. Hence, our analysis predicts a decline of 13.9 percent over the six-year period, which is very close to the actual decline of 13.1 percent.

Overall decline in Winter Gas Use per Customer	=	*Price Effect Elasticity with Price Increase*	+	*Conservation and Turnover to More Efficient Appliances*
13.9%	=	$0.18 \times 44\%$	+	$6 \times 1.0\%$
	=	7.9%	+	6.0%

In the expression above, the left hand term is the overall predicted decline of winter gas use per customer, the first term on the right hand side is the price effect reflecting the elasticity estimate multiplied by the price increase, and the second term the effect from conservation and turnover to more efficient appliances that occurs naturally every year with or without a price increase.

The results from analyzing the AGA sample data lead to a general rule of thumb. This rule does not apply to all companies in all situations, but the general rule with its caveats provides valuable insight to the underlying processes governing consumer behavior. This rule appears to capture consumers' winter price sensitive consumption behavior reasonably well across both the LDCs and Census regions. Twelve months after a 10 percent increase in natural gas prices at the national level, there will be nearly a 3 percent decline in natural gas use per customer on a national level. This 3 percent decline is comprised of about a 1 percent drop in gas use with the current capital stock, about a 1 percent drop in use per customer because households respond to the higher gas prices by replacing still functional appliances with more efficient units, and about a 1 percent drop in gas usage per customer due to the natural turnover of old gas appliances to the more efficient gas appliances that are available in the market each year. This rule of thumb will vary by LDC because they are heterogeneous in terms of weather, housing stocks, and standards of living.

Other factors that impacts residential energy use are the many programs that encourage consumers to save energy. These include:

- The federal government encourages conservation through weatherization programs funded by the Low-Income Household Energy Assistance Program (LIHEAP), tax credits for the purchase of efficient appliances and housing shell improvements, and consumer education on the importance of saving energy.
- State and local governments also encourage efficiency through similar programs.
- Many utilities provide rebates, incentives, and assistance to their customers to conserve energy use. For example, electric and natural gas utilities provided more than $140 million in 2005 to assist low-income customers to weatherize their homes.[6]

[6] Source: http://liheap.ncat.org/tables/FY2005/05stlvtb.htm

From a planning and policy perspective, even if gas prices do not increase in a given year, there will still be approximately a 1 percent fall in gas usage per household in the following year. This is driven by the historical forces related to the natural turnover of old appliances to the more efficient appliances that are available on the market each year. The annual time trend impacts will vary somewhat by LDC, because of regional differences in weather, appliance stocks, housing shell efficiency, demographic and economic characteristics.

There is a caveat. We cannot address whether the phenomenon will continue at the same rate for the long-term. Further gains in efficiency in absolute and relative terms may or may not have the same impact as they did previously. This is an issue for more detailed engineering studies on the efficiency of appliances and housing shells and economic research on the change in conservation habits of consumers for energy use and winter season comfort levels. We would note, however, that legislative and regulatory pressure for greater efficiency is likely to increase as climate change becomes a more pronounced national and international priority.

The policy implications of the 13.1 percent decline since 2000 are significant. First, regulators must recognize these trends and allow rate structures to incorporate these variations. Second, the natural turnover of appliances and increases in thermal shell efficiency from new construction will result in continued conservation, impacting utility operations. Third, even if future natural gas prices remain constant or even decrease, the appliance and house shell efficiency gains achieved in prior years will not be reversed.

Future Research

As with any study, there is room for future research. Suggestions for future research are the following:

- Obtain data from natural gas companies that did not participate in the initial study.
- Try different specifications of the model.
- Use the Iterative Bayes Shrinkage Estimation Technique to get individual LDC parameter estimates.
- Consider the impact of competition from the electric utility industry.

Introduction

Demand for natural gas per residential customer has been declining since the 1980's, and in recent years this decline has increased. Between 1980 and 2001, weather adjusted natural gas use per consumer in the US declined almost 1 percent on an annual basis. Since 2000, however, the decline for winter only use has accelerated, decreasing 13.1 percent between 2000 and 2006 for the sample of companies analyzed in this report.

It is important from a budgeting point of view for Local Distribution Companies (LDCs) to understand the cause of this decline. Was it caused by the recent increases in natural gas prices and customer's response to these price increases? Did customers change their behavior in response to these price increases? Have they become more sensitive to natural gas price movements or has the price induced response behavior remained relatively the same over time? Did customers switch to more efficient gas appliances in response to these natural gas price increases? Is it due to technological innovations which lead to increased efficiencies in appliances and thermal shells of homes? These efficiencies are in some sense passive as older appliances are replaced with more efficient models through natural attrition.

To address these issues, the American Gas Association (AGA) funded a study to re-estimate the price elasticity of natural gas demand by residential households using a sample of data that covers the recent period of large natural gas price increases. The main objective of this study was to document changes in use per residential customer on a weather normalized basis, particularly since the year 2000, and to identify the reasons for these changes. A second purpose of this study was to test for an increase in the price elasticity[7] of demand for natural gas since the year 2000. A third and equally important purpose of this study was to obtain updated elasticity estimates for all nine US Census Regions and for the US as a whole. Finally, the study attempts to estimate a natural rate of decline in use per customer due to technology induced gains in appliance and shell efficiency that would even occur in an environment of constant real natural gas prices.

There are hundreds of studies on the elasticities of natural gas demand. These studies have generated a range of elasticity estimates. If one goes back to the 1970's and even to the 1960s, these estimates vary over a wide range. Estimates of short-run price elasticity range from as low as –0.05 in Beirlein, Dunn and McConnon (1981) to a high of –0.68 in Barnes, Gillingham & Hagemann (1982). For long-run price elasticity estimates, the range of estimates is even higher, with the low being -0.017 in Hewlett (1977) to a high of –3.42 in Beirlein, Dunn and McConnon (1981). See Dahl and Roman (2004) and Dahl, et. al. (2005) for recent surveys of energy elasticity demand estimates. Other surveys of energy demand price elasticity estimates are Taylor (1975 and 1977), Bohi (1981), Bohi and Zimmerman (1984), Al-Sahlawi (1989), Dahl (1993), and Espy and Espy (2004). See Appendix C for a brief literature review of price elasticity estimates.

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[7] The price elasticity of demand is defined as the ratio of the percent change in quantity demanded of a particular good to the percent change in the price of that good, such as natural gas demand in this study.

Many of the studies estimated elasticities of natural gas demand with data aggregated at the state and national level and collected by the States; or collected by the Energy Information Administration (EIA). Examples of these are Balestra and Nerlove (1966), Jaskow and Baughman (1976), Berndt and Watkins (1977), and more recently, Maddala, Trost, Li, and Joutz (1997). Other studies use individual micro data to estimate demand elasticities. Examples of these are Hewlett (1977), Barnes, Gillingham and Hagemann (1982), and Green and Gilbert (1983). While the former studies using state and national aggregate data may provide some useful information at the state and national level, and the latter studies may provide good estimates of individual demand elasticities, neither provide adequate estimates at the individual LDC level of aggregation. Most of these studies do not allow for a natural rate of decline in use per customer due to technologically induced efficiency gains in appliances and thermal shells of homes. In addition, there are few, if any, studies that use current data that includes the recent run-up in natural gas prices. This study will fill these gaps in the literature by using high quality data collected and compiled at the individual LDC level and covering the period as recent as March, 2006.

This paper is divided into the following five sections. In Section 1, background information at the regional, as well as the national level, is provided. The information includes residential natural gas consumption, the declining trend of consumption, and price movements. In Section 2, the database constructed from the survey of LDCs is described. Section 3 explains the mathematical equations used to estimate short- and long-run price elasticity of demand. Empirical results of short-run and long-run elasticity and the declining trend in gas usage are presented in Section 4. The report concludes in Section 5 with a summary of the results and policy implications. In addition, there is a list of suggestions for future research. References and technical appendices can be found at the end of the report. The appendices include construction of the weather-normalized series for use per customer, a map of the Census regions, a brief literature review, and a discussion of statistical hypothesis testing.

Section 1: Background

Residential natural gas consumption per customer in the US has been declining. Figure 1 below shows the winter season use per consumption actual and weather normal (in dekatherms) from 1996 to 2006 using the data collected from the sample LDCs. The winter season for this report is defined as the sum of the monthly consumption between October and March.

Figure 1
US Annual Winter Use per Customer

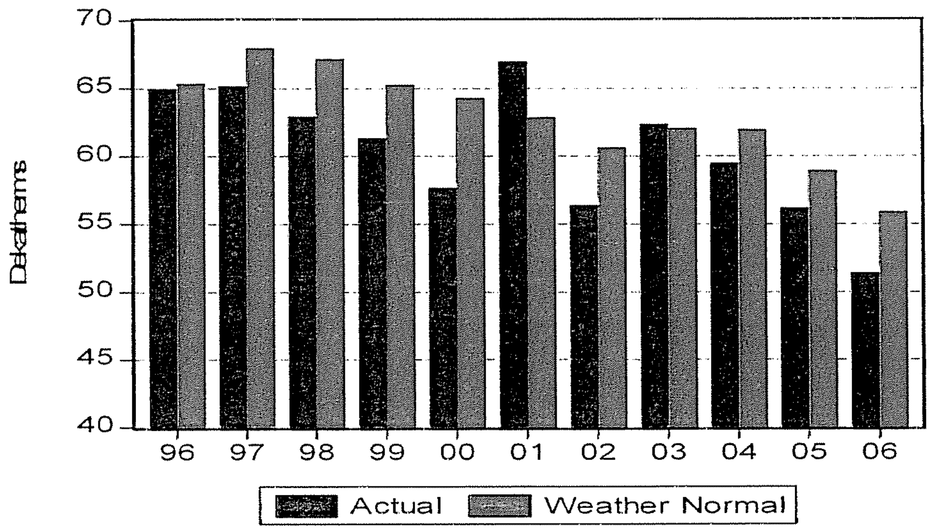


Table 1: US Annual Winter Use per Residential Customer in Dekatherms

Year	Actual		Winter Normal	
	Level	Percent Change	Level	Percent Change
1996	64.9		65.3	
1997	65.2	0.5	67.9	4.0
1998	62.9	-3.5	67.1	-1.2
1999	61.3	-2.5	65.2	-2.8
2000	57.7	-5.9	64.3	-1.4
2001	67.0	16.1	62.8	-2.3
2002	56.4	-15.8	60.6	-3.5
2003	62.3	10.5	62.0	2.3
2004	59.5	-4.5	61.9	-0.2
2005	56.2	-5.6	58.9	-4.9
2006	51.4	-8.5	55.9	-5.1
Annual Percent Change 1996-2000		**-1.64**		**-1.48**

As can be seen from Figure 1 and Table 1, there has been a marked decline in weather normal use per customer. The annual percent change from 1996 to 2006 was -1.64 percent and -1.48 percent respectively, for actual and weather normal consumption. Since 2000, however, the decline for winter only use has accelerated, decreasing 13.1 percent between 2000 and 2006 and by 9.7 percent between 2004 and 2006 for the sample of companies analyzed in this report.

The phenomenon of declining weather normal use per customer is not new[8]. Some even feel it started on February 1, 1977 when then President Jimmy Carter, after only two weeks in office, said in his now famous fireside chat:

"All of us must learn to waste less energy. Simply by keeping our thermostats, for instance, at 65 degrees in the daytime and 55 degrees at night we could save half the current shortage of natural gas."

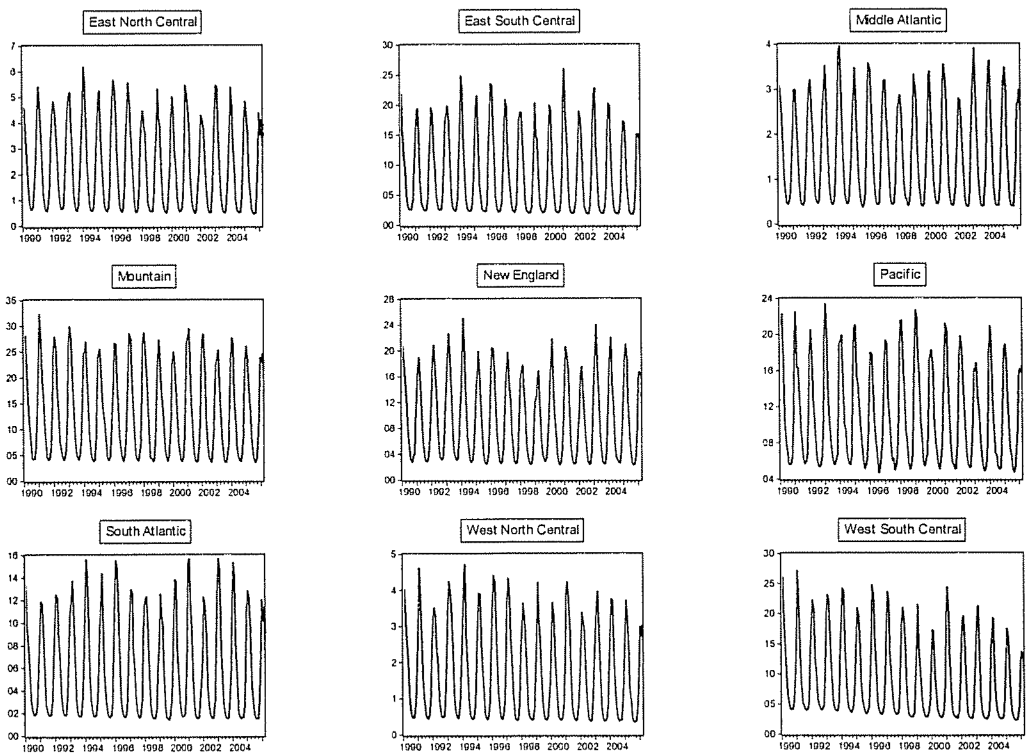
In the years since, the first President Bush established the first National Energy Strategy in June of 1989, and the government has imposed efficiency standards, subsidized technological improvements in both shell and appliance efficiency, and generally encouraged its citizenry to conserve on energy. Efficiency improvements are sure to continue, and if natural gas prices stay high, it will most certainly encourage natural gas

[8] Between 1978 and 1982, energy consumption per household actually decreased by 26%. See EIA's Annual Energy Review, URL http://www.eia.doe.gov/emeu/aer/ep/ep_frame.html.

customers to trade in old inefficient appliances for newer more efficient ones. The impact on the natural gas industry will be an obvious decrease in revenue accruing to natural gas LDC's.

This study will examine the reasons for this decline in use per customer, with particular emphasis on estimating the short-run and long-run price elasticity of natural gas demand since the year 2000. It will also analyze and measure the rate of decline caused by the natural turnover rate of old inefficient appliances with newer more efficient ones. The trends in the AGA sample are validated from trends in other data. The U.S. Energy Information Administration (EIA) reports aggregate estimates of residential consumption in BCF/day and residential prices in $/MCF on a monthly basis from 1990 to the present. The EIA sample data covers all LDCs in the US. These series are plotted by US Census Region in residential consumption per household per day in Figure 2 and in nominal and real terms in ($2000)/MCF in Figure 3 below. A map of the US Census Regions is shown in Appendix B. These figures provide a comparison with the subsequent figures from the AGA survey database. They demonstrate that the trends and patterns in the survey are consistent with a recognized national source of data even before adjusting for normal weather.

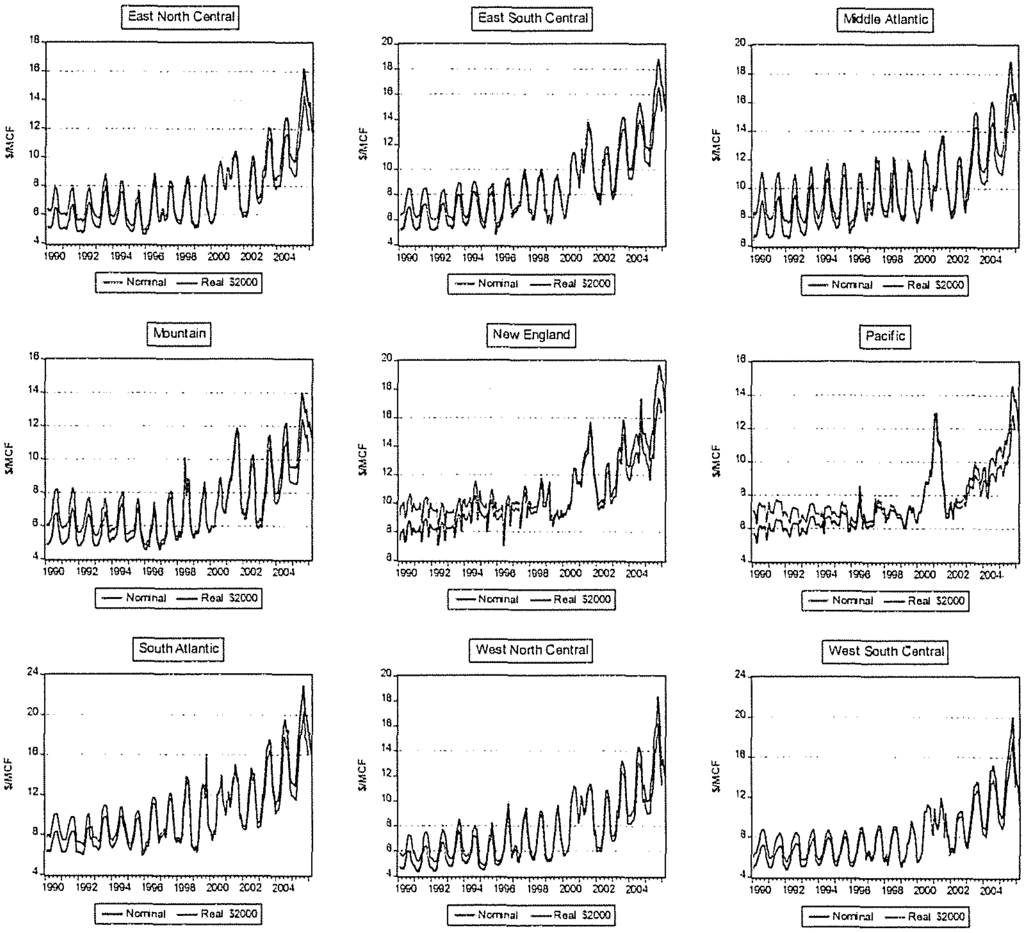
Figure 2
Regional Consumption per Customer per Day
Mcf per Day



Source: U.S. Energy Information Administration

Regional consumption per customer appears to decline for every region for most of the period and particularly after 2000. This has occurred while residential natural gas prices have more than doubled over the same period.

Figure 3
Nominal and Real ($2000) Delivered Natural Gas Prices

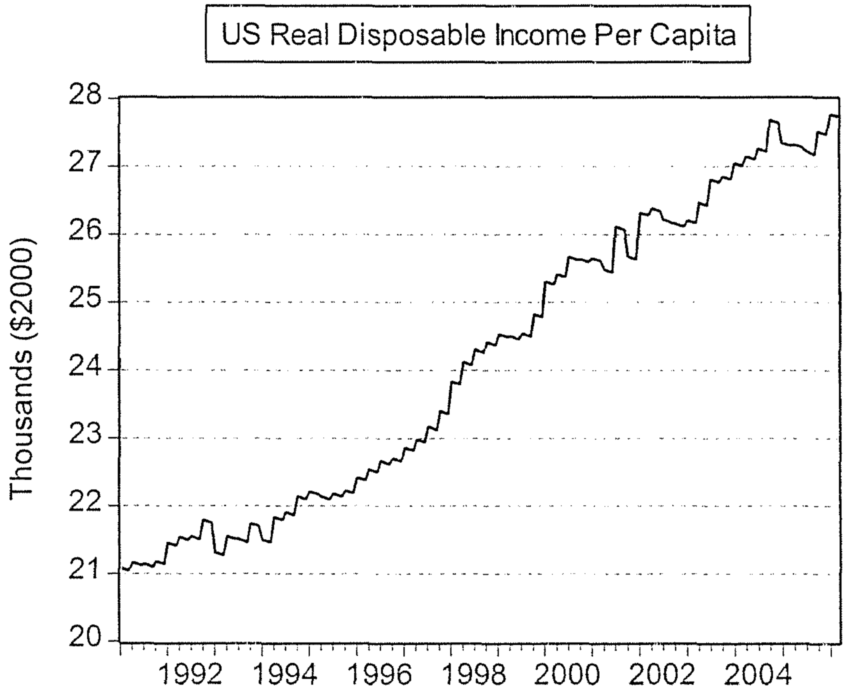


Source: U.S. Energy Information Administration

Residential natural gas prices were fairly stable between 1990 and 1997 during the so-called "gas bubble" period. However, they have been increasing, particularly since 2000 due to a variety of factors, including increasing oil prices (Villar and Joutz, October 2006). Nominal prices have risen faster in some regions than in others; the spread in nominal terms has been between $12/MCF to almost $20/MCF. The real price has more than doubled to over $12/MCF. Natural gas prices have risen about 35 percent to 40 percent faster than the general U.S. price level since 1990. Figure 3 shows the monthly residential natural gas prices per MCF according to the EIA. Figure 4 shows U.S. real disposable income per capita has risen about 33 percent from $21,000 to $28,000 today.

While income is important in any economic analysis of demand, income was not included in our final model for several reasons. First, estimates of real disposable income (per customer, household, or person) are difficult to obtain at the LDC level, which is the building block of this research. Second, the services from natural gas is a normal good, one would expect a positive income effect, which should have been reflected in a positive trend in natural gas use per household. However, in our sample and specification, we observe a negative trend in use per household. The income series are highly positively autocorrelated and trend-like; see Figure 4. The income coefficient(s) were erratic and even negative. This is consistent with the declining use per household due to a naturally occurring and non-natural gas price-induced replacement of old inefficient appliances with new more efficient appliances. At present, we believe a time trend appropriately captures this new technology-induced naturally occurring adoption of more energy efficient appliances and improvements in housing shell efficiency or conservation. Third, our findings are similar to surveys of natural gas demand by Bohi (1981), Dahl (1993, and personal discussions about preliminary results regarding an update to Dahl's previous study). In a number of papers, Bohi dismisses the large income elasticities from some static cross section estimates and concluded that income is not found to be an important variable in natural gas demand. Dahl found that income effects in residential demand models are consistently small in both aggregate and disaggregate data. Both authors suggest that representing the income effect in residential is problematic and sensitive to the particular study.

Figure 4



Source: Bureau of Economic Analysis, U.S. Department of Commerce

Table 2 shows the cumulative decline of winter weather normal use per customer between 2000 and 2006 for the sample of the LDCs. The focus of Table 2 is the post 2000 period. The intent is to capture the effects of the large increases in natural gas prices and (possible) conservation activities by consumers.[9] The fall, on average, is greater than two per cent per year for six of the nine Census Regions and for the U.S.

[9] The pre-2000 period will be addressed in the statistical modeling sections.

Table 2
Annual Winter Season Weather Normal Natural Gas Use per Residential Customer, By Region and for the U.S.
(Dekatherms per Customer)

Census Region	2000	2001	2002	2003	2004	2005	2006	Percent Change
National	64.3	62.8	60.6	62.0	61.9	58.9	55.9	-13.1%
East North Central	81.1	79.2	80.1	77.8	76.1	73.1	70.2	-13.4%
East South Central	64.9	64.2	61.3	62.2	60.8	58.7	55.9	-13.9%
Middle Atlantic	93.7	95.0	91.2	93.5	92.8	88.3	85.1	-9.2%
Mountain	80.6	77.9	75.8	76.4	71.8	72.0	70.5	-12.5%
New England	80.7	79.8	75.3	82.3	80.3	75.9	72.4	-10.3%
Pacific	43.8	40.9	40.0	41.8	40.6	40.4	37.3	-14.8%
South Atlantic	71.7	69.4	63.8	69.1	62.0	62.5	62.5	-12.8%
West North Central	80.1	79.5	79.8	80.4	78.3	75.9	70.2	-12.4%
West South Central	46.3	46.4	40.2	44.1	54.1	41.7	40.6	-12.3%

Table 2 shows the overall decline between 2000 and 2006 for the AGA sample of LDCs. As shown in Table 2, the decline in weather normal use per customer for the national sample is from 64.3 dekatherms in 2000 to 55.9 dekatherms per household in 2006. This represents a cumulative decline of 13.1 percent or an average decline of 2.2 percent per year. The decline since 2004 is even more dramatic, going from 61.9 dekatherms per household in 2004 to 55.9 dekatherms in 2006, nearly a 6 percent decline per year. As shown in this table, every region in the US experienced a decline in use per residential customer.

Section 2: Data

Sixteen AGA member companies provided data for this study. The companies supplied monthly data on residential consumption, average prices, number of customers, heating-degree data, and economic data. Most companies were able to provide a time series of data starting in 1992 and in some cases even into the 1980s. Three companies were unable to contribute data prior to 1999 for accounting or reorganization reasons. The remaining fifteen corporations comprise 46 local distribution companies. This represents more than 16 million customers and 28 percent of all residential customers nationwide.

Micro data on individual consumers is best suited for obtaining estimates of price elasticities. In rate case decisions and in internal LDC corporate strategy decisions however, the most relevant and useful piece of information is how the external forces that bombard it now impact the LDC. These external forces can vary from announcements by Presidents, changes in a competitors pricing, new gas appliance technologies, economic recessions, and gas price increases imposed by fuel surcharges. Since it is the impact of these forces on actual individual LDC's that is relevant, current data on consumption and prices collected by each individual LDC and aggregated at the individual LDC level is best suited to measure the impact of these external forces on a LDC in the current time period.

But data on a single LDC is often not enough information. The problem with using current data from only one LDC is that the number of observations will be quite small, and statistical reliability will be compromised. Instead of tens of thousands of observations on individual consumers, one may be left with 50 or 60 observations for any given LDC during the important winter season months. From a statistical reliability point of view then, it is important to obtain on many different individual LDCs, data that are collected by each individual LDC rather than using survey data collected by government agencies such as the EIA.

In this study, the breadth and depth of the data collected by the AGA has not to our knowledge been done before. The breadth of the data spans the entire US, covering 46 different LDCs. The depth of the data covers almost a decade or more for most of the companies. Therefore, this is a data set that is uniquely suited for the analysis of residential natural gas consumption in the US.

The number of LDCs in each of the nine Census Regions and the percent of total customers the sample covers for each Region is given in Table 3 below.

Table 3
Percent of Total Residential Customers Represented by the AGA Sample

Census Regions	Census Abbreviation	Number of participating LDCs	Coverage
East North Central	ENC	3	8%
East South Central	ESC	3	11%
Mid-Atlantic	MAC	6	45%
Mountain	MTN	5	42%
New England	NEC	8	50%
Pacific	PAC	5	39%
South Atlantic	SAC	5	17%
West North Central	WNC	3	20%
West South Central	WSC	8	32%

Section 3: Approaches to Estimating Short- and Long-run Price Elasticity of Demand

Economists often distinguish between a short-run response and long-run response when referring to how a household changes its natural gas usage when faced with price and income changes. The short-run response is defined as a household's natural gas demand response to natural gas price and income changes given their current capital stock of natural gas-using appliances and shell efficiency of the house. The long-run response is defined as a household's response to natural gas prices changes and income changes after the household has had time to change their stock of gas using appliances and house shell efficiency.

The idea behind the short-run and long-run responses to price changes is that when natural gas prices change, a household's short-run response is to alter the intensity with which they use their current stock of natural gas-using appliances. The long-run response to a change in natural gas prices is to alter the number and efficiency of natural gas using appliances, while at the same time changing the shell efficiency of the house.

A household's percentage change in natural gas demand per one percent change in natural gas price is called the price elasticity of natural gas demand. When this percentage change is computed for a household with a given stock of natural gas-using appliances and house shell efficiency, it is termed the short-run price elasticity of natural gas demand for that household. When this percentage change is computed over a time period long enough to allow a household to change it's stock and efficiencies of house and natural gas using appliances, it is termed the long-run price elasticity of natural gas demand for that household. A similar definition is given to short-run and long-run income elasticities of natural gas demand. If the natural gas demand equation is specified in logarithmic form, the price and income coefficients in a regression equation can be interpreted as the price and income elasticities.

A Dynamic Model of Capital Stock Choice and Natural Gas Demand

For a typical household, natural gas is demanded not for its own sake but for use in furnaces, appliances and the like. The household's accumulated energy saving "capital stock" is determined by income, habits, and past prices of fuels. Consequently, in any period, the household's demand for natural gas is a function of the current price, which influences how intensively the stock of equipment is used, and past prices, which influences the size and composition of that stock. A very simple structural model (Fisher and Kaysen, 1962) of these effects for a given household might be

Demand: $Y_t = \alpha + \beta_1 X_{t-1} + \lambda Z_t + \delta(K_t + E_t) + \varepsilon_t$ (1)

Equipment: $K_t = \gamma_1 X_{t-12} + \gamma_2 Z_t$ (2)

Efficiency: $E_t = \gamma_3 T_t$, (3)

where Y_t is use per household of weather normalized Natural gas at time t, X_{t-1} is the real (base = \$2000) price of natural gas at time t - 1, Z_t is real (base = \$2000) household income at time t, K_t is capital stock with a given efficiency E_t at time t, T_t is a annual time trend to capture technological improvements in the efficiency of the capital stock, and ε_t is a random error term.

We use the real price lagged one period to capture the short-run response to a price change since the current price is not known until the gas bill arrives in the next billing period. Hence, a household's price-induced consumption adjustment during this period is based on last period's real gas price.

If equation (1) is in natural logarithms for Y_t, X_{t-1} and Z_t, the coefficient β_1 can be interpreted at the short-run price elasticity of natural gas demand. It measures the responsiveness of natural gas demand at time t to a change in natural gas price at time t-1 for a fixed capital stock of natural gas appliances K_t. In order to derive the long-run price elasticity of natural gas demand, we need to substitute equations (2) and (3) into equation (1) to get

$$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 X_{t-12} + \beta_3 Z_t + \beta_4 T_t + \varepsilon_t \qquad (4)$$

If all variables except the time trend are in logarithms, then the coefficient on X_{t-1} is an estimate of the short-run price elasticity, the sum of the coefficients on all price variables is an estimate of the long-run price elasticity, and a negative coefficient (β_4) on the annual time trend is the decline in use per household of natural gas demand due to the adoption of newer and more efficient capital equipment. Although the length of the lag (t-12) on price in equation (2) to capture the capital stock adjustment process is somewhat arbitrary in this formulation, one can put other restrictions on the shape and length of the price and lagged price coefficients by using models such as the Koyck (1954) or Almon (1965) lag.

The coefficient β_1 in equation (4) gives the short-run price elasticity of natural gas demand. In equation (4) the coefficient β_2 captures capital stock adjustments that depend on past natural gas prices, while still allowing for an annual decline in use per customer that occurs because of a non-gas price induced rate of turnover of the capital stock to more energy efficient equipment. The sum of the coefficients $\beta_1 + \beta_2$ represents the long-run elasticity of natural gas demand. The coefficient β_4 on the time trend variable represents the pure turnover to newer more efficient capital equipment after subtracting out the gas price effect on this turnover rate captured by β_2. A negative coefficient (β_4) on the annual time trend is the annual decline in use per household of natural gas demand due to the natural adoption of newer and more efficient capital equipment.

Section 4: Empirical Results Using the AGA Sample of LDCs

The AGA study is interested in answering the following five questions:

(a) What are the changes in natural gas use per residential customer on a weather normalized basis since the year 2000?
(b) What is the short-run price elasticity of demand for residential natural gas customers?
(c) What is the long-run price elasticity of demand for residential natural gas customers?
(d) Has elasticity of natural gas demand changed since 2000?
(e) What is the annual reduction in natural gas usage per customer due to the natural replacement of old inefficient natural gas appliances with more energy efficient appliances; and the building of new homes with greater shell efficiencies compared to existing homes?

To answer these questions we estimated two variants of equations[10] (1) to (3). The first variant assumes the short-run price elasticity has a structural shift in the year 2000 and the second model assumes there is no shift in the short-run price elasticity in the year 2000 and beyond. These two equations are given below as (4a) and (4b), respectively:

$$Y_t = \alpha + \beta_1 X_{t-1} + \delta_{2000} X_{t-1} * D2000 + \beta_2 X_{t-12} + \beta_4 T_t + \varepsilon_t, \quad (4a)$$

$$Y_t = \alpha + \beta_1 X_{t-1} + \beta_2 X_{t-12} + \beta_4 T_t + \varepsilon_t, \quad (4b)$$

where all variables except the time trend are in natural logarithms and D2000 is a 0,1 indicator variable, equal to 0 if the time period is pre year 2000, and equal to 1 if the time period is the year 2000 or greater. The dependent variable Y_t in equations (4a) and (4b) is daily natural gas use per customer in month t.

In equation (4a), the coefficient δ_{2000} is a shift coefficient on the price elasticity given by β_1. The interpretation of δ_{2000} is that β_1 represents the price elasticity of natural gas demand for the period prior to the year 2000, and $\beta_1 + \delta_{2000}$ gives the price elasticity of natural gas demand for the year 2000 and beyond. So a negative δ_{2000} in equation (4a) would indicate that demand

[10] We omitted the income variable Z_t for the reasons outlined the Background Section of the paper. First, estimates of real disposable income (per customer, household, or person) are difficult to obtain at the LDC level, which is the building block of this research. Second, the services from natural gas is a normal good, one would expect a positive income effect, which should has been reflected in a positive trend in natural gas use per household. However, in our sample and specification, we observe a negative trend in use per household. The income series are highly positively autocorrelated and trend-like; see Figure 4. The income coefficient(s) were erratic and even negative. This is consistent with the declining use per household due to a naturally occurring and non-natural gas price-induced replacement of old inefficient appliances with new more efficient appliances. At present, we believe a time trend appropriately captures this new technology-induced naturally occurring adoption of more energy efficient appliances and improvements in housing shell efficiency or conservation.

has become more elastic since the year 2000. The coefficient β_2 captures capital stock adjustments that depend on past natural gas prices, while still allowing for an annual decline in use per customer that occurs because of a non-gas price induced rate of turnover of the capital stock to more energy efficient equipment. A negative coefficient (β_4) on the annual time trend is the annual decline in use per household of natural gas demand due to the adoption of newer and more efficient capital equipment.

The sum of the coefficients $\beta_1 + \delta_{2000}$ in equation (4a) gives the short-run price elasticity of natural gas demand in the post-2000 period, the sum of the coefficients $\beta_1 + \delta_{2000} + \beta_2$ represents the long-run elasticity of natural gas demand in the post-2000 period, and the coefficient β_4 on the time trend variable represents the pure turnover to newer more efficient capital equipment after subtracting out the gas price effect on this turnover rate captured by β_2.

The interpretation of the coefficients for equation (4b) is similar, except in equation (4b) the slope shift coefficient δ_{2000} for the short-run elasticity is constrained to zero.

Shrinkage Estimators

With a panel data set such at the one used in this study, there is always the question of whether to pool the data and obtain a single estimate of the parameters from the whole sample, or to estimate the equations separately for each cross-section. The implicit assumption in the fixed effects model is that the intercepts are different for each cross-section, but the slope coefficients are the same for all cross sections. This may not be a tenable assumption. Indeed, in practice the constancy of slope coefficients across different cross-section units is often rejected. This implies that the equations should be estimated separately for each cross-section rather than obtaining an overall pooled estimate.

The problem with the two usual estimation methods of either pooling the data or obtaining separate estimates for each cross section is that both are based on extreme assumptions. If the data are pooled as in the fixed effects model, it is assumed the coefficients are all the same. If separate estimates are obtained for each cross section, it is assumed that the coefficients are all different for each cross section. The truth probably lies somewhere in-between. The coefficients are not exactly the same, but there is some similarity between them.

One way to allow for some similarity among the slope coefficients without constraining them to be exactly the same is to assume the coefficients all come from a joint distribution with a common mean and non-zero covariance matrix. This suggests that the resulting coefficient estimates should be a weighted average of the overall pooled estimate and the separate time series estimates based on each cross section. Thus, each cross-section estimate is "shrunk" towards the overall pooled estimate.

For example, consider the model given by equation (4b) and using aggregate data on the nine census Regions to estimate the coefficients. This model is:

$$Y_{it} = \alpha_i + \beta_{i1}X_{i,\,t-1} + \beta_{i2}X_{i,\,t-12} + \beta_{i4}T_{it} + \varepsilon_{it},$$

i = 1,2,3,…..,N (N = 9, Census Regions)

t = 1,2,3,…..T (Time Periods)

The implicit assumption in the fixed effects model is that we retain the i subscript on α but remove the subscript on the β's. The implicit assumption if we run separate regressions for each cross section is that the i subscript is retained on both α and all the β's.

A shrinkage estimator sometimes suggested is the Stein rule estimator defined by:

$$\tilde{\beta}_i = (1 - \frac{c}{F})\hat{\beta}_i + (\frac{c}{F})\hat{\beta}_p, \quad (5)$$

where $\tilde{\beta}_i$ is the shrinkage estimator, $\hat{\beta}_i$ is the separate ordinary least square (OLS) estimate from each time series, $\hat{\beta}_p$ is the fixed effects pooled estimator. The F is the F-test statistic used to test the null hypothesis that all the β's are equal across each cross-section. The constant c is given by

$$c = \frac{(N-1)K - 2}{NT - NK + 2}, \quad (6)$$

and K = 3 and N = 9 in equation 4b.

We will present the shrinkage estimates for the nine Census Regions below when we discuss the regional results.

National Results

We estimated equations (4a) and (4b) for each of the LDCs using OLS on monthly data for the winter season months[11] of October to March. These results are given in the last column of Tables 4 and 5. The average of these individual LDC estimates indicates that the short-run price elasticity of natural gas demand is –0.11, the short-run price elasticity shift in post 2000 is positive but for all practical purposes is zero, the long-run price elasticity given by $\beta_1 + \beta_2$ is –0.20, and the natural annual rate of decline[12] in use per customer due to the adoption of new gas appliance capital equipment is 0.8 percent per year.

[11] Although the dependent variables used to estimate the model are only for the months of October to March, the lagged independent real price variables represent actual lagged calendar month real prices. Hence, for the observation on weather normal use per household in October, the lagged real price (t-1) will be the September real price. Similarly, the lagged real price variable (t-12) for an October observation will be the real price of natural gas in October of the previous calendar year.

[12] If the coefficient on the time trend (T) in equation 4a and 4b is negative, it means there is an annual decline in natural gas weather normal use per customer. The percent decline will be equal to the coefficient on the time trend multiplied by 100%. For example, in Table 4 for the National sample, we see the coefficient on the

We also estimated equations (4a) and (4b) in a pooled regression where each LDC is given company specific intercepts for each of the six winter months in the sample, but all the slope coefficients were assumed to be the same across all LDCs. These estimates are shown in column two of Tables 4 and 5 below. Based on these estimates, we see the short-run price elasticity is –0.09, there is neither a practical nor a statistically significant[13] shift in the elasticity in post 2000, the long-run price elasticity given by $\beta_1 + \beta_2$ is –0.18, and the natural annual rate of decline due to the adoption of new capital equipment is 1.0 percent per year in Table 5. Note the results did not indicate a change in price elasticity in the post-2000 time period in Table 4.

Although we did not obtain Iterative Bayes shrinkage estimates for each individual LDC, based on our experience we expect the average of these shrinkage estimates to fall between the pooled with LDC dummy results and the average of the individual OLS LDC regression results. We conclude therefore, that the short-run price elasticity of natural gas for the national sample lies between –0.09 and –0.10, the long-run price elasticity is between –0.18 and -0.20, and the natural annual rate of decline due to the adoption of new gas appliance capital equipment is between 0.7 percent and 1.0 percent per year. This natural annual rate of decline is consistent with a finding by an earlier AGA report on the decline in weather adjusted gas use per customer. See the AGA report "2004 AGA Energy Analysis: Patterns in Residential Natural Gas Consumption, 1980-2001".

From Table 5 we see the total annual percent decline in use per household one year after a ten percent price increase[14] is between 2.7 percent and 2.8 percent.

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time trend variable is –0.011 for the pooled with LDC dummy variables model. This means there is a 0.011 x 100% = 1.1% annual decline in natural gas weather normal use per customer.

[13] We base this conclusion on the statistical significance of the coefficient on the variable "Ln(Price$_{t-1}$)*D2000" in Table 4. See Appendix D for a discussion of the meaning of the term "statistical significance" in statistical hypothesis testing.

[14] Since both the dependent and independent variables are in natural logarithms in equations (4a) and (4b), the coefficients on the two price variables are price elasticities, which give the percent decline in use per customer quantity demanded per one percent increase in price. Similarly, a negative coefficient on the time trend gives the proportionate decline in use per customer per one-year increase in time. To get the percent decline in use per customer one year after a 10 percent increase in price, we have:

percent decline = 10*coefficient on P_{t-1} + 10*coefficient P_{t-12} + 100*coefficient on time trend.

Table 4
National Elasticity Model Estimates for Equation (4a)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.09 (-6.46)	-0.10
$Ln(Price_{t-1})$*D2000	0.0036 (0.97)	-0.0003
$Ln(Price_{t-12})$	-0.09 (-5.93)	-0.09
Annual Time Trend	-0.011 (-9.47)	-0.008
$Rbar^2$	0.97	
Std. Error of Regression	0.115	
Mean of the Dependent Variable	1.183	
AIC	-1.403	
Schwarz Criterion	-0.906	
Number of Observations	3023	41

Table 5
National Elasticity Model Estimates for Equation (4b)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.09 (-6.44)	-0.10
$Ln(Price_{t-12})$	-0.09 (-5.92)	-0.10
Annual Time Trend	-0.010 (-12.25)	-0.007
$Rbar^2$	0.97	
Std. Error of Regression	0.115	
Mean of the Dependent Variable	1.183	
AIC	-1.403	
Schwarz Criterion	-0.908	
Number of Observations	3023	41

Regional Results

Figure 5 shows the normalized consumption of natural gas use per household by U.S. Census region for the AGA sample. There appears to be a decline over much of the sample in all nine Census Regions.

Figure 5
Regional Weather Normal Consumption per Customer
(Dth)

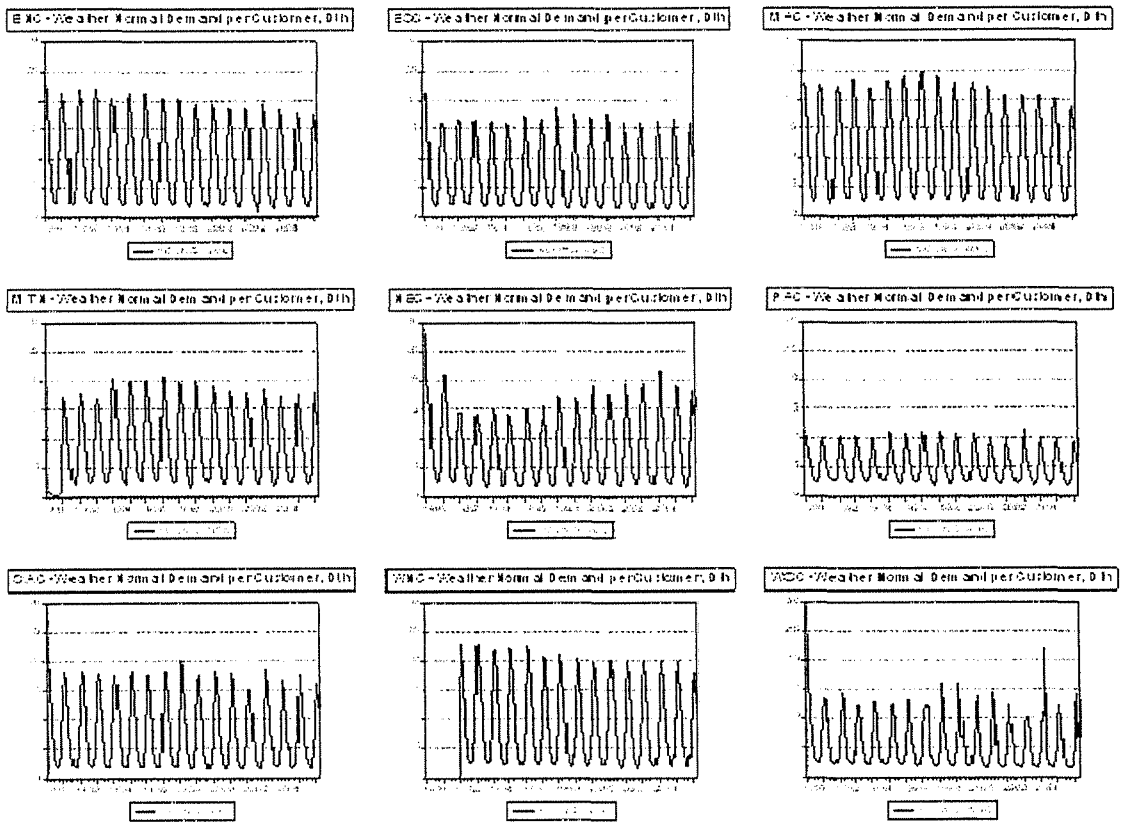
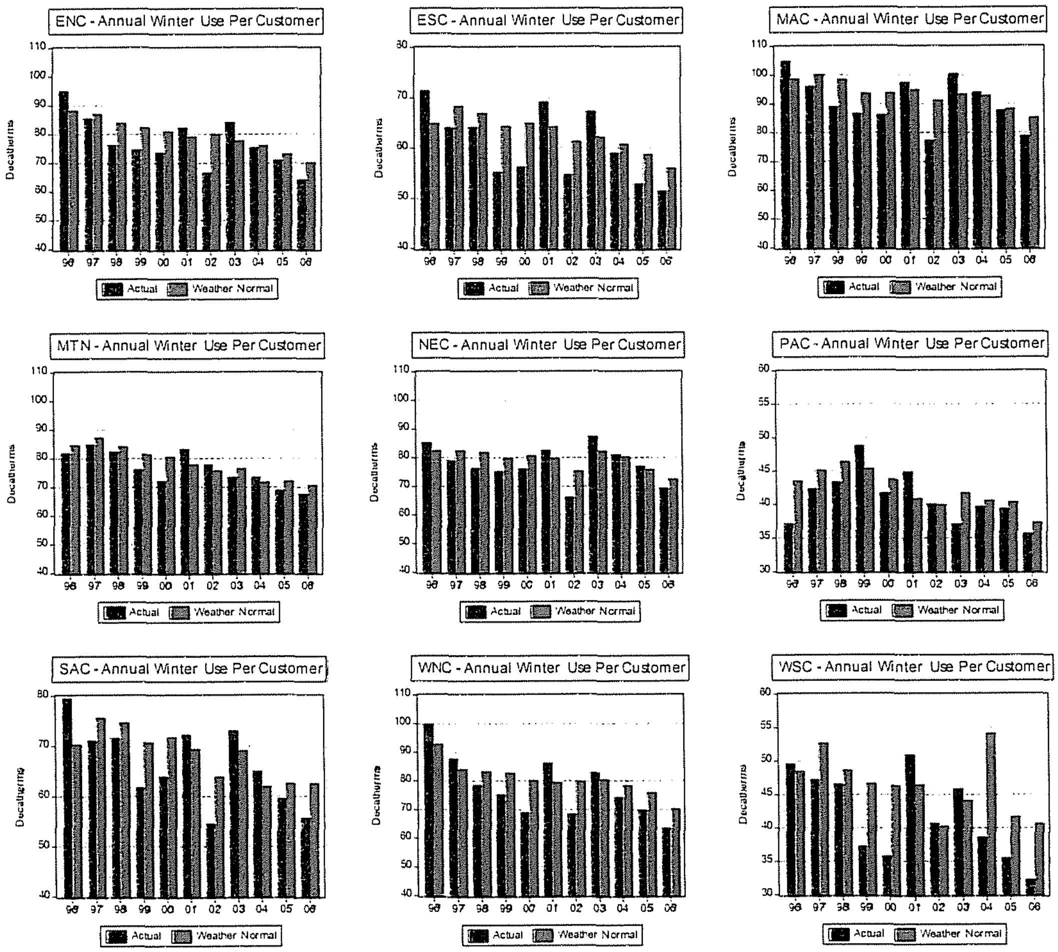


Figure 6 shows the actual and normalized winter season consumption for natural gas per customer by U.S. Census region for the AGA sample. Again, there is a decline over much of the sample in all regions.

Figure 6
Regional Annual Winter Use per Customer
(Dth)



Regional OLS Estimates

Tables 6A and 6B to Tables 14A and 14B give the estimates of equations (4a) and (4b) for each of the nine census Regions using data on the individual LDCs in each of the respective regions. For the most part, the regional results are similar to the national results, with some differences noted below.

East North Central Region

The regression output for the ENC Region is given in Tables 6A and 6B. In Table 6A, we estimate neither a practical nor a statistically significant shift in the short-run elasticity in the post 2000 year period. According to equation (4b) in Table 6B, the short-run elasticity is between -0.08 and –0.12, and is statistically significantly different from zero in the pooled model. The long-run elasticity is between –0.22 and –0.27. In the pooled regression, we observe a statistically significant annual declining rate of weather normal use per household demand of 1.0 percent. From Table 6B we see the total annual percent decline in use per customer one year after a ten percent price increase is between 2.8 percent and 3.2 percent, which is close to the annual percent decline in the national sample.

Table 6A
ENC Regional Elasticity Model Estimates for Equation (4a)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.09 (-3.02)	-0.12
$Ln(Price_{t-1})$*D2000	0.005 (0.51)	-0.006
$Ln(Price_{t-12})$	-0.14 (-3.63)	-0.16
Annual Time Trend	-0.011 (-3.92)	0.0013
$Rbar^2$	0.99	
Std. Error of Regression	0.064	
Mean of the Dependent Variable	1.319	
AIC	-2.569	
Schwarz Criterion	-2.200	
Number of Observations	195	3

Table 6B
ENC Regional Elasticity Model Estimates for Equation (4b)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.08 (-3.02)	-0.12
$Ln(Price_{t-12})$	-0.14 (-3.66)	-0.15
Annual Time Trend	-0.010 (-4.57)	-0.001
$Rbar^2$	0.99	
Std. Error of Regression	0.063	
Mean of the Dependent Variable	1.319	
AIC	-2.578	
Schwarz Criterion	-2.225	
Number of Observations	195	3

East South Central Region

The regression output for the ESC Region is given in Tables 7A and 7B. In Table 7A, we estimate neither a practical nor a statistically significant shift in the short-run elasticity in the post 2000 year period. According to equation (4b) in Table 7B, the short-run elasticity is -0.06 when computed from the average of the individual LDC results and for all practical purposes is zero in the pooled regression. The long-run elasticity is between –0.01 and –0.12. In the pooled regression, we observe a statistically significant annual declining rate of weather normal use per household demand of 2.0 percent. From Table 7B we see the total annual percent decline in use per customer one year after a ten percent price increase is between 2.0 percent and 2.1 percent, which is slightly lower than the annual percent decline in the national sample.

Table 7A
ESC Regional Elasticity Model Estimates for Equation (4a)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.007 (-0.12)	-0.08
$Ln(Price_{t-1})$*D2000	0.0169 (1.09)	0.02
$Ln(Price_{t-12})$	-0.03 (-0.47)	-0.06
Annual Time Trend	-0.023 (-4.92)	-0.016
$Rbar^2$	0.97	
Std. Error of Regression	0.129	
Mean of the Dependent Variable	1.013	
AIC	-1.167	
Schwarz Criterion	-0.835	
Number of Observations	227	3

Table 7B
ESC Regional Elasticity Model Estimates for Equation (4b)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	0.012 (0.23)	-0.06
$Ln(Price_{t-12})$	-0.026 (-0.44)	-0.06
Annual Time Trend	-0.020 (-5.33)	-0.012
$Rbar^2$	0.97	
Std. Error of Regression	0.129	
Mean of the Dependent Variable	1.013	
AIC	-1.170	
Schwarz Criterion	-0.853	
Number of Observations	227	3

Middle Atlantic Region

The regression output for the MAC Region is given in Tables 8A and 8B. In Table 8A, we estimate neither a practical nor a statistically significant shift in the short-run elasticity in the post 2000 year period. According to equation (4b) in Table 8B, the short-run elasticity is -0.13 when computed from the average of the individual LDC results, and is –0.10 in the pooled regression. The long-run elasticity is between –0.18 and –0.20. In the pooled regression we observe a statistically significant annual declining rate of weather normal use per household demand of 1.3 percent. Table 8B we see the total annual percent decline in use per customer one year after a ten percent price increase is between 2.5 percent and 3.3 percent, which is close to the annual percent decline in the national sample.

Table 8A
MAC Regional Elasticity Model Estimates for Equation (4a)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
Ln($Price_{t-1}$)	-0.11 (-2.35)	-0.12
Ln($Price_{t-1}$)*D2000	0.01 (1.21)	0.005
Ln($Price_{t-12}$)	-0.09 (-1.70)	-0.04
Annual Time Trend	-0.015 (-5.21)	-0.009
$Rbar^2$	0.97	
Std. Error of Regression	0.100	
Mean of the Dependent Variable	1.508	
AIC	-1.681	
Schwarz Criterion	-1.325	
Number of Observations	465	6

Table 8B
MAC Regional Elasticity Model Estimates for Equation (4b)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
Ln($Price_{t-1}$)	-0.10 (-2.24)	-0.13
Ln($Price_{t-12}$)	-0.10 (-1.77)	-0.05
Annual Time Trend	-0.013 (-5.80)	-0.007
$Rbar^2$	0.97	
Std. Error of Regression	0.100	
Mean of the Dependent Variable	1.508	
AIC	-1.682	
Schwarz Criterion	-1.335	
Number of Observations	465	6

Mountain Region

The regression output for the MTN Region is given in Tables 9A and 9B. In Table 9A, we estimate shift of –0.035 in the short-run elasticity in post 2000 and beyond. According to equation (4b) in Table 9B, the short-run elasticity is -0.11 when computed from the average of the individual LDC results and is –0.07 and statistically significant in the pooled regression. The long-run elasticity is between –0.10 and –0.19. In the pooled regression we observe a statistically significant annual declining rate of weather normal use per household demand of 0.9 percent. In Table 9B we see the total annual percent decline in use per customer one year after a ten percent price increase is between 1.9 percent and 2.8 percent, which in the pooled regression (1.9 percent) is slightly lower than the annual percent decline in the national sample.

Table 9A
MTN Regional Elasticity Model Estimates for Equation (4a)
(t-stats in parentheses)

Variable	**Pooled With LDC Fixed Effects Dummies**	**Average of Individual LDC OLS Estimates**
Ln($Price_{t-1}$)	-0.014 (-0.52)	-0.08
Ln($Price_{t-1}$)*D2000	-0.035 (-4.19)	-0.02
Ln($Price_{t-12}$)	-0.018 (-0.75)	-0.07
Annual Time Trend	-0.004 (-2.47)	-0.007
$Rbar^2$	0.99	
Std. Error of Regression	0.060	
Mean of the Dependent Variable	1.262	
AIC	-2.700	
Schwarz Criterion	-2.353	
Number of Observations	298	4

Table 9B
MTN Regional Elasticity Model Estimates for Equation (4b)
(t-stats in parentheses)

Variable	**Pooled With LDC Fixed Effects Dummies**	**Average of Individual LDC OLS Estimates**
Ln($Price_{t-1}$)	-0.07 (-2.73)	-0.11
Ln($Price_{t-12}$)	-0.03 (-1.33)	-0.08
Annual Time Trend	-0.009 (-6.22)	-0.009
$Rbar^2$	0.99	
Std. Error of Regression	0.060	
Mean of the Dependent Variable	1.262	
AIC	-2.644	
Schwarz Criterion	-2.309	
Number of Observations	298	4

New England Region

The regression output for the NEC Region is given in Tables 10A and 10B. In Table 10A, we estimate a statistically significant shift in the short-run price elasticity in the post 2000 year period, although in this case it is a shift that lowers the short-run price elasticity and is not practically significant with only 0.015 decrease. According to equation (4b) in Table 10B, the short-run elasticity is -0.08 when computed from the average of the individual LDC results and is also –0.08 and statistically significant in the pooled regression. The long-run elasticity is between –0.25 and –0.28. In the pooled regression we observe a statistically significant annual declining rate of weather normal use per customer demand of 0.4 percent. Table 10B we see the total annual percent decline in use per customer one year after a ten percent price increase is between 2.9 percent and 3.0 percent, which is close to the annual percent decline in the national sample.

Table 10A
NEC Regional Elasticity Model Estimates for Equation (4a)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.09 (-3.34)	-0.09
$Ln(Price_{t-1})$*D2000	0.015 (2.44)	0.01
$Ln(Price_{t-12})$	-0.17 (-5.06)	-0.20
Annual Time Trend	-0.008 (-4.24)	-0.005
$Rbar^2$	0.97	
Std. Error of Regression	0.096	
Mean of the Dependent Variable	1.307	
AIC	-1.767	
Schwarz Criterion	-1.413	
Number of Observations	660	8

Table 10B
NEC Regional Elasticity Model Estimates for Equation (4b)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.08 (-2.86)	-0.08
$Ln(Price_{t-12})$	-0.17 (-5.00)	-0.20
Annual Time Trend	-0.004 (-3.73)	-0.002
$Rbar^2$	0.97	
Std. Error of Regression	0.097	
Mean of the Dependent Variable	1.307	
AIC	-1.760	
Schwarz Criterion	-1.412	
Number of Observations	660	8

Pacific Region

The regression output for the PAC Region is given in Tables 11A and 11B. In Table 11A, we estimate a statistically significant shift in the short-run price elasticity in the post 2000 year period, although from a practical point of view this decline is small with an impact of only 0.02. According to equation (4b) in Table 11B, the short-run elasticity is -0.07 when computed from the average of the individual LDC results and is also –0.07 and statistically significant in the pooled regression. The long-run elasticity is between –0.12 and –0.15. In the pooled regression we observe a statistically significant annual declining rate of weather normal use per customer of 0.8 percent. In Table 11B, we see the total annual percent decline in use per customer one year after a ten percent price increase of 2.0 percent, which is lower than the annual percent decline in the national sample.

Table 11A
PAC Regional Elasticity Model Estimates for Equation (4a)
(t-stats in parentheses)

Variable	**Pooled With LDC Fixed Effects Dummies**	**Average of Individual LDC OLS Estimates**
$Ln(Price_{t-1})$	-0.04 (-1.29)	-0.03
$Ln(Price_{t-1})$*D2000	-0.02 (-2.13)	-0.02
$Ln(Price_{t-12})$	-0.05 (-1.66)	-0.07
Annual Time Trend	-0.005 (-1.96)	-0.004
$Rbar^2$	0.98	
Std. Error of Regression	0.072	
Mean of the Dependent Variable	0.910	
AIC	-2.314	
Schwarz Criterion	-1.929	
Number of Observations	258	4

Table 11B
PAC Regional Elasticity Model Estimates for Equation (4b)
(t-stats in parentheses)

Variable	**Pooled With LDC Fixed Effects Dummies**	**Average of Individual LDC OLS Estimates**
$Ln(Price_{t-1})$	-0.07 (-2.61)	-0.07
$Ln(Price_{t-12})$	-0.05 (-1.83)	-0.08
Annual Time Trend	-0.008 (-3.87)	-0.005
$Rbar^2$	0.98	
Std. Error of Regression	0.073	
Mean of the Dependent Variable	0.910	
AIC	-2.302	
Schwarz Criterion	-1.931	
Number of Observations	258	4

South Atlantic Region

The regression output for the SAC Region is given in Tables 12A and 12B. In Table 12A, we estimate neither a practical nor a statistically significant shift in the short-run elasticity in the post 2000 year period. According to equation (4b) in Table 12B, the short-run elasticity is -0.11 when computed from the average of the individual LDC results and is -0.12 and statistically significant in the pooled regression. The long-run elasticity is between -0.24 and -0.29. In the pooled regression we observe a statistically significant annual declining rate of weather normal use per customer of 0.8 percent. Table 12B, we see the total annual percent decline in use per customer one year after a ten percent price increase is between 3.4 percent to 3.7 percent, which is higher than the annual percent decline in the national sample.

Table 12A
SAC Regional Elasticity Model Estimates for Equation (4a)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.115 (-3.09)	-0.10
$Ln(Price_{t-1})$*D2000	-0.002 (-0.15)	-0.005
$Ln(Price_{t-12})$	-0.17 (-4.16)	-0.13
Annual Time Trend	-0.008 (-2.58)	-0.009
$Rbar^2$	0.97	
Std. Error of Regression	0.109	
Mean of the Dependent Variable	1.218	
AIC	-1.509	
Schwarz Criterion	-1.146	
Number of Observations	280	4

Table 12B
SAC Regional Elasticity Model Estimates for Equation (4b)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.12 (-3.30)	-0.11
$Ln(Price_{t-12})$	-0.17 (-4.18)	-0.13
Annual Time Trend	-0.008 (-3.76)	-0.010
$Rbar^2$	0.97	
Std. Error of Regression	0.108	
Mean of the Dependent Variable	1.218	
AIC	-1.516	
Schwarz Criterion	-1.166	
Number of Observations	280	4

West North Central Region

The regression output for the WNC Region is given in Tables 13A and 13B. In Table 13B, we estimate a statistically significant shift in the short-run price elasticity in the post 2000 year period, although it is a shift that lowers the short-run price elasticity by only–0.014 and from a practical point of view is not significant. According to equation (4b) in Table 13B, the short-run elasticity is -0.08 when computed from the average of the individual LDC results and is –0.09 and statistically significant in the pooled regression. The long-run elasticity is between -0.13 and -0.15. In the pooled regression we observe a statistically significant annual declining rate of weather normal use per customer of 1.1 percent. In Table 13B we see the total annual percent decline in use per customer one year after a ten percent price increase is between 2.5 percent and 2.6 percent, which is close to the annual percent decline in the national sample.

Table 13A
WNC Regional Elasticity Model Estimates for Equation (4a)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.10 (-5.19)	-0.09
$Ln(Price_{t-1})$*D2000	0.014 (1.98)	0.01
$Ln(Price_{t-12})$	-0.06 (-2.62)	-0.05
Annual Time Trend	-0.014 (-5.48)	-0.014
$Rbar^2$	0.99	
Std. Error of Regression	0.048	
Mean of the Dependent Variable	1.314	
AIC	-3.141	
Schwarz Criterion	-2.765	
Number of Observations	190	3

Table 13B
WNC Regional Elasticity Model Estimates for Equation (4b)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.09 (-4.78)	-0.08
$Ln(Price_{t-12})$	-0.06 (-2.69)	-0.05
Annual Time Trend	-0.011 (-5.35)	-0.012
$Rbar^2$	0.99	
Std. Error of Regression	0.048	
Mean of the Dependent Variable	1.314	
AIC	-3.129	
Schwarz Criterion	-2.770	
Number of Observations	190	3

West South Central Region

The regression output for the WSC Region is given in Tables 14A and 14B. In Table 14A, we estimate neither a practical nor a statistically significant shift in the short-run elasticity in the post 2000 year period. According to equation (4b) in Table 14B, the short-run elasticity is -0.14 when computed from the average of the individual LDC results and is – 0.13 and statistically significant in the pooled regression. The long-run elasticity is -0.16 in both the pooled regression and when computed as the average of the individual LDC OLS estimates. In the pooled regression we observe a statistically significant annual declining rate of weather normal use per customer of 1.6 percent. In Table 14B, we see the total annual percent decline in use per customer one year after a ten percent price increase is between 2.9 percent and 3.2 percent, which is close to the annual percent decline in the national sample.

Table 14A
WSC Regional Elasticity Model Estimates for Equation (4a)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.12 (-1.71)	-0.13
$Ln(Price_{t-1})$*D2000	-0.008 (-0.48)	-0.009
$Ln(Price_{t-12})$	-0.03 (-0.40)	-0.02
Annual Time Trend	-0.015 (-2.52)	-0.01
$Rbar^2$	0.92	
Std. Error of Regression	0.198	
Mean of the Dependent Variable	0.722	
AIC	-0.318	
Schwarz Criterion	0.048	
Number of Observations	450	6

Table 14B
WSC Regional Elasticity Model Estimates for Equation (4b)
(t-stats in parentheses)

Variable	Pooled With LDC Fixed Effects Dummies	Average of Individual LDC OLS Estimates
$Ln(Price_{t-1})$	-0.13 (-1.87)	-0.14
$Ln(Price_{t-12})$	-0.03 (-0.40)	-0.02
Annual Time Trend	-0.016 (-3.79)	-0.013
$Rbar^2$	0.92	
Std. Error of Regression	0.198	
Mean of the Dependent Variable	0.722	
AIC	-0.322	
Schwarz Criterion	0.034	
Number of Observations	450	6

Shrinkage Estimates

We also estimate equation (4a) and (4b) with a type of shrinkage estimator, time series data on the Nine Census Regions, aggregated over the respective LDCs in each region. We will apply the Stein rule estimator discussed above in the sub-section on Shrinkage Estimators. The advantage of shrinkage estimators is that they allow for some similarity among the slope coefficients without constraining them to be exactly the same as in the case of pooled estimates.

Using aggregate regional data, Table 15 below gives the pooled fixed effects estimates of equation (4b) and the average of the individual regional coefficient estimates. These estimates are similar to the estimates presented in Table 5B based on individual LDC data. Note that in Table 5B the impact of a 10 percent price increase was a 2.8 percent decline in use per customer one year later. Using regional aggregate data we see the impact of a ten percent price increase is a similar 2.9 percent decline in use per customer one year later.

Table 15
Regional Elasticity Model Estimates using aggregate data for Equation (4b)
(t-stats in parentheses)

Variable	**Pooled With Regional Dummies**	**Average of Individual Regions**
Ln($Price_{t-1}$)	-0.12 (-3.4)	-0.10
Ln($Price_{t-12}$)	-0.06 (-1.63)	-0.08
Annual Time Trend	-0.011 (-3.72)	-0.011
$Rbar^2$	0.98	
Std. Error of Regression	0.094	
Mean of the Dependent Variable	12.14	
AIC	-1.79	
Schwarz Criterion	-1.34	
Number of Observations	540	9

Tables 16 to 24 below present the Stein Shrinkage coefficient estimates of equation (4b) using aggregate regional data. In this case, the shrinkage results are very close to the individual OLS estimates for each Region since F = 0.86 and c = 0.04 since T=60. Plugging into equation (5) we get:

$$\tilde{\beta}_i = 0.95\hat{\beta}_i + 0.05\hat{\beta}_p, \qquad (7)$$

East North Central Region

Table 16 shows the shrinkage estimates of the short-run and long-run elasticity derived from equation (7) for the ENC Region is -0.047 and -0.122, and the annual time trend shows a declining annual rate of 1.7 percent.

Table 16

ENC - Regional Model Elasticity Estimates with Aggregate Data for Equation 4b

Variable	**OLS on Individual Regional Data**		**Shrinkage Estimator**
	Estimate	t-stat	
Ln($Price_{t-1}$)	-0.043	-0.349	-0.047
Ln($Price_{t-12}$)	-0.076	-0.544	-0.075
Annual Time Trend	-0.017	-1.530	-0.017
Number of Observations	60		

East South Central Region

Table 17 shows the shrinkage estimates of the short-run and long-run elasticity derived from equation (7) for East South Central is -0.030 and -0.085, and the annual time trend shows a declining annual rate of 1.8 percent.

Table 17

ESC – Regional Model Elasticity Estimates with Aggregate Data for Equation 4b

Variable	**OLS on Individual Regional Data**		**Shrinkage Estimator**
	estimate	t-stat	
Ln($Price_{t-1}$)	-0.026	-0.180	-0.030
Ln($Price_{t-12}$)	-0.055	-0.337	-0.055
Annual Time Trend	-0.018	-1.270	-0.018
Number of Observations	60		

Middle Atlantic Region

Table 18 shows the shrinkage estimates of the short-run and long-run elasticity derived from equation (7) for the Middle Atlantic Region is -0.164 and -0.46, and the annual time trend shows a declining annual rate of 0.6 percent.

Table 18

MAC - Regional Model Elasticity Estimates with Aggregate Data for Equation 4b

Variable	OLS on Individual Regional Data		Shrinkage Estimator
	estimate	t-stat	
$Ln(Price_{t-1})$	-0.167	-1.198	-0.164
$Ln(Price_{t-12})$	-0.309	-1.887	-0.296
Annual Time Trend	0.006	0.633	0.006
Number of Observations	60		

Mountain Region

Table 19 shows the shrinkage estimates of the short-run and long-run elasticity derived from equation (7) for the Mountain Region is -0.058 and -0.076, and the annual time trend shows a declining annual rate at of 2.22 percent.

Table 19

MTN - Regional Model Elasticity Estimates with Aggregate Data for Equation 4b

Variable	OLS on Individual Regional Data		Shrinkage Estimator
	estimate	t-stat	
$Ln(Price_{t-1})$	-0.055	-0.675	-0.058
$Ln(Price_{t-12})$	0.022	0.263	0.018
Annual Time Trend	-0.022	-2.767	-0.022
Number of Observations	60		

New England Region

Table 20 shows the shrinkage estimates of the short-run and long-run elasticity derived from equation (7) for the New England Region is -0.074 and -0.364, and the annual time trend shows a declining annual rate of 0.3 percent.

Table 20

NEC - Regional Model Elasticity Estimates with Aggregate Data for Equation 4b

Variable	OLS on Individual Regional Data		Shrinkage Estimator
	Estimate	t-stat	
$Ln(Price_{t-1})$	-0.072	-0.537	-0.074
$Ln(Price_{t-12})$	-0.302	-1.767	-0.290
Annual Time Trend	-0.003	-0.384	-0.003
Number of Observations	60		

Pacific Region

Table 21 shows the shrinkage estimates of the short-run and long-run elasticity derived from equation (7) for the Pacific Region is -0.089 and -0.179, and the annual time trend shows a declining annual rate of 1.0 percent.

Table 21

PAC - Regional Model Elasticity Estimates with Aggregate Data for Equation 4b

Variable	OLS on Individual Regional Data		Shrinkage Estimator
	estimate	t-stat	
$Ln(Price_{t-1})$	-0.087	-1.066	-0.089
$Ln(Price_{t-12})$	-0.092	-1.194	-0.090
Annual Time Trend	-0.010	-1.157	-0.010
Number of Observations	60		

South Atlantic Region

Table 22 shows the shrinkage estimates of the short-run and long-run elasticity derived from equation (7) for the South Atlantic Region is -0.182 and -0.327, and the annual time trend shows a declining annual rate of 1.9 percent.

Table 22

SAC - Regional Model Elasticity Estimates with Aggregate Data for Equation 4b

Variable	OLS on Individual Regional Data		Shrinkage Estimator
	estimate	t-stat	
$Ln(Price_{t-1})$	-0.185	-1.747	-0.182
$Ln(Price_{t-12})$	0.156	1.371	0.145
Annual Time Trend	-0.019	-1.989	-0.019
Number of Observations	60		

West North Central Region

Table 23 shows the shrinkage estimates of the short-run and long-run elasticity derived from equation (7) for the West North Central Region is -0.088 and -0.120, and the annual time trend shows a declining annual rate of 0.90 percent.

Table 23

WNC - Regional Model Elasticity Estimates with Aggregate Data for Equation 4b

Variable	OLS on Individual Regional Data		Shrinkage Estimator
	estimate	t-stat	
$Ln(Price_{t-1})$	-0.086	-0.966	-0.088
$Ln(Price_{t-12})$	-0.031	-0.355	-0.032
Annual Time Trend	-0.009	-1.053	-0.009
Number of Observations	60		

West South Central Region

Table 24 shows the shrinkage estimates of the short-run and long-run elasticity derived from equation (7) for the West South Central Region is -0.209 and -0.258, and the annual time trend shows a declining annual rate of 1.1 percent.

Table 24

WSC - Regional Model Elasticity Estimates with Aggregate Data for Equation 4b

Variable	OLS on Individual Regional Data		Shrinkage Estimator
	estimate	t-stat	
$Ln(Price_{t-1})$	-0.214	-1.719	-0.209
$Ln(Price_{t-12})$	-0.049	-0.368	-0.049
Annual Time Trend	-0.011	-0.946	-0.011
Number of Observations	60		

Our overall assessment of the regional models is that individual coefficients vary[15] greatly across the nine regional models and are often insignificant. This is due to the small sample sizes relative to the national sample, multicollinearity between the two lagged prices, and to some extent multicollinearity with the time trend as well. Yet the average impact of a 10 percent price increase on use per household is remarkably stable and negative across all nine Census Regions in the pooled regressions using individual LDC data. This total decline after a 10 percent price increase for the nine Census Regions is roughly centered on the national impact of a 2.8 percent decline in weather normal use per customer; with the Mountain Region having a 1.9 percent impact at the low end of the range and the South Atlantic Region having a 3.7 percent impact at the high end of the range.

[15] There may be differences in shell efficiency and new home construction and LDC sponsored energy conservations programs across regions that would lead to some heterogeneity in coefficient estimates across the nine census regions. We feel the iterative Bayes shrinkage estimator could remove much of the inconsistency between the national and regional coefficient estimates in a follow up study.

Section 5: Summary of Results and Policy Implications

This research project was initiated to examine the decline in residential natural gas consumption since 2000 and to determine whether there had been a change in the response by residential consumers to higher (and more volatile) natural gas prices. The data that were collected and analyzed support two important findings and a general rule of thumb. This rule appears to capture consumers' winter price sensitive consumption behavior reasonably well across the LDCs and Census regions.

First, consumption is strongly influenced by seasonal heating needs, response to price change, and the efficiency changes in appliances and home shell efficiency coupled with conservation behavior by consumers. While the separate efficiency and conservation effects due to appliance and housing shell turnover are difficult to disentangle in the current sample, they appear to be discernable from the price effects. Table 25 gives a summary of the national and separate regional price and naturally occurring time trend effects found in this study.

Second, we could not find evidence supporting an appreciable change in the short-run price elasticity of natural gas consumption in the post year 2000 period.

Table 25
Summary of National and Regional Natural Gas Price Estimates[16]

Region	Short-run elasticity	Long-run elasticity*	Annual Time Trend	Total Response to a 10% Price Increase**
National	-0.09	-0.18	-1.0%	-2.8%
East North Central	-0.08	-0.22	-1.0%	-3.2%
East South Central	0.01	-0.01	-2.0%	-2.1%
Middle Atlantic	-0.10	-0.20	-1.3%	-3.3%
Mountain	-0.07	-0.10	-0.9%	-1.9%
New England	-0.08	-0.25	-0.4%	-2.9%
Pacific	-0.07	-0.12	-0.8%	-2.0%
South Atlantic	-0.12	-0.29	-0.8%	-3.7%
West North Central	-0.09	-0.15	-1.1 %	-2.6%
West South Central	-0.13	-0.16	-1.6%	-3.2%

* Cumulative: includes impacts of short-run elasticities
** The total response to a 10 percent price increase is the sum of the long-run elasticity and the annual time trend effect.

The results from the price elasticity estimates and the combination of efficiency and conservation estimates are able to explain the post 2000 winter consumption per customer actual experience. Normal winter season natural gas use per household in the US has declined

[16] Estimates obtained from the "fixed effects" pooled regression.

about 13.1 percent between 2000 and 2006. There has been an increase in real natural gas prices of 44 percent for the same time period, which according to our analysis would lead to approximately a 7.9 percent (0.18 x 44 percent) decline in use per customer by the year 2006. In addition to this 7.9 percent price induced decline in weather normal use per household, there would be an additional 6.0 percent (6 x 1.0 percent) decline because of the natural annual rate of turnover of old gas appliances to newer more efficient appliances. Hence, our analysis predicts a decline of 13.9 percent over the six-year period, which is very close to the actual decline of 13.1 percent.

Overall decline		*Price Effect*		*Conservation and*
in Winter Gas Use	=	*Elasticity with*	+	*Turnover to More*
per Customer		*Price Increase*		*Efficient Appliances*
13.9%	=	$0.18 \, x \, 44\%$	+	$6 \, x \, 1.0\%$
	=	7.9%	+	6.0%

In the expression above, the left hand term is the overall declining rate of winter gas use per customer, the first term on the right hand side is the price effect reflecting elasticity with price increase, and the second term the effect from conservation and turnover to more efficient appliances that occurs naturally every year with or without a price increase.

This proposed rule of thumb suggests that twelve months after a 10 percent increase in natural gas prices at the national level, there will be nearly a 3 percent decline in natural gas use per customer. This 3 percent decline is comprised of about a 1 percent drop in gas use with the current capital stock, about a 1 percent drop in use per customer because households respond to the higher gas prices by buying more efficient appliances, and a 1 percent drop in gas usage per customer due to the natural turnover to more efficient gas appliances each year. This rule of thumb will vary by LDC because they are heterogeneous in terms of weather, housing stocks, and standards of living.

It should be noted that the 1 percent price-induced drop with the current capital stock is what economist refer to as the elasticity of "short-run" demand. This refers to customers "turning down the thermostat". There is a second 1 percent price induce drop in use per customer that occurs one year later due to consumers buying more efficient appliances and increasing the tightness of the home. The price elasticity in the "long-run" is the sum of the short-run demand elasticity and the additional changes that occur to quantity demanded one year later because of natural gas price impacts on consumer choice of appliance and home thermal shell efficiency.

The heightened conservation behavior by consumers is partly due to the many government and utility programs that currently exist to encourage residential consumers to save energy:

- The federal government encourages conservation through weatherization programs funded by the Low-Income Household Energy Assistance Program (LIHEAP), tax credits for purchase of efficient appliances and shell improvements, and consumer education on the importance of saving energy.

- State and local governments also encourage efficiency through similar programs
- Many utilities provide rebates, incentives, and assistance to their customers to improve use of energy. For example, electric and natural gas utilities provided more than $140 million in 2005 to assist low-income customers to weatherize their homes {Source: http://liheap.ncat.org/tables/FY2005/05stlvtb.htm }

From a planning and policy perspective, even if gas prices do not increase in a given year, there will still be approximately a 1 percent fall in gas usage per household in the following year. This is driven by the historical forces related to the natural turnover of old appliances to the more efficient appliances that are available on the market each year. The annual time trend impacts will vary somewhat by LDC, because of regional differences in weather, appliance stocks, housing shell efficiency, demographic and economic characteristics.

There is a caveat. We cannot address whether the phenomenon will continue at the same rate for the long-term. Further gains in efficiency in absolute and relative terms may or may not have the same impact as they did previously. This is an issue for more detailed engineering studies on the efficiency of appliances and housing shells and economic research on the change in conservation habits of consumers for energy use and winter season comfort levels. We would note, however, that legislative and regulatory pressure for greater efficiency is likely to increase as climate change becomes a more pronounced national and international priority.

The policy implications of the 13.1 percent decline since 2000 are significant. First, regulators must recognize these trends and allow rate structures to incorporate these variations. Second, the natural turnover of appliances and increases in shell efficiency from new construction will result in continued conservation, regardless of price changes, impacting utility operations. Third, even if future gas prices remain constant or even decrease, the appliance and home shell efficiency gains achieved in prior years will not be reversed.

Suggestions for Future Research

As with any study, there is room for future research. Suggestions for future research are the following:

- Obtain data from Natural Gas Companies that did not participate in the initial study.

- Try different specifications of the model.

- Use the Iterative Bayes Shrinkage Estimation Technique to get individual LDC parameter estimates.

- Consider the impact of competition from the electric utility industry.

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Appendix A: Construction of Weather-Normalized Series for Use per Customer

Step 1. Calculate the ratio of HDDN to HDD (normal heating degree days / actual heating degree days.) this is referred to as the weather normalization factor

Step 2. Construct a proxy for base natural gas consumption per customer for each "year". Calculate the average of July and August for each year.

Step 3. Subtract the base consumption from Actual consumption for the September through June for the next 10 months. Refer to this as "heating" consumption. Example: the average of July and August 1999 will be subtracted from September 1999 through June 2000. Retain the actual values for July and August 1999 in the "heating" consumption variable.

Step 4. Calculate the weather normal consumption per customer series. Multiply the "heating" consumption variable by the weather normalization factor. Intuitively, a very cold winter will have relatively high levels of consumption. The very cold weather means that the denominator in the weather normalization factor is large relative to the normal HDD. Multiplying the large consumption variable times the factor, which is less than one, will bring back or reduce consumption towards the normal "heating" consumption level.

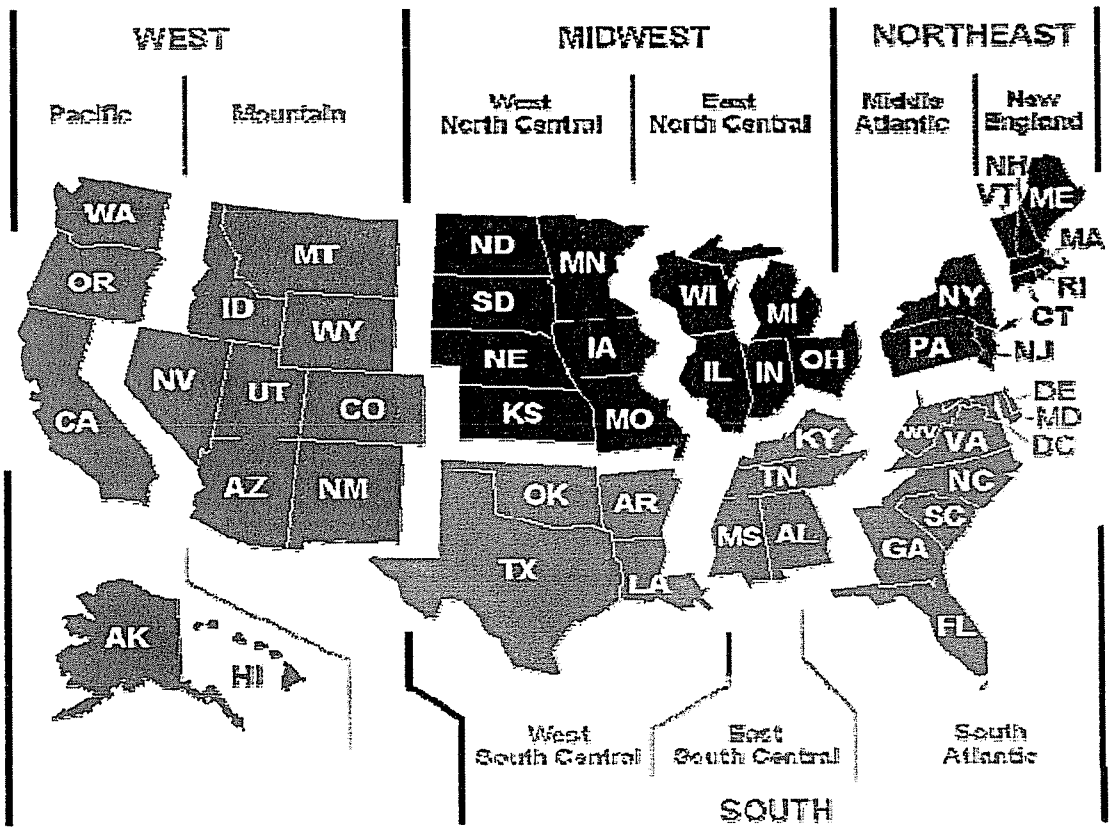
Step 5. Add the base consumption per customer back into the September through June normal heating consumption levels.

Variable list omitting the region identifiers:

HDD	– Actual Heating Degree Days
HDDN	- Normal Heating Degree Days
CUNG	- Natural Gas Use per Customer per Month
ZSAJQUS	- Days per Month
WNF	- Weather Normalization Factor WNF = HDDN / HDD
Base	- Average of July and August in a year
HCUNG	- "Heating" Natural Gas Use per Customer per Month HCUNG = CUNG – Base
NCUNG	- "Normalized" Natural Gas Use per Customer per Month NCUNG = (HCUNG * WNF) + Base
CUNGW	- Actual Daily Natural Gas Use per Customer per Month CUNGW = CUNG / ZSAJQUS
NCUNGW	- "Normalized" Natural Gas Use per Customer per Month NCUNGW = NCUNG / ZSAJQUS

Appendix B: U.S. Census Regions

Figure B.1
U.S. Census Region Map



Source: U.S. Dept. of Energy http://www.eia.doe.gov/emeu/cbecs/census_maps.html

Table B.1
U.S. Census Region Definitions

Division 1
New England

Connecticut
Maine
Massachusetts
New Hampshire
Rhode Island
Vermont

Division 2
Middle Atlantic

New Jersey
New York
Pennsylvania

Division 3
East North Central

Illinois
Indiana
Michigan
Ohio
Wisconsin

Division 4
West North Central

Iowa
Kansas
Minnesota
Missouri
Nebraska
North Dakota
South Dakota

Division 5
South Atlantic

Delaware
District of Columbia
Florida
Georgia
Maryland
North Carolina
South Carolina
Virginia
West Virginia

Division 6
East South Central

Alabama
Kentucky
Mississippi
Tennessee

Division 7
West South Central

Arkansas
Louisiana
Oklahoma
Texas

Division 8
Mountain

Arizona
Colorado
Idaho
Montana
Nevada
New Mexico
Utah
Wyoming

Division 9
Pacific

Alaska
California
Hawaii
Oregon
Washington

Source: Energy Information Administration, Office of Integrated Analysis and Forecasting.

U.S. Census Region Pneumonic	
ENC	East North Central
ESC	East South Central
MAC	Middle Atlantic
MTN	Mountain
NEC	New England
PAC	Pacific
SAC	South Atlantic
WNC	West North Central
WSC	West South Central

Appendix C: Literature Review[17]

There are many studies on the price and income elasticities of residential energy goods in general, and of residential natural gas demand in particular. Table 1 below lists some of these studies, along with the short-run and long-run estimates. See Dahl and Roman (2004) and Dahl (2005) for recent surveys of energy elasticity demand estimates. Other surveys of energy demand price elasticity estimates are Taylor (1975 and 1977), Bohi (1981), Bohi and Zimmerman (1984), Al-Sahlawi (1989), Dahl (1993), and Espy and Espy (2004). Common drawbacks of these studies are: (1) they do not include data that contain the recent increases in residential natural gas prices, (2) they do not focus on the winter season demand, (3) they do not contain company level data across the entire US, and (4) most do not allow for a non-price related decline in use per customer that occurs automatically as consumers replace old inefficient appliances with newer more efficient ones.

The AGA study overcomes the missing elements in the existing literature by looking at individual company level winter season monthly data from all nine US Census Regions over the period 1981 to 2006. Also, the AGA study allows for a naturally occurring decline in use per customer that results from the replacement of old inefficient gas appliances with newer more efficient models.

There have been many papers written that estimate the price elasticity of residential demand for natural gas. A partial list of these papers is given in the references section. Estimates of short-run price elasticity range from as low as –0.05 in Beirlein, Dunn and McConnon (1981) to as high as –0.68 in Barnes, Gillingham & Hagemann (1982). For long-run price elasticity estimates the range of estimates is even higher, with the low being -0.017 in Hewlett (1977) to as high as –3.42 in Beirlein, Dunn and McConnon (1981).

It is fair to say there is no real consensus on residential natural gas price elasticity demand estimates. For overall residential energy demand in general, the median estimate of short-run price elasticity is about –0.2, with the long-run dynamic models with lagged dependent variables yielding a median estimate of about –0.48. For natural gas in particular, using EIA state level aggregate data, Maddala, et. al. (1997) estimate the average short-run price elasticity of natural gas is –0.1 and the long-run price elasticity of residential natural gas demand is –0.27.

[17] This appendix benefited from discussions and on-going research by Professor Carol Dahl, the Colorado School of Mines, Golden, Colorado. All errors are ours.

Table C.1
Residential Price Elasticity Estimates

Authors	Data	Estimation Method	Short-run	Long-run
Balestra & Nerlove (1966)	Pooled: 36 States for 1957-62)	GLS(EC)	NA	-0.63
Jaskow & Baughman (1976)	Pooled: 48 States for 1968-72	OLS	-0.15	-1.01
Berndt & Watkins (1977)	Pooled: Ontario and British Columbia for 1959-74	Maximum Likelihood	-0.15	-0.69
Hewlett (1977)	Cross Section: New York State household survey	OLS	NA	-0.45
Hewlett (1977)	Pooled: New York State customer survey for 1976 and 1977.	OLS	NA	-0.17
Beirlein, Dunn & McConnon (1981)	Pooled: 9 States for 1967-77	OLS	-0.23	-2.90
		GLS (EC)	-0.23	-2.96
		GLS (EC-SUR)	-0.05	-3.42
Barnes, Gillingham & Hagemann (1982)	Pooled: 10,000 households in 23 US cities. Quarterly data for 1972-73.	IV	-0.68	NA
Green & Gilbert (1983)	Cross-Sectional: non-poverty homeowners and poverty homeowners	OLS	NA	-1.25
		OLS	NA	-1.09
Blattenberger, Taylor, & Rennhack (1983)	Pooled: 48 states for 1961-74	GLS (EC)	-0.32	-0.39
Green, Salley, Grass & Osei (1986)	Pooled: between 6 and 7 thousand households for 1974 to 1979.	OLS	-0.16	NA

Appendix D: Statistical Hypothesis Testing

The practical question that is addressed in statistical hypothesis testing concerns the relative strength of some "treatment"; such as does price have an impact on weather normal use per household natural gas demand. The question addressed might be: Do the data contained in the sample present sufficient evidence that increases in price lead to a lower use per household natural gas demand?

The reasoning employed in testing a hypothesis bears a striking resemblance to the procedure used in a court trial. In tying a person for a crime, the court assumes the accused innocent until proven guilty. The prosecution collects and presents all the available evidence in an attempt to contradict the "not guilty" hypothesis and hence to obtain a conviction. However, if the prosecution fails to disprove the "not guilty" hypothesis, this does not prove that the accused is "innocent" but merely that there is not sufficient evidence to conclude that the accused is "guilty".

The statistical problem in this study portrays "natural gas price" as the accused. The hypothesis to be tested, called the **null hypothesis**, is that price does not negatively impact the weather normal use per household natural gas demand. The evidence in this case is contained in the sample drawn from the population of LDCs who supply this demand. The researcher, playing the role of the prosecutor, believes that an **alternative hypothesis** is true - namely, that natural gas price does have a negative impact on natural gas use per household demand. Hence, the researcher attempts to use the evidence contained in the sample to reject the null hypothesis (no impact of natural gas price on natural gas demand) and thereby to support the alternative hypothesis, the contention that price does in fact inversely impact natural gas demand.

The statistician will calculate a test statistic from the information contained in the sample. All possible values the test statistic may assume are divided into two groups -- one called the rejection region and the other the acceptance region. After the sample is collected the test statistic is calculated and observed. If the test statistic takes on a value in the rejection region, the null hypothesis is rejected. Otherwise, one fails to reject the null hypothesis.

You will notice that the researcher is faced with two possible types of errors. On the one hand, the researcher might reject the null hypothesis when it is true, and falsely conclude that natural gas price does negatively impact the natural gas demand. This would result in forecasting lower revenues after a rate increase than would actually be the case. On the other hand, the researcher might decide not to reject the null hypothesis when it is false, and falsely conclude that natural gas price does not impact natural gas demand. This error would result in forecasting higher revenues after a rate increase than would actually be the case.

Rejecting the null hypothesis when it is true is called a Type I error for a statistical test. The probability of making a type I error is usually denoted by the Greek symbol α, and is referred to as the "statistical significance level". In practice some common values used for

α are 0.10 (a 10 percent chance of a Type I error), 0.05 (a 5 percent chance of a Type I error), 0.025 (a 2.5 percent chance of a Type I error), and 0.01 (a 1 percent chance of a Type I error).

The probability α will increase or decrease as we increase or decrease the size of the rejection region. Then why not decrease the size of the rejection region and make α as small as possible? Unfortunately, decreasing α increases the probability of not rejecting the null hypothesis when it is false and some alternative hypothesis is true. This second type of error is called the type II error for a statistical test and its probably is commonly denoted by the Greek symbol β. More formally, accepting the null hypothesis when it is false is called a type II error for a statistical test. The probability of making a type II error when some specific alternative is true is denoted by β.

Notice that both errors cannot be committed simultaneously. A type I error is possible only if the decision is to reject the null hypothesis; a type II error is possible only if the decision in to not reject the null hypothesis.

When the null hypothesis is rejected in favor of the alternative hypothesis, it is called a statistically significant test. When one fails to reject the null hypothesis, it is referred to as a statistically insignificant test.

As noted on page 29 of Maddala (2001), a statistically significant test means, "sampling variation is an unlikely explanation of the discrepancy between the null hypothesis and the sample values (estimate)". On the other hand, a statistically insignificant test means, "sampling variation is a likely explanation of the discrepancy between the null hypothesis and the sample value".

The appropriate test statistic for the null hypotheses tested in this report is the t-statistic, which is reported for each of the coefficients in equations (4a) and (4b). For sample sizes larger than 120 and for an alternative hypothesis that states the price coefficient is less than zero, a t-statistic less than -1.28 is statically significant at the 10 percent level, a t-statistic less than -1.64 is statistically significant at the 5 percent level, a t-statistic less than -1.96 is statically significant at the 2.5 percent level, and a t-statistic less than -2.33 is statistically significant at the 1 percent level.

American Gas Association

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www.aga.org

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 007:

Please identify any proposed gas-using appliance efficiency or usage standards or building envelop construction or building standards that are presently being considered for adoption by any Kentucky state agency or the Kentucky state legislature, or by any Federal agency or the United States Congress.

Response:

Columbia objects to and declines to respond to this discovery request to the extent it calls for information that is not in Columbia's current possession, custody, or control. Columbia also objects to and declines to respond to this discovery request that seeks information already known or readily available by less onerous means, including without limitation, information available to the public. Without waiving its objection, Columbia states that given the time constraints for responding to discovery in this case, Columbia is currently unaware of any documents that would be responsive to this data request.

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 008:

Please identify all gas-using appliance efficiency or usage standards, including building envelope construction or building standards, federal or state, that are presently in effect for customers of Columbia Gas of Kentucky.

Response:

Columbia objects to and declines to respond to this discovery request to the extent it calls for information that is not in Columbia's current possession, custody, or control. Columbia also objects to and declines to respond to this discovery request that seeks information already known or readily available by less onerous means, including without limitation, information available to the public. Without waiving its objection, Columbia states that given the time constraints for responding to discovery in this case, Columbia is currently unaware of any documents that would be responsive to this data request.

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 009:

Please provide any studies or other written material discussing the impact of a straight-fixed-variable rate upon gas consumption patterns.

Response:

Please see the direct testimony and attachments of Mark P. Balmert. Also please refer to the response to data request PSC DR Set 2-005.

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 010:

Please provide any studies or other written material discussing the technical potential for gas energy efficiency among the Company's customers or gas customers similarly situated.

Response:

The Company has not prepared any such studies or written material.

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 011:

Please provide any studies or other written materials discussing the economic potential for gas energy efficiency among the Company's customers or gas customers similarly situated.

Response:

The Company has not prepared any such studies or written material.

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 012:

Please provide any studies or other written materials discussing the achievable potential for gas energy efficiency among the Company's gas customers or customers similarly situated.

Response:

The Company has not prepared any such studies or written material.

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 013:

(a) Please provide the results of the California standard cost-benefit tests for each of the DSM programs proposed by the Company.
(b) Please detail how customers will be informed of the proposed DSM offerings.
(c) Please describe the expected participants, by such socio-demographic characteristics as age, home ownership, income, employment, and any others considered pertinent to marketing the program.
(d) Please provide the Company's understanding of the market barriers and imperfections, if any, that prevent its customers from taking advantage of energy efficiency absent the Company's DSM offerings, and explain in detail how each proposed DSM program overcomes any of the identified market barriers or imperfections.

Response:

(a) The cost benefit studies performed by the Company are included in the spreadsheet provided in response to Item 19(b) of the Second Data Request of the Commission Staff. The Company did not perform the California cost-benefit tests, which would not be required under the proposed tariff.

(b) For the Energy Audit Program and the High-Efficiency Appliance Rebate Program the Company will inform customers through interactions with customer account representatives. The Company may also notify customers through bill inserts or through other forms of education. For the Low-Income High-Efficiency Furnace Replacement Program, the Company plans to rely on Community Action Council for Lexington-Fayette, Bourbon, Harrison, and Nichols Counties, Inc. ("CAC") to inform potential participants in the program.

(c) The Company has not performed the requested demographic research.

(d) The Company has not performed the requested market/economic research.

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 014:

Please provide the number of residential customers in arrears in each of the last 36 months, broken out by length of time in arrears, such as 0 – 30 days, 31-60 days, 61-90 days, over 90 days. Please use the time periods used by the company for bill collection and arrearage management purposes. Please break out each group by the number who are low-income, or elderly, and provide your definition of the terms "low-income" and "elderly." Please break out each group by receipt of LIHEAP in the last 12 months.

Response:

Columbia does not maintain this information, and thus it is not available.

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 015:

Please provide the aggregate and average dollar amount of residential customer bills in arrears in each of the last 36 months, broken out by length of time in arrears, such as 0 – 30 days, 31-60 days, 61-90 days, over 90 days. Please use the time periods used by the company for bill collection and arrearage management purposes. Please break out each group by the number who are low-income, or elderly, and provide your definition of the terms "low-income" and "elderly." Please break out each group by receipt of LIHEAP in the last 12 months.

Response:

AARP DR Set 1-015 Attachment 1 shows the aggregate dollar amount of residential customer bills for each of the last 36 months, broken out according to 0-30 days, 31-60 days, 61-90 days, and over 90 days. Columbia does not track the number of customers in the manner addressed in the data request, therefore Columbia is unable to provide the average customer dollar amount. Columbia does not track by low-income, elderly, or LIHEAP.

RESIDENTIAL AGING REPORT

Month/Year	CURRENT	31 - 60 DAYS	61 - 90 DAYS	Over 90 DAYS
May-06	$ 3,697,252	$ 5,688,261	$ 4,776,918	$ 1,721,663
Jun-06	$ 1,854,961	$ 2,111,788	$ 2,846,509	$ 2,252,496
Jul-06	$ 826,693	$ 847,815	$ 996,392	$ 1,527,912
Aug-06	$ (1,770,845)	$ 258,085	$ 159,985	$ 547,753
Sep-06	$ (4,944,500)	$ 223,038	$ 90,777	$ 273,070
Oct-06	$ (7,821,328)	$ 164,027	$ 71,226	$ 169,268
Nov-06	$ (6,311,257)	$ 208,027	$ 56,426	$ 144,240
Dec-06	$ (1,493,689)	$ 392,156	$ 64,466	$ 122,354
Jan-07	$ 2,095,087	$ 666,340	$ 100,741	$ 96,300
Feb-07	$ 11,163,972	$ 1,051,250	$ 175,874	$ 101,832
Mar-07	$ 7,744,359	$ 3,984,231	$ 376,487	$ 147,048
Apr-07	$ 4,865,161	$ 3,851,895	$ 1,470,203	$ 223,833
May-07	$ 1,600,057	$ 2,575,551	$ 1,850,826	$ 632,791
Jun-07	$ 578,221	$ 1,034,049	$ 1,274,927	$ 909,176
Jul-07	$ 242,560	$ 408,476	$ 401,430	$ 710,622
Aug-07	$ (2,064,842)	$ 235,565	$ 141,151	$ 347,699
Sep-07	$ (4,574,545)	$ 222,076	$ 108,085	$ 222,753
Oct-07	$ (8,242,183)	$ 232,327	$ 98,844	$ 160,829
Nov-07	$ (7,230,844)	$ 241,301	$ 104,867	$ 142,932
Dec-07	$ (873,377)	$ 549,368	$ 93,259	$ 126,717
Jan-08	$ 6,860,837	$ 1,024,341	$ 137,856	$ 98,997
Feb-08	$ 12,167,828	$ 2,323,612	$ 295,040	$ 101,102
Mar-08	$ 13,914,860	$ 4,319,755	$ 748,793	$ 191,591
Apr-08	$ 8,107,141	$ 6,819,327	$ 1,931,209	$ 474,812
May-08	$ 3,876,730	$ 5,073,677	$ 342,976	$ 895,109
Jun-08	$ 2,402,166	$ 2,588,042	$ 2,709,914	$ 1,595,300
Jul-08	$ 1,159,088	$ 1,042,416	$ 1,088,965	$ 1,418,675
Aug-08	$ (1,361,458)	$ 436,558	$ 322,151	$ 849,862
Sep-08	$ (5,872,973)	$ 387,734	$ 189,033	$ 531,491
Oct-08	$ (10,679,887)	$ 279,925	$ 122,285	$ 280,574
Nov-08	$ (8,145,142)	$ 325,247	$ 118,719	$ 232,256
Dec-08	$ 642,841	$ 676,913	$ 95,817	$ 157,657
Jan-09	$ 9,738,063	$ 1,827,908	$ 203,163	$ 143,363
Feb-09	$ 15,371,215	$ 3,349,326	$ 536,655	$ 151,162
Mar-09	$ 9,094,042	$ 5,710,285	$ 1,343,051	$ 337,628
Apr-09	$ 5,935,090	$ 4,649,289	$ 2,519,626	$ 800,577

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 016:

Please provide the number of residential customers in each of the last 36 months who (a) have been sent late notices within the last month (or billing period), (b) have been sent termination notices within the last month (or billing period), (c) have been terminated from service within the last month (or billing period), (d) have been reconnected in the last month (or billing period), and (e) have paid a reconnection charge in the last month (or billing period). Please provide this information broken out by income, age and LIHEAP receipt in the last 12 months, to the extent possible.

Response:

a) Columbia does not send late notices to customers separate from the customer's regular monthly bill.

b) The number of termination notices sent for the last 36 months for residential customers is shown on the attached AARP Set 1 No. 16 Response (b) hereto. We do not have this information broken out by income, age, and LIHEAP status.

c) The number of accounts terminated for non payment for the last 36 months for residential customers is shown on the attached AARP Set 1 No. 16 Response (c) hereto. We do not have this information broken out by income, age, and LIHEAP status.

d) The number of accounts reconnected for the last 36 months for residential customers is shown on the attached AARP Set 1 No. 16 Response (d) hereto. We do not have this information broken out by income, age, and LIHEAP status.

e) The number of accounts that paid a reconnection charge for the last 24 months for residential and small commercial customers is shown on the attached AARP Set 1 No. 16 Response (e) hereto (residential reconnections are not tracked separately). We do not have this information for the previous 12 months or broken out by income, age, and LIHEAP status.

Month	Termination Notices Sent
May-06	15,822
Jun-06	10,977
Jul-06	8,003
Aug-06	5,556
Sep-06	3,245
Oct-06	2,645
Nov-06	6,663
Dec-06	12,562
Jan-07	15,863
Feb-07	17,697
Mar-07	19,728
Apr-07	16,258
May-07	14,079
Jun-07	3,349
Jul-07	2,555
Aug-07	1,851
Sep-07	1,222
Oct-07	1,260
Nov-07	998
Dec-07	4,156
Jan-08	8,738
Feb-08	11,257
Mar-08	10,409
Apr-08	8,483
May-08	5,700
Jun-08	4,143
Jul-08	3,133
Aug-08	2,589
Sep-08	3,559
Oct-08	3,060
Nov-08	3,479
Dec-09	8,231
Jan-09	13,955
Feb-09	16,991
Mar-09	14,982
Apr-09	10,891

Month	Accounts Turned Off for Non Payment
May-06	1,398
Jun-06	1,562
Jul-06	876
Aug-06	797
Sep-06	728
Oct-06	437
Nov-06	295
Dec-06	168
Jan-07	483
Feb-07	442
Mar-07	1,260
Apr-07	1,344
May-07	1,318
Jun-07	1,033
Jul-07	382
Aug-07	436
Sep-07	292
Oct-07	241
Nov-07	224
Dec-07	157
Jan-08	420
Feb-08	446
Mar-08	1,226
Apr-08	1,256
May-08	1,231
Jun-08	956
Jul-08	677
Aug-08	652
Sep-08	505
Oct-08	720
Nov-08	292
Dec-09	260
Jan-09	509
Feb-09	1,094
Mar-09	1,357
Apr-09	1,348

Month	Number Reconnected
May-06	488
Jun-06	504
Jul-06	445
Aug-06	405
Sep-06	593
Oct-06	880
Nov-06	607
Dec-06	319
Jan-07	399
Feb-07	341
Mar-07	547
Apr-07	634
May-07	529
Jun-07	369
Jul-07	251
Aug-07	225
Sep-07	242
Oct-07	380
Nov-07	677
Dec-07	264
Jan-08	301
Feb-08	315
Mar-08	494
Apr-08	453
May-08	399
Jun-08	279
Jul-08	256
Aug-08	251
Sep-08	267
Oct-08	681
Nov-08	882
Dec-08	311
Jan-09	204
Feb-09	264
Mar-09	430
Apr-09	409

Month	Number Reconnect Fees Charged
May-07	605
Jun-07	387
Jul-07	257
Aug-07	269
Sep-07	204
Oct-07	474
Nov-07	498
Dec-07	217
Jan-08	295
Feb-08	291
Mar-08	480
Apr-08	504
May-08	402
Jun-08	305
Jul-08	248
Aug-08	232
Sep-08	245
Oct-08	800
Nov-08	402
Dec-08	296
Jan-09	152
Feb-09	192
Mar-09	316
Apr-09	323

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 017:

Please state the mean, mode, medium, maximum and minimum lengths of time residential customers were without power between disconnection for non-payment and reconnection in the last year, broken out by income, age, and LIHEAP receipt in the last 12 months, to the extent possible.

Response:

Columbia does not have the requested information.

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 018:

Please identify the annual revenue that would have been charged and the average revenue per terminated residential customer that would have been charged, had the customer continued to obtain service during the time of termination, broken out by income, age, and LIHEAP receipt in the last 12 months, to the extent available.

Response:

Columbia does not have the requested information.

PSC Case No. 2009-00141
AARP DR Set 1-019
Respondent(s): Stephen B. Seiple
Assistant General Counsel

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 019:

Please provide any memoranda, internal policy documents, instructions to employees, statutes or regulations, or any other written material describing and prescribing the company' bill collection policies, covering any of the following topics:

(a) Effectiveness of preconditions for becoming a customer, including arrearages, credit ratings, prior payment patterns, or the like;
(b) Effective methods for collecting payments;
(c) Effectiveness of non-payment notices and notice policies and practices;
(d) Effectiveness of non-payment termination policies, including any minimum amount in arrears for any minimum time, and any other preconditions to termination;
(e) Effectiveness of payment plan policies, including eligibility, and treatment of inability to meet existing payment plan terms;
(f) Effectiveness of winter, summer, extreme weather (defined), customer category (e.g. elderly, defined), or other restraints on termination; and
(g) Effectiveness of fees for non-payment, late-payment, returned checks, or other credit and collection-related fees.

Response:

Objection. Columbia objects to and declines to respond to this discovery request because it is vague, ambiguous, or contains terms and/or phrases that are undefined and/or are subject to varying interpretations or meanings, and could, therefore, cause responses to be misleading and/or incorrect. Columbia is unsure how AARP office would define the term "effectiveness." In addition, Columbia objects to and declines to respond to this discovery request to the extent that it is overbroad and causes annoyance, embarrassment, oppression, or undue burden or expense. To comply with this data request, which has no time parameters, Columbia would have to review the files and emails of dozens of people. To review the files and emails of that many people would be unduly burdensome. It is impossible for Columbia to conduct such a review given the time constraints of the discovery process in this case. If the AARP can submit a more focused request Columbia will attempt to provide the data requested.

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 020:

With regard to payment plans offered to customers in the last two years, please provide: (a) the average period (in months) for successful plan satisfaction; (b) the average amount of arrearages placed in the payment plan; and (c) the average down payment requested, if any. Please break this information out by income, age, and LIHEAP receipt in the last 12 months.

Response:

a) The average period for a payment plan for the last two years is three billing periods (or months) after the plan is established. Columbia does not track successful plan satisfaction through current reports nor do we track any payment plan information by income, age, and LIHEAP status.

b) The average amount of arrearages placed in a payment plan is not readily available. The average account balance associated with a customer on a payment plan was $279.01 for 2007 and $321.81 for 2008. Columbia does not have this information by income, age, and LIHEAP status.

c) Columbia does not track the down payment amount requested.

COLUMBIA GAS OF KENTUCKY, INC.
RESPONSE TO FIRST DATA REQUEST OF AARP

Data Request 021:

Please provide any information in the possession of the company regarding the elasticity of demand of residential customers, broken out by income, age, and LIHEAP receipt in the last 12 months to the extent available.

Response:

We are not aware of any estimates of elasticity of demand for residential customers broken out by income, age, and LIHEAP receipt.