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Energy Information Administration

November 2009

Short-Term Energy Outlook Model Documentation:
Regional Residential Propane Price Model

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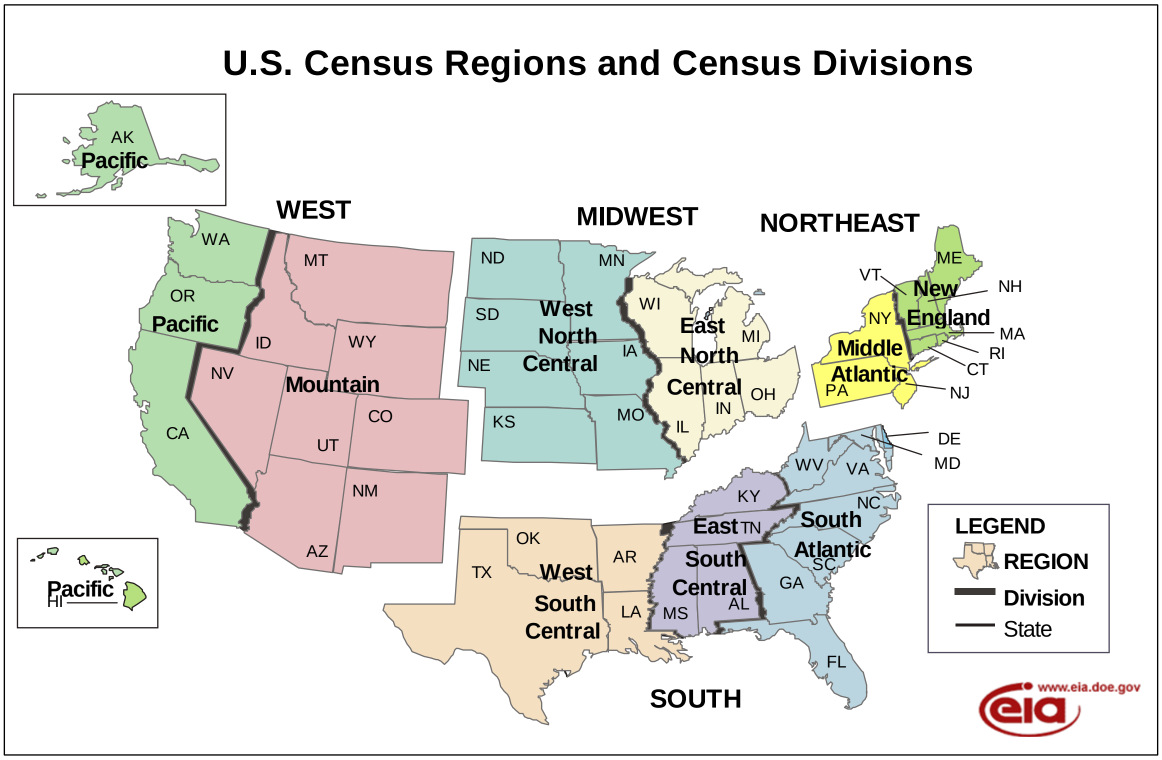
1. Overview of the Short-Term Propane Model

The regional residential propane price module of the *Short-Term Energy Outlook* (*STEO*) model is designed to provide residential retail price forecasts for the 4 census regions: Northeast, South, Midwest, and West (Figure 1).

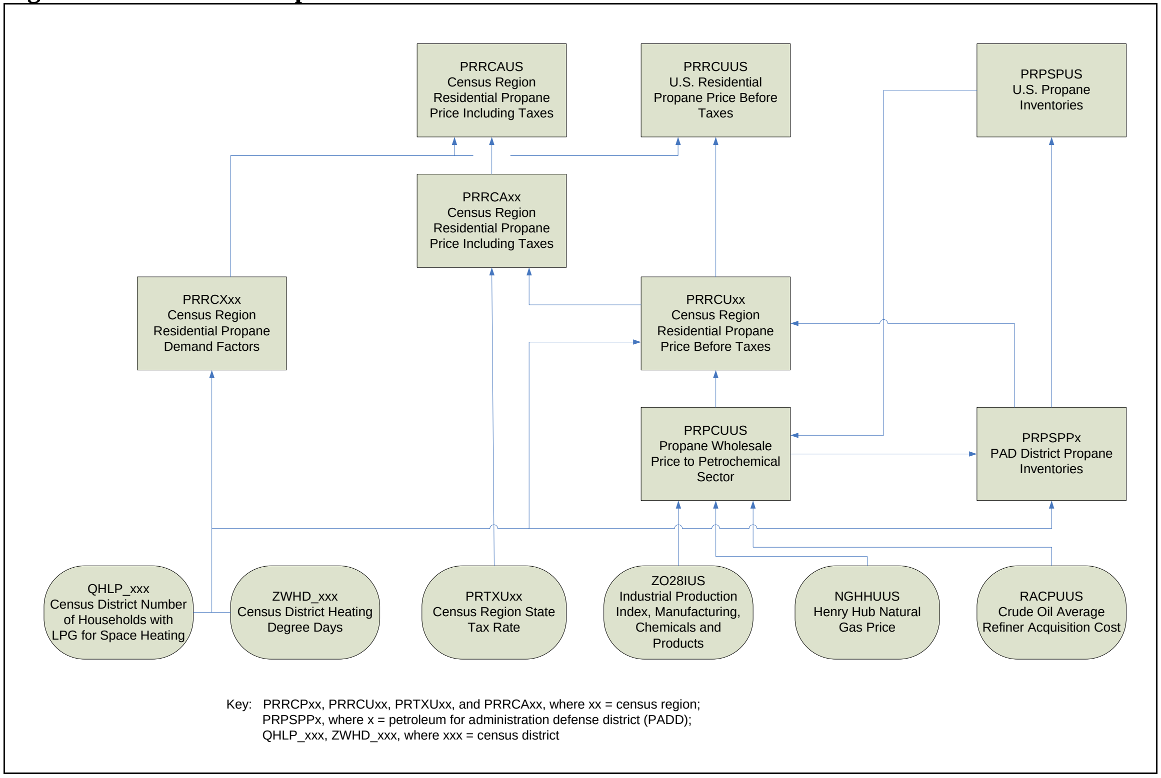
Figure 1. U.S. Census Regions and Census Divisions



The *STEO* model contains over 2,300 equations, of which about 450 are estimated regression equations. The regional residential propane price module, which is documented in this report, contains 31 equations, of which 14 are estimated. Some input variables to the *STEO* model are exogenous, coming from other forecasting models in EIA or forecasts produced by other organizations (e.g., weather forecasts from the National Oceanic and Atmospheric Administration). The frequency of the *STEO* model is monthly and the model equations are used to produce monthly forecasts over a 13-to-24 month horizon (every January the *STEO* forecast is extended through December of the following year).

Regional residential propane prices are estimated as a function of the propane wholesale price to the petrochemical sector, regional stocks, and weather (Figure 2). Regional residential propane prices are aggregated to the U.S. level by weighting regional prices by estimated regional consumption shares.

Figure 2. Residential Propane Model



A generalized representation of the regional residential propane price module is provided in the following equations. Equation (EQ 1) is an identity and equations (EQ 2) - (EQ 5) are estimated regression equations.

$$P_t^r = \sum_{i=1}^{4} C_{i,t} \, P_{i,t}^r \Big/ \sum_{i=1}^{4} C_{i,t} \ , \qquad i = 1, 2, 3, 4 \qquad \text{(EQ 1)}$$

$$C_{i,t}^r = f\left(W_{i,t}, W_{i,t-1}, S_{i,t}, \ C_{i,t-1}^r \right), \qquad i = 1, 2, 3, 4 \qquad \text{(EQ 2)}$$

$$P_{i,t}^r - P_t^w = f\left(\Delta P_t^w, N_{i,t-1}^*, W_{i,t}, \ P_{i,t-1}^r - P_{t-1}^w\right), \qquad i = 1, 2, 3, 4 \qquad \text{(EQ 3)}$$

$$\Delta N_{jt} = f\left(N_{j,t-1}^*, W_{jt}\right), \qquad j = 1, 2, 3, 4, 5 \qquad \text{(EQ 4)}$$

$$P_t^w = f\left(P_t^{oil}, P_t^{gas}, (P_{t-1}^w - P_{t-1}^{oil}), (P_{t-1}^w - P_{t-1}^{gas}), N_{t-1}^*, Q_{t-1}, P_{t-1}^w\right) \qquad \text{(EQ 5)}$$

where,

f(.) = general linear function,

$C_{i,t}$ = propane residential consumption in region *i* during month *t* as a share of total U.S. consumption,

$N^*_{j,t}$ = propane inventory in region *j* at end-of-month *t*, deviation from previous 4-year average,

P^r_t = average U.S. propane residential retail price during month *t*,

$P^r_{i,t}$ = average propane residential retail price in region *i* during month *t*,

P^w_t = average U.S. propane wholesale price to the petrochemical sector during month *t*,

P^{oil}_t = average U.S. refiner average acquisition cost of crude oil during month *t*,

P^{gas}_t = natural gas spot price at Henry Hub, LA. during month *t*,

Q_t = industrial production index, chemicals, during month *t*,

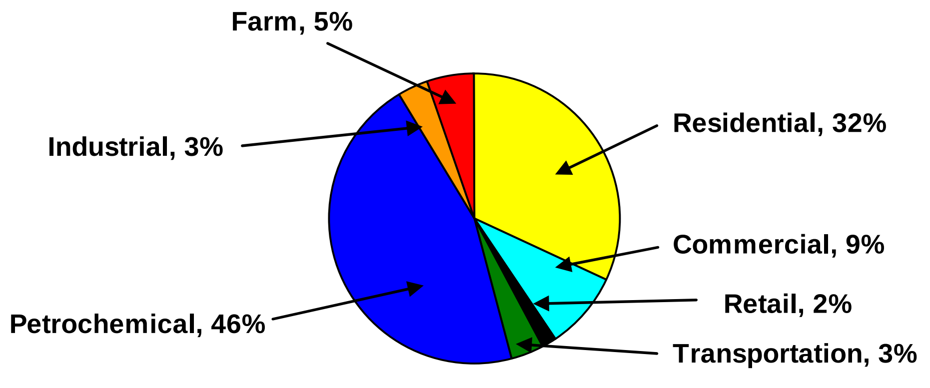
$S_{i,t}$ = region *i* share of U.S. homes that use propane as primary space heating fuel during month *t*,

$W_{i,t}$ = heating degree-days deviation from normal in region *i* during month *t*,

2. Overview of the Residential Propane Market

Propane is consumed in several different sectors, including residential, commercial, petrochemical, industrial, and agricultural (Figure 3). Other sectors, which account for the remainder of propane consumption, include use as fuel in internal combustion engines such as generators, pumps, and fork lifts.

Figure 3. Propane End-User Market Shares, 2007.

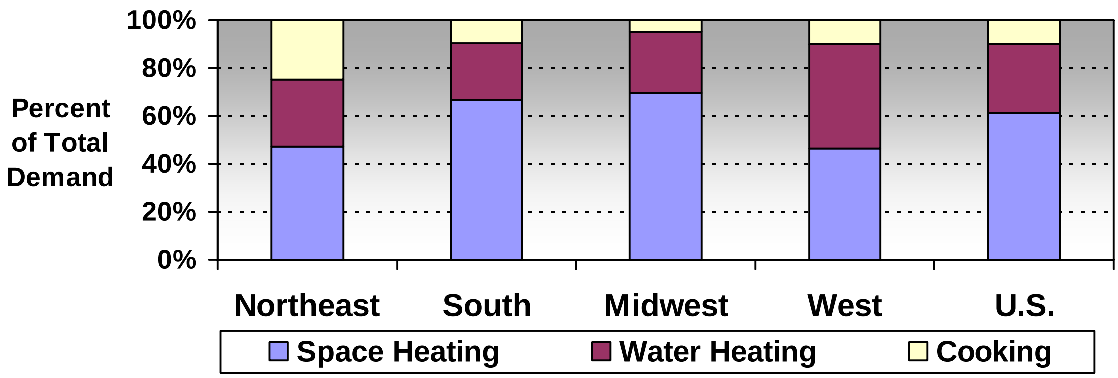


Source: American Petroleum Institute, 2007 Sales of Natural Gas Liquids and Liquefied Refinery Gases.

Propane ranks as the fourth most important source of residential energy in the Nation, with about 5 percent of all households using propane as their primary space heating fuel (EIA, *2005 Residential Energy Consumption Survey*, Table SH6).

Propane has three primary uses in the residential sector: space heating, water heating, and cooking (appliances). Space heating makes up about 60 percent of total residential propane consumption while the balance of consumption is split between water heating and cooking (Figure 4).

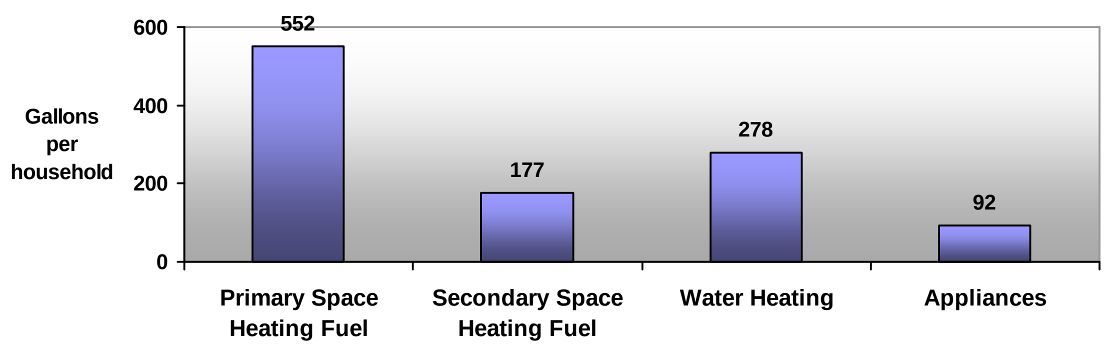
Figure 4. Residential Propane Use by Census Region, 2005.



Source: EIA, 2005 Residential Energy Consumption Survey, Tables SH3, WH3 and AP2.

Propane for space heating is further broken into whether it is the primary or secondary space heating fuel. Homes that use propane as the primary space heating fuel consumed on average 552 gallons in 2005 (Figure 5). Consumption as the secondary space heating fuel averaged 177 gallons per home in 2005, and water heating and cooking averaged 278 and 92 gallons per home, respectively.

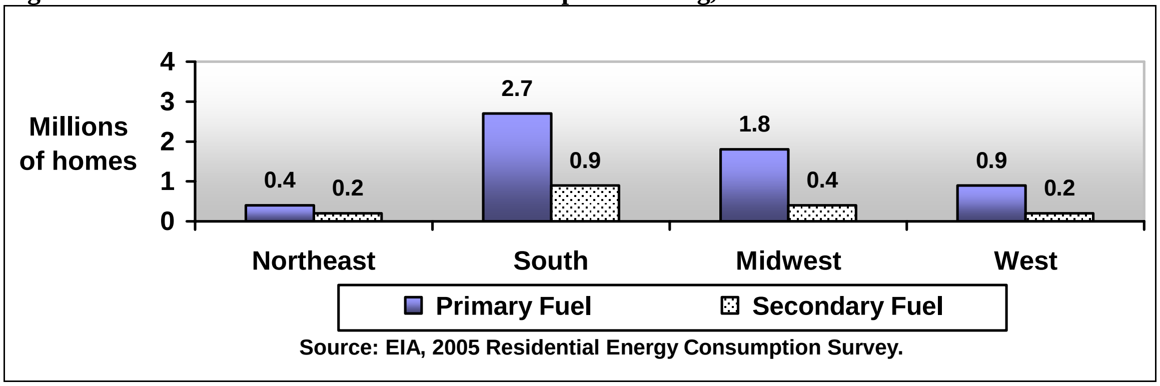
Figure 5. Average LPG consumption per Household by Use, 2005.



Source: EIA, 2005 Residential Energy Consumption Survey.

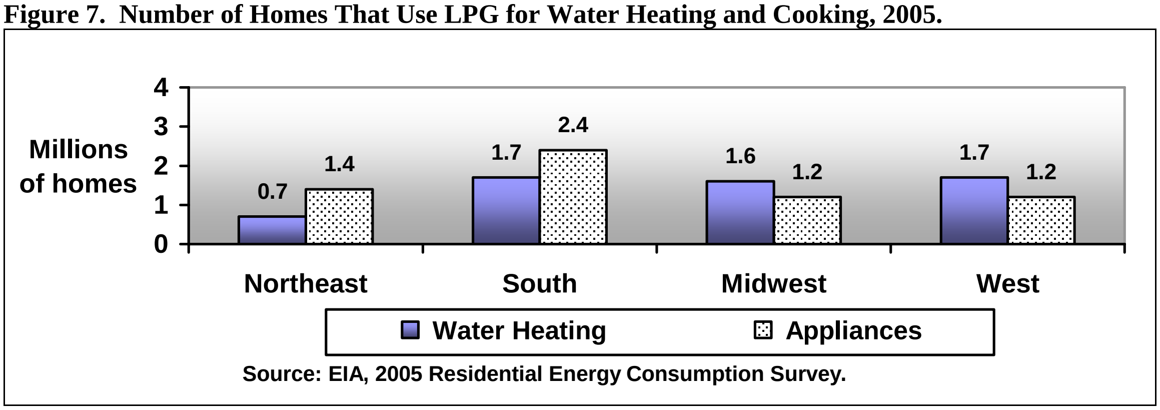
The Midwest is the largest regional residential market share for propane with 1.8 million homes, about 7.0 percent of all homes in the region, using propane as their primary space heating fuel and an additional 0.4 million that use propane as a secondary fuel (Figure 6). While more homes in the South use propane as their primary fuel for space heating, the market share is smaller (6.6 percent) than in the Midwest because of the greater number of homes (40.7 million in the South compared with 25.6 million in the Midwest). The smallest market share is in the Northeast where only 0.4 million, or 1.9 percent of homes (out of 20.6 million total), use propane as their primary space heating fuel. The number of homes by census division are provided in Appendix A.

Figure 6. Number of Homes That Use LPG for Space Heating, 2005.



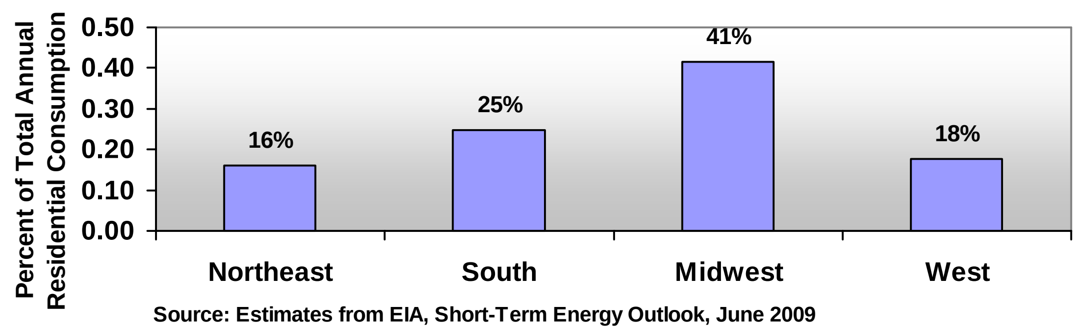
The number of homes that use propane for water heating and cooking (appliances) is greater than the number with propane space heating in some regions (Figure 7). However, average consumption for these other uses is far smaller than for space heating.

Figure 7. Number of Homes That Use LPG for Water Heating and Cooking, 2005.



Total residential sector propane consumption is greatest in the Midwest because of the greater number of homes using LPG fuel for space heating and colder weather in the region (Figure 8).

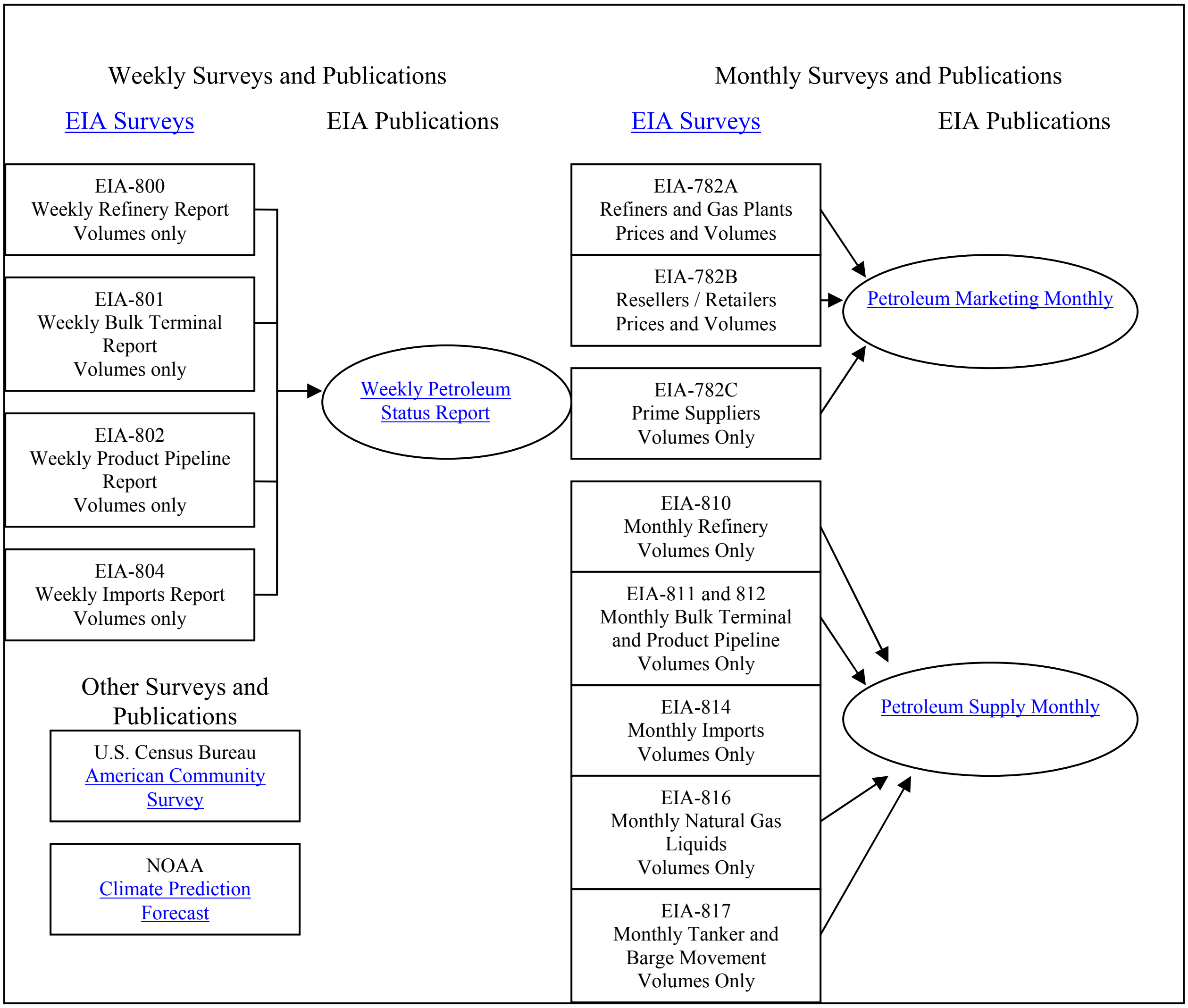
Figure 8. Residential Propane Consumption per Census Region, 2008.



3. Data Sources

The monthly volume and price data used in the regional propane residential price module appear in two EIA publications: the *Petroleum Supply Monthly* (*PSM*) and *Petroleum Marketing Monthly* (*PMM*) (Figure 9). Weekly regional inventory data published in the *Weekly Petroleum Status Report* (*WPSR*) are used for the most recent two months where monthly inventories published in the *PSM* are not yet available.

Figure 9. Propane Surveys and Data Publications.



The *PSM* includes volume data from surveys of primary suppliers such as refineries, natural gas plants, pipelines, and bulk terminals. The *PMM* includes volume and price data from the primary suppliers as well as other wholesale and retail suppliers. Because *PSM* surveys do not classify products by end use it is not possible to produce a complete regional supply and consumption balance for residential propane.

The average U.S. propane wholesale price to the petrochemical sector is published in the *PMM* Table 12. The census region residential propane retail prices are derived from State residential prices reported to EIA in the EIA-782A and 782B surveys and published in Table 34 of the *PMM*.

Consumption shares derived from unpublished volume data reported in the EIA-782A and 782B surveys are used to weight State prices in the calculation of regional and U.S. average prices and to weight monthly regional and U.S. prices in the calculation of quarterly and annual average prices.

Propane inventories by Petroleum Administration for Defense District (PADD) appear in the *PSM* Table 54 and the *WPSR* Table 11.

The number of households that utilize propane for home heating in each Census division is reported in the Census Bureau's annual American Community Survey (ACS). Forecasts of the number of households are generated by applying the trend in the share of all homes consuming propane calculated from the *ACS* data from previous years to the forecast of total households reported in the macroeconomic forecasts of Global Insight.

Heating degree-days are obtained from the National Oceanic and Atmospheric Administration (NOAA). NOAA also publishes a 14-month forecast of population-weighted regional heating degree-days. Where the *STEO* forecast horizon goes beyond the NOAA forecast period, "normal" heating degree-days may be used. NOAA reports normal heating degree-days as the average of the 30-year period 1971-2000. The *STEO* model uses a corrected normal that adjusts for the warming trend that began around 1965 (The Impact of Temperature Trends on Short-Term Energy Demand).

4. Variable Naming Convention

Over 2000 variables are used in the *STEO* model for estimation, simulation and report writing. Most of these variables adhere to the following naming convention:

Characters	PR	RC	U	NE	A
Positions	1 and 2	3 and 4	5	6 and 7	8+
Identity	Type of energy	Energy activity or consumption end-use sector	Type of data	Geographic area or special equation factor	Data treatment

In this example, PRRCUNE is the identifying code for propane (PR) residential sector (RC) price excluding taxes (U) in the Northeast census region (NE).

Some examples of the identifiers used in this naming convention are:

Type of energy categories:

PR = propane
NG = natural gas
QH = number of households
ZW = weather

Energy activity or consumption end-use sectors:

LP = households that use liquefied petroleum gas
HD = heating degree-days
HN = heating degree-days normal (e.g., 30-year average)
PS = petroleum stocks
RC = residential sector
TX = Federal, state, and local taxes
WH = wholesale sales

Type of data:

P = data in standardized physical units
X = share or ratio expressed as a fraction
U = price per standardized physical unit, excluding taxes
A = price per standardized physical unit, including taxes

The physical units for petroleum data series in the Short-Term Intergated Forecast System (STIFS) model, represented by a "P" in the fifth character, are million barrels (stocks) or million barrels per day (flows). The pricing units for petroleum data are dollars per barrel for crude oil and cents per gallon for petroleum products.

Geographic identification or special equation factor:

US = United States
P1 = Petroleum Administration for Defense District 1 (East Coast)
P2 = Petroleum Administration for Defense District 2 (Midwest)
P3 = Petroleum Administration for Defense District 3 (Southwest)
P4 = Petroleum Administration for Defense District 4 (Mountain)
P5 = Petroleum Administration for Defense District 5 (Pacific)
MW = Midwest census region
NE = Northeast census region
SO = South census region
WE = West census region

Data treatment:

BLD = stock change (stock level at end of current month – level at end of previous month)
A = add factor
SA = seasonally adjusted series from Census X-11 method
SF = seasonal factors derived from Census X-11 method

Monthly dummy variables are generally designated Dyymm, where yy = the last two digits of the year and mm = the number of the month (from "01" for January to "12" for December). Thus, a monthly dummy variable for March 2002 would be D0203 (i.e., D0203 = 1 if March 2002, = 0 otherwise). Monthly dummy variables might be subtracted from a yearly dummy variable to include a portion of a year such as D03-D0301 (i.e., D03-D0301= 1 if 2003 except for January, 0 otherwise). Likewise, a monthly dummy variable can be added to a yearly variable to include more than a single year.

All propane model variables in this report and their definitions are provided in Appendix B.

5. Residential Propane Consumption Shares

A. Introduction

Regional consumption volumes or consumption shares are needed to weight regional prices in the calculation of a U.S. average price and to weight monthly prices for average quarterly or annual prices.

There are no published monthly data series for regional residential propane consumption. EIA does obtain volume data on residential propane sales in the monthly EIA-782A and 782B surveys but does not publish this data. The 782A and 782B surveys are designed to produce State price data and are not designed or maintained to produce consistent or representative State consumption volumes.

For the regional propane residential price module, regional consumption shares are calculated from the EIA-782A and 782B survey unpublished volume data. A region's consumption share for a given month is calculated as the region's consumption that month divided by the annual total U.S. consumption in that year. Weighting prices using consumption shares yields identical results to weighting prices using actual consumption volumes as shown in Table 1. The consumption shares cannot be used to calculate price averages that span more than one year because they do not account for changing consumption from year to year. Because the objective of the regional propane residential price module is to generate regional residential prices we do not attempt to create, maintain, and validate regional consumption volume data series.

The error in the calculated average prices is expected to be much smaller than the error in the estimated consumption shares. For example, consider two regions, one with a price of $1.50 and the other with a price of $1.00. Assume the actual consumption in the two regions are identical but are each measured with 20 percent error in opposite directions: Region A's measured consumption share is 0.6 and region B's is 0.4, rather than 0.5 each. While the errors in the consumption shares are large, the error in the volume-weighted average price is smaller: $1.30 when consumption is measured with error and $1.25 when consumption shares are correct (a 4 percent error).

Table 1. Comparison of Price Weighting Using Consumption Versus Consumption Shares.

Region	Jan	Feb	…	Dec	Year
Consumption (gallons or barrels):					
Region A	V_A^J	V_A^F	...	V_A^D	$\sum V_A^i$
Region B	V_B^J	V_B^F	...	V_B^D	$\sum V_B^i$
U.S.	$V_A^J + V_B^J$	$V_A^F + V_B^F$	...	$V_A^D + V_B^D$	$\sum (V_A^i + V_B^i)$
Consumption Shares (dimensionless)					
Region A	V_A^J / X	V_A^F / X	...	V_A^D / X	$\sum V_A^i X$
Region B	V_B^J / X	V_B^F / X	...	V_B^D / X	$\sum V_B^i / X$
U.S.	$(V_A^J + V_B^J) / X$	$(V_A^F + V_B^F) / X$	...	$(V_A^D + V_B^D) / X$	$\sum (V_A^i + V_B^i) / X$
Prices (per unit of volume):					
Region A	P_A^J	P_A^F	...	P_A^D	see calculation below
Region B	P_B^J	P_B^F	...	P_B^D	see calculation below
U.S.	see calculation below				see calculation below

where, U.S. is total or average of regions A and B
V_x^y = Volume in region x in month y
P_x^y = Price in region x in month y
X = total annual U.S. consumption volume

	Consumption-Weighted Price	Consumption-Share-Weighted Price
Monthly average U.S. price (e.g., Jan)	$(P_A^J \cdot V_A^J + P_B^J \cdot V_B^J) / (V_A^J + V_B^J)$	$(P_A^J \cdot V_A^J /X + P_B^J \cdot V_B^J/ X) / (V_A^J + V_B^J) / X$ $= (P_A^J \cdot V_A^J + P_B^J \cdot V_B^J) / (V_A^J + V_B^J)$
Annual average regional price	$\sum P_A^i \cdot V_A^i / \sum V_A^i$	$\sum (P_A^i \cdot V_A^i / X) / \sum V_A^i / X$ $= \sum P_A^i \cdot V_A^i / \sum V_A^i$
Annual average U.S. price	$\sum (P_A^i \cdot V_A^i + P_B^i \cdot V_B^i) / \sum (V_A^i + V_B^i)$	$\sum (P_A^i \cdot V_A^i / X + P_B^i \cdot V_B^i/ X) / \sum (V_A^i + V_B^i) / X$ $= \sum (P_A^i \cdot V_A^i + P_B^i \cdot V_B^i) / \sum (V_A^i + V_B^i)$

B. Regional Consumption Share Equations

The regional propane residential price module includes residential sector propane consumption shares for the four census regions. The census region residential propane consumption share equations (EQ 6) are estimated as linear functions of current and previous month regional heating degree-day deviations from normal, the region's share of U.S. households that consume propane as the primary space-heating fuel, and monthly dummy variables using ordinary least squares. Additional dummy variables may be included in individual equations to control for observed outliers in the data series.

$$PRRCXxx = a_0 + a_1 \left\{ \begin{bmatrix} (QHLP\_xxx\,(ZWHD\_xxx - ZWHN\_xxx)/ZSAJQUS \\ + QHLP\_yyy\,(ZWHD\_yyy - ZWHN\_yyy)/ZSAJQUS \end{bmatrix} \\ /(QHLP\_xxx + QHLP\_yyy) \right\}$$

$$+ a_2 \left\{ \begin{bmatrix} (QHLP\_xxx(-1)\,(ZWHD\_xxx(-1) - ZWHN\_xxx(-1))/ZSAJQUS(-1) \\ + QHLP\_yyy(-1)\,(ZWHD\_yyy(-1) - ZWHN\_yyy(-1))/ZSAJQUS(-1) \end{bmatrix} \\ /(QHLP\_xxx(-1) + QHLP\_yyy(-1)) \right\} \quad \text{(EQ 6)}$$

$$+ a_3\, PRRCXxx\_SF \left[(QHLP\_xxx + QHLP\_yyy)/QHLP\_US \right] + \sum_{i=4}^{14} a_i D_i$$

where,

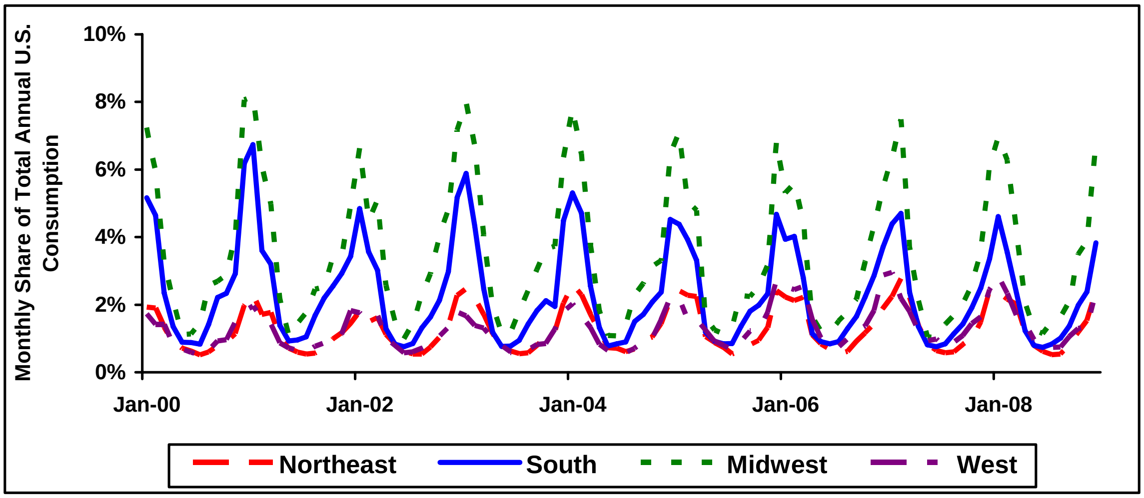
PRRCX*xx* = monthly consumption in census region *xx* as a share of total annual U.S. consumption;
PRRCX*xx*_SF = seasonal factor for census region *xx* derived from Census X-11,
ZWHD_*xxx* = total heating degree days in census division *xxx*;
ZWHN_*xxx* = normal heating degree days in census division *xxx*;
ZSAJQUS = number of days in the month;
QHLP_*xxx* = number of homes in census division *xxx* that use propane as the primary space heating fuel;
QHLP_US = number of homes nationwide that use propane as primary space heating fuel;
D_i = monthly dummy variables for January through November; and
(-1) = variable lagged one month.

The regional consumption share regression equations are estimated over the period beginning February 2000 through December 2008, the last year of complete historical data.

1. Weather

Propane consumption in the residential sector is highly seasonal because of the weather-related space heating consumption. Fuel consumption for space heating is highest during the winter months and lowest during the summer. Consequently, monthly propane consumption as a share of total annual U.S. consumption is also highly seasonal as shown in Figure 10.

Figure 10. Propane Residential Consumption by Census Region, 2000 – 2008.



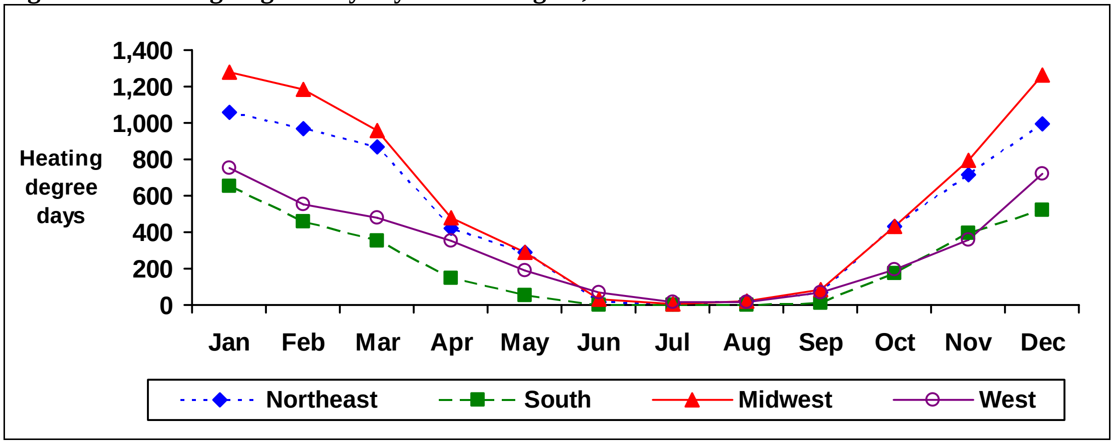
Heating degree days are a useful indicator of the energy required for space heating. When the daily mean temperature is below 65 degrees F, most buildings require heat to maintain inside temperatures of 70 degrees. Heating degree days are calculated by subtracting the daily mean temperature (the average of the day's high and low temperatures) from 65 degrees F. Each degree below 65 degrees is one degree day. The daily totals are summed for each month.

Heating degree days for each census region are calculated by weighting the heating degree days for each census division within the region by the number of homes with LPG as the primary space heating fuel in each district. An example calculation of the LPG-weighted heating degree days for the Northeast region is shown in Table 2. Heating degrees days by month for each census region are shown in Figure 11.

Table 2. Calculation of Northeast Census Region LPG Weighted-Heating Degree Days, January 2007

Census District	Heating degree days		Number of homes with LPG space heat (millions)		
New England	1,110	x	0.234	=	259.9
Middle Atlantic	976	x	0.458	=	447.5
			0.693		707.4
Divided by total number of homes				÷	0.693
Northeast census region LPG-weighted heating degree days				=	1,021

Figure 11. Heating Degree Days by Census Region, 2008.



The normal seasonality in residential propane consumption is captured by the monthly dummy variables discussed below. The weather variables in the propane residential consumption equations capture the effect of weather that is significantly warmer or colder than normal for that month. The residential propane consumption share equations include heating degree day deviations from normal. If a region is colder than normal then we expect the consumption share for that region to be larger. A one month lag of weather deviations from normal is also included. Some of the residential consumption impact of a cold month may not show up until the following month as residences get their propane tanks refilled.

2. Number of Homes

An additional explanatory variable included in the consumption share equations is the number of homes in the region that use propane as the primary space heating fuel divided by the total number of homes in the United States that use propane. We expect a region's consumption share to be positively related to the share of homes.

However, the contribution is not constant for every month but is proportional to the seasonality in the consumption share. The share of U.S. homes is multiplied by the seasonal factor derived from the Census X-11 deseasonalization program. For example, if a region's share of annual U.S. consumption is 5 percent in January and 2 percent in June, a 10 percent increase in the share of homes in the region might increase the January consumption share to 5.5 percent and the June share to 2.2 percent.

There are two surveys that report the number of homes than consume a particular fuel as the primary space heating fuel: EIA's Residential Energy Consumption Survey (RECS) and the Census Bureau's American Community Survey (ACS).

The RECS survey is not designed to be the most accurate possible estimate of the number of homes in a region. Rather, it seeks to provide very detailed information concerning housing characteristics, appliances, and energy usage by households that are not available in the ACS or any other survey.

The residential propane model utilizes the ACS reported number of homes for two reasons. First, the ACS is conducted annually while the RECS is conducted only once every four years (1989, 1993, 1997, 2001, and 2005).

The second reason for using the ACS is this survey incorporates a larger sample than the RECS. As a result, the standard errors of the estimated numbers of households are smaller in the ACS survey. For example, the total number of US homes using propane as the primary space heating fuel as reported by the RECS has a 90-percent confidence interval around the estimate of plus or minus 0.85 million homes (15 percent). In contrast, the 90-percent confidence interval around the 2005 ACS estimate was plus or minus 0.05 million homes (less than 1 percent) (Table 3). The difference is even more dramatic on a regional level. The 90- percent confidence interval around the estimated number of homes in a census region that use propane as the primary space heating fuel ranges from plus or minus 21 percent in the South to 36 percent in the West for the 2005 RECS. The same confidence intervals in the 2005 ACS are 1.1 percent and 1.4 percent, respectively.

Table 3. RECS 2005 and ACS 2005 U.S. Homes Using Propane As The Primary Space Heating Fuel.

Survey	Number of Homes (millions)	90 Percent Confidence Interval
RECS	5.8	+/- 0.85 (14.6 percent)
ACS	6.6	+/- 0.05 (0.7 percent)

Note: RECS 90-percent confidence interval based on +/- 1.645 times the standard error.
Sources EIA, 2005 Residential Energy Consumption Survey, SH6
Census Bureau, 2005 American Community Survey, B25040.

A simple linear regression equation of the share of all households in a region that use propane as the primary space heating fuel is estimated as a function of a constant term and a linear time trend using annual 2000 through 2007 ACS data. A forecast of the annual average share of total households is generated from this equation. The household shares are then multiplied by the number of households in a region from the Global Insight macroeconomic model. The annual data are converted to monthly time series using the Eviews cubic match average procedure.

3. Dummy Variables

Dummy variables are included to capture the seasonality in heating oil consumption and to eliminate the effects of outliers in the data series.

First, we have dummy variables for each individual month except December. For example, JAN equals 1 for every January in the time series and is equal to 0 in every other month. These individual monthly dummy variables are intended to capture normal seasonality consumption shares as deviations from the December consumption share. In other words, if the estimated coefficient for JAN is 0.001, then the consumption share in January is expected to be 0.001 percentage point higher than in December with all other variables held constant.

A second category of dummy variables have been created for the periods March 2002 through September 2004 and October 2004 through the present. These dummy variables are added because of a periodic change in the companies included in the EIA-782 survey sample. While refiners and companies with large market shares are not rotated from sample to sample, some smaller firms are added or subtracted between surveys when the sample changes. These dummy variables account for the potential break between these sample periods in terms of regional prices and consumption shares due to a different sample.

A third group of dummy variables control for outliers. Dummy variables are included for those months in which the absolute value of the estimated regression error was greater than 2 times the standard error of the regression (the standard error of the regression is a summary measure based on the estimated variance of the residuals). No attempt was made to identify market or survey factors that may have contributed to the identified outliers.

4. Calculation of Price Averages

The regional propane consumption shares are used to calculate monthly U.S. average prices and regional and U.S. quarterly and annual price averages. The historical regional propane consumption shares are calculated with the additivity restriction that all shares across all regions during each year sum to one (EQ 7). Moreover, there is an implicit positivity restriction that all monthly regional shares are between 0 and 1 (EQ 8). However, monthly regional consumption shares estimated using the regression equations are not guaranteed to meet the additivity or positivity restrictions.

Additivity Restriction: $$\sum_{t=1}^{12}\left(\sum_{i=1}^{4} C_t^i\right) = 1 \qquad \text{(EQ 7)}$$

Positivity Restriction: $$0 \le C_t^i \le 1 \qquad \text{(EQ 8)}$$

where, $C_t^i = \textit{region i consumption in period t as a share of annual U.S. consumption.}$

Violation of the additivity restriction could result in average monthly or annual U.S. prices that are outside (larger or smaller) the range of regional prices. For example, if all the shares sum to less than 1.0 and all regional prices are equal to $2.00, the average U.S. price would be less than $2.00. To avoid this problem shares are normalized in the calculation of average monthly and annual prices (EQ 9 through EQ 11).

Monthly Average U.S. Price: $$P_t^{US} = \sum_{i=1}^{4} C_t^i \, P_t^i \Big/ \sum_{i=1}^{4} C_t^i \qquad \text{(EQ 9)}$$

Annual Average Region *i* Price: $$P^i = \sum_{t=1}^{12} C_t^i \, P_t^i \Big/ \sum_{t=1}^{12} C_t^i \qquad \text{(EQ 10)}$$

Annual Average U.S. Price: $$P^{US} = \sum_{t=1}^{12}\left(P_t^{US} \sum_{i=1}^{4} C_t^i \right) \Bigg/ \sum_{t=1}^{12}\left(\sum_{i=1}^{4} C_t^i \right) \qquad \text{(EQ 11)}$$

Handling a violation of the positivity restriction is somewhat more problematic. The easiest solution would be to create a temporary consumption share variable equal to zero and then replace zero values only when the estimated consumption share is greater than zero (e.g., C* = 0, and C* = C > 0). However, this capability is not available when solving simultaneous equations in an Eviews model. Consequently, the forecasts for each of these consumption share variables must be inspected by the analyst to verify that the positivity restriction is not violated.

6. Inventories

A. Introduction

Propane inventory withdrawals provide the second largest source of propane during the winter heating season after new production. During the peak consumption months of December, January, and February, propane inventories provide over 20 percent of total U.S. propane supply on average. Inventories are built up during the spring and summer months, typically peak by the end of September or October, and reach their lowest point in March.

Propane storage consists of three types: primary, secondary, and tertiary. Primary storage consists of refinery, gas plant, pipeline, and bulk terminal stocks. Secondary storage consists primarily of large above-ground tanks owned by propane retail distributors, while tertiary storage consists mainly of non-chemical end-users such as residential and commercial customers.

Inventory survey data are available only at the primary storage level. Propane storage facilities at the primary level are located near the major production and transportation hubs. These facilities consist of pressurized depleted mines and underground salt dome storage caverns clustered mostly in Conway, Kansas, and Mont Belvieu, Texas. Smaller storage hubs are located in New York, Ohio, Illinois, Michigan, Minnesota, and Louisiana. Primary storage also includes stocks held at refineries.

B. Regional Inventory Equations

The regional propane residential price module includes inventories for the five Petroleum Administration for Defense Districts (PADDs). Inventory data for the census regions are not available.

The five PADD inventory series were tested for the presence of a unit root. Unit roots were present in the propane stock levels in PADDs 4 (Mountain region) and 5 (West). Inventories are modeled as first difference stock changes (EQ 12) rather than as stock levels to make the series stationary. Moreover, stock changes rather than stock levels reflect the balance between supply and consumption.

$$
\begin{aligned}
PRPSPxBLD = {} & a_0 \\
& + a_1 \left\{ \begin{array}{l} \left[\begin{array}{l} (QHLP\_xxx * (ZWHD\_xxx - ZWHN\_xxx) / ZSAJQUS \\ + QHLP\_yyy * (ZWHD\_yyy - ZWHN\_yyy) / ZSAJQUS \end{array} \right] \\ /(QHLP\_xxx + QHLP\_yyy) \end{array} \right\} \qquad \text{(EQ 12)} \\
& + a_2 \, [PRPSPPx(-1) - PRPSPPx(average)] + \sum_{i=3}^{13} a_i D_i
\end{aligned}
$$

where,

PRPSP*x*BLD = Inventory change (end of current month – end of previous month) in PADD *x*, million barrels;
PRPSPP*x* = propane end-of-month inventory in PADD *x*, million barrels;
PRPSPP*x*(average) = prior 4-year average, [PRPSPP*x*(-13) + PRPSPP*x*(-25)+ PRPSPP*x*(-37)+PRPSPP*x*(-49)]/4, million barrels;
ZWHD_*xxx* = total heating degree days in census division *xxx*;
ZWHN_*xxx* = normal heating degree days in census division *xxx*;
ZSAJQUS = number of days in the month;
QHLP_*xxx* = number of homes in census division *xxx* that use propane as the primary space heating fuel and
D_i = monthly dummy variables for January through November.

1. Weather

The propane stock change equations include heating degree-day deviations from normal for selected census divisions as shown below. A more detailed description of the correspondence between census regions and PAD Districts is provided in Appendix A.

PAD District	Census Divisions
1	New England, Middle Atlantic, and South Atlantic
2	East and West North Central
3	East and West South Central
4	Mountain
5	Pacific

The census division heating degree days are weighted by the number of households within each division that use propane as the primary space heating fuel to arrive at the PADD heating degree days.

Weather that is colder than normal should lead to smaller stock builds or larger stock draws because of the increase in consumption. The estimated coefficients are negative as expected and statistically significant in all PADDs.

2. Beginning Stocks

The beginning of month (end of prior month) PADD inventory as a deviation from the prior four-year average for that month is included as a right-hand side variable. Higher than historical average beginning inventory levels are expected to be correlated with smaller stock builds or larger stock draws.

The four-year average generally provided the best model fit compared with shorter and longer averages. The estimated coefficients for all PADDs were negative as expected and statistically significant. A beginning-of-month inventory that is 1 million barrels above the previous four-year average in PADDs 2, 3, and 4 reduces the month's normal stock change by between 0.1 and 0.2 million barrels. The PADD 1 stock change response was larger at close to 0.3 million barrels, while PADD 5 was smallest at slightly less than 0.1 million barrels.

3. Dummy Variables

Dummy variables are again included to capture the seasonality in stock changes and to eliminate the effects of certain events that are considered outliers in the data series.

First, we have dummy variables for each individual month except December. For example, JAN equals 1 for every January in the time series and is equal to 0 in every other month. These individual monthly dummy variables are intended to capture normal seasonality as deviations from the December build.

The regression results for the monthly dummy variables conform to expectations that stock builds occur during the spring and summer months and stock draws during the winter. This seasonality is strongest in PADDs 2 and 3 where the average monthly stock change (relative to December) ranges from a nearly 8 million barrel build in May for PADD 3 to a 2 million barrel draw in January for PADD 2.

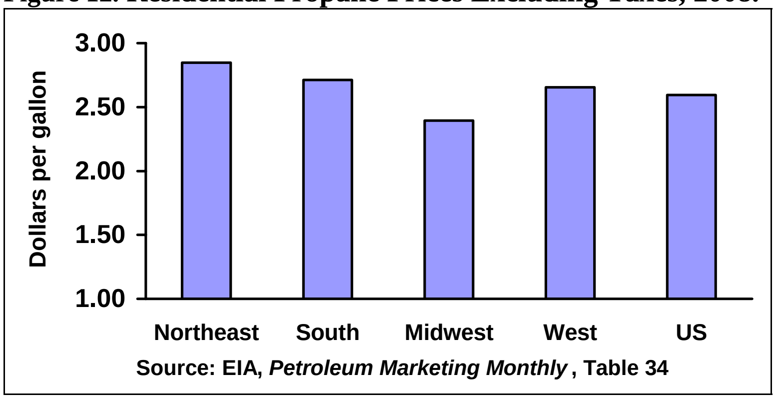
A second group of dummy variables control for outliers. Dummy variables are included for those months in which the absolute value of the estimated regression error was greater than 2 times the standard error of the regression (the standard error of the regression is a summary measure based on the estimated variance of the residuals). No attempt was made to identify market or survey factors that may have contributed to the identified outliers.

7. Propane Prices

A. Introduction

Residential propane retail prices are highly variable within and across regions (Figure 12). In the Midwest, South, and Northeast regions residential propane prices appear inversely related to consumption. Prices are lowest in the Midwest where total consumption is highest and highest in the Northeast where consumption is the lowest. Other market factors also influence the regional differences such as transportation costs from supply sources, as well as inventory levels, weather, and consumption trends in each region in a given year.

Figure 12. Residential Propane Prices Excluding Taxes, 2008.



The propane price model begins with an estimate of the average U.S. propane wholesale price to the petrochemical sector. This wholesale price is used as a proxy for the wholesale price to the residential sector. Residential propane retail prices excluding state taxes are modeled as a function of the wholesale price, regional inventory, and regional weather that may affect the markup of retail prices over the wholesale price.

Unit roots were found in every retail price time series. The retail price series were transformed to stationary series by calculating price differentials to the wholesale price to the petrochemicals sector and converting to real prices by dividing by the GDP deflator.

B. Wholesale Price to Petrochemical Sector

There are three primary measures of wholesale prices that can be used:

- Spot price at Mont Belvieu, Texas,
- Spot price at Conway, Kansas, and

- Wholesale price to the petrochemical sector.

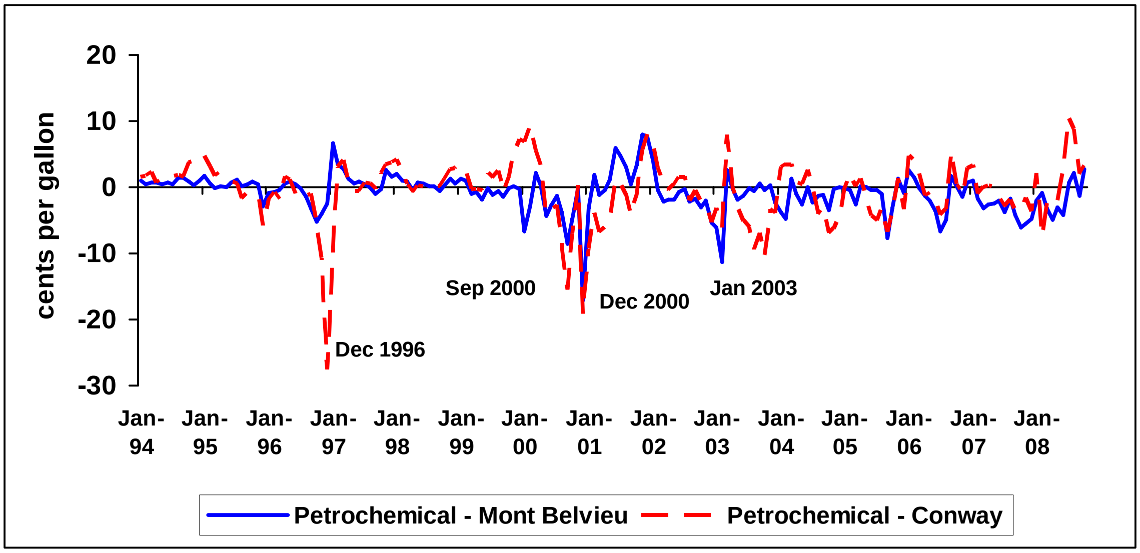
Mont Belvieu is the center of natural gas liquids fractionation and storage on the Gulf Coast. Located between Houston and Beaumont, the facilities at Mont Belvieu include a number of fractionating plants and pipeline facilities, situated on top of a natural salt dome structure containing millions of barrels of cavern storage for gas liquids. This facility serves the petrochemical industry of the Gulf Coast and is connected to the major pipelines that serve the Southeast, lower Midwest, and East Coast markets.

Conway, Kansas, is also a natural gas liquids storage and transportation hub, consisting of fractionation and pipeline installations adjacent to cavern storage facilities. Product sold at Conway may be shipped by pipeline throughout the Midwest, or loaded into rail cars for shipment anywhere in the United States. Conway sales dominate the agricultural sector as well as serving the large Midwest residential region.

About 46 percent of the U.S. propane supply is used in the petrochemical industry (Figure 3). Most of this propane is used as feedstock for about 40 olefin plants, which produce building block chemicals (ethylene, propylene, butylenes, butadiene, and benzene) from which most petrochemicals are derived. Olefins plants and propane consumption as a petrochemical feedstock are concentrated in the U.S. Gulf Coast States.

The wholesale price to the petrochemical sector and the Mont Belvieu and Conway spot prices are generally closely related with the petrochemical wholesale price averaging about 0.5 cent per gallon below the spot prices (Figure 13). However, some events such as particularly cold weather in December 2000 and January 2003 can lead to increases in the spot prices that are not matched by the wholesale price to the petrochemical sector. Unexpected high consumption in the Midwest in the fourth quarter 1996 from crop drying and cold weather pulled Midwest stocks down to two-thirds normal level and boosted Conway spot prices.

Figure 13. Propane Wholesale Price Differentials



The wholesale price to the petrochemical sector was selected for the regional residential propane price module because it a more valid representation of an average monthly price where it is a volume-weighted average of all sales derived from EIA price and volume surveys while the spot prices are simple daily averages that do not include contract sales. The wholesale price to the petrochemical sector also provides the best model fit in all retail residential price equations.

The estimating equation for the wholesale propane price to the petrochemical sector is shown in equation EQ 13, which is estimated using ordinary least squares:

$$\begin{aligned} PRPCUUS = a_0 &+ a_1(100 * RACPUUS / 42) \\ &+ a_2(100 * RACPUUS / 42)^2 \\ &+ a_3 NGHHUUS \\ &+ a_4[PRPCUUS(-1) - 100 * RACPUUS(-1)/42] \\ &+ a_5[PRPCUUS(-1) - 9.1 * NGHHUUS(-1)] \qquad \text{(EQ 13)} \\ &+ a_6[PRPSPUS(-1) - PRPSPUS(average)] \\ &+ a_7\ Z028IUS \\ &+ a_8\ PRPCUUS(-1) \\ &+ \sum_{i=9}^{19} a_i D_i \end{aligned}$$

where

NGHHUUS = natural gas spot price at Henry Hub, Louisiana, \$/million Btu;
PRPCUUS = propane wholesale price to petrochemical sector, cents/gallon;

PRPSPUS = total U.S. propane end-of-month inventory, million barrels;
PRPSPUS(average) = prior 4-year average, [PRPSPUS(-13)+PRPSPUS(-25)+PRPSPUS(-37)+PRPSPUS(-49)]/4, million barrels;
RACPUUS = refiner average crude oil acquisition cost, $/barrel;
ZO28IUS = manufacturing, nondurables, chemicals and products (SIC-28) industrial production index, 2000 = 100 and
D_i = monthly dummy variables for January through November.

1. Crude Oil and Natural Gas Prices

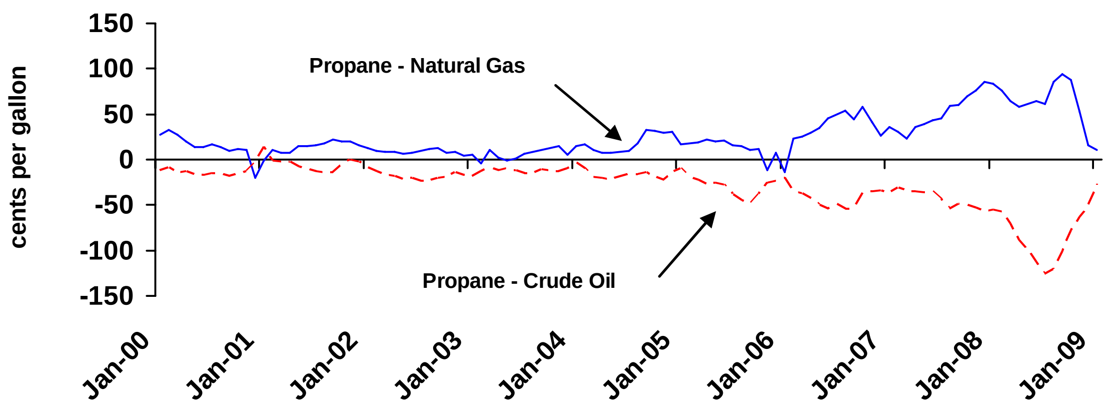
Since propane is a byproduct of crude oil refining and is also recovered from wet natural gas we assume propane wholesale prices are related to both crude oil and natural gas prices. The wholesale price of propane is also related to oil and gas because the demand for propane as an olefins plant feedstock depends on its economics relative to the other feedstocks. Propane competes with ethane, normal butane, naphtha, and gas oil as a feedstock in olefins plans. Thus, other feedstocks for the petrochemical market derived from oil and gas provide some buffer to winter weather-related propane demand shocks.

There are limits to swings in the feedstock mix that olefins plants can handle given equipment, process, and market constraints. For example, from August 1996 to December 1996, when wholesale propane prices increased by 21.5 cents per gallon (from 36.9 to 58.4 cents per gallon), propane feed to ethylene crackers dropped from 350 thousand barrels per day to 217 thousand barrels per day, but overall feedstock throughput hardly fell. Since ethane and naphtha prices did not rise as dramatically these inputs were increased, offsetting the drop in propane (EIA, *An Analysis of U.S. Propane Markets Winter 1996-97*, SR/OOG/97-01, Washington, DC, June 1997, p. 10)

2. Propane - Crude Oil and Propane-Natural Gas Price Differentials

The wholesale propane price does not react completely to changes in either natural gas or crude oil prices. Figure 14 shows that when the price of natural gas increases relative to the price of crude oil the propane-to-natural gas price differential falls while the propane-to-crude oil price differential rises.

Figure 14. Wholesale Propane - Natural Gas and Crude Oil Price Differentials



Source: EIA, *Short-Term Energy Outlook* (STEO)
Notes: Natural gas price at Henry Hub in $/million Btu multiplied by 9.1 to convert to propane equivalent price. Crude oil price is refinery average acquisition cost converted to cents per gallon.

The propane-to-natural gas price differential is calculated based on the Henry Hub natural gas spot price. The Henry Hub spot price in dollars per million Btu is converted to a propane-equivalent value in cents per gallon by multiplying by the approximate propane heating value of 91,000 Btu per gallon (EIA, *Annual Energy Review*, Appendix A).

The propane-to-crude oil price differential is calculated based on the refiner average crude oil acquisition cost. The crude oil price in dollars per barrel is divided by 42 to convert it to a dollars per gallon basis.

3. Inventories

The beginning of month (end of prior month) total U.S. inventory as a deviation from the prior four year average for that month is included as a right-hand side variable. Higher than historical average U.S. inventory levels are expected to lower the wholesale propane price. The estimated regression equation coefficient is consistent with this expectation.

4. Industrial Production Index

The industrial production index for the chemical sector (SIC-28) is included to capture changes in demand for propane as a feedstock. The estimated coefficient is positive as expected. An increase in the chemical industry production index raises the wholesale price of propane.

5. Dummy Variables

Dummy variables are included to capture the seasonality in wholesale propane prices and to eliminate the effects of certain events that are considered outliers in the data series.

First, we have dummy variables for each individual month except December. For example, JAN equals 1 for every January in the time series and is equal to 0 in every other month. These individual monthly dummy variables are intended to capture normal wholesale price seasonality as deviations from the December price. In other words, if the estimated coefficient for JAN is 1.00, then the wholesale price in January is expected to be 1.0 cent per gallon higher than in December with all other variables held constant.

The regression results for the monthly dummy variables conform to expectations with the wholesale price lowest in March through May and peaking at the start of the heating season in September. The observed seasonality in price provides an incentive for firms to build and hold propane inventories during the summer months for delivery during the winter heating season.

A second group of dummy variables control for outliers. Dummy variables are included for those months in which the absolute value of the estimated regression error was greater than 2 times the standard error of the regression (the standard error of the regression is a summary measure based on the estimated variance of the residuals). No attempt was made to identify market or survey factors that may have contributed to the identified outliers.

C. Residential Propane Prices Before State Taxes

The regional residential propane price module includes residential sector propane prices excluding State taxes for the four census regions. The difference between the census region residential propane retail price are modeled as a function of the wholesale price, regional inventory, and regional weather that may affect the markup of retail prices over the wholesale price. The estimating equation for the residential propane prices is shown in equation EQ 14, which is estimated using ordinary least squares:

$$
\begin{aligned}
&(PRRCUxx - PRPCUUS)/(GDPIUS/100) = a_0 \\
&\quad + a_1\left[PRPCUUS - PRPCUUS(-1)\right] \\
&\quad + a_2\left[PRPSPPx(-1) - PRPSPPx(average)\right] \\
&\quad + a_3\left\{\begin{array}{l}\left[\begin{array}{l}(QHLP\_xxx*(ZWHD\_xxx - ZWHN\_xxx)/ZSAJQUS \\ +QHLP\_yyy*(ZWHD\_yyy - ZWHN\_yyy)/ZSAJQUS\end{array}\right] \\ /(QHLP\_xxx + QHLP\_yyy)\end{array}\right\} \qquad \text{EQ 14} \\
&\quad + a_4\left\{\left[PRRCUxx(-1) - PRPCUxx(-1)\right]/\left[GDPIUS(-1)/100\right]\right\} \\
&\quad + \sum_{i=5}^{15} a_i D_i
\end{aligned}
$$

where,

PRRCUxx = residential propane price in region xx;
PRPCUUS = propane wholesale price to petrochemical sector, cents/gallon;
GDPIUS = GDP deflator;
PRPSPPx = total propane end-of-month inventory in PADDx, million barrels;
PRPSPPx(average) = prior 4-year average, [PRPSPPx(-13)+PRPSPPx(-25)+PRPSPPx(-37)+PRPSPPx(-49)]/4, million barrels;
ZWHDP*xxx* = total heating degree days in census division x*xx*;
ZWHNP*xxx* = normal heating degree days in census division x*xx*;
ZSAJQUS = number of days in the month;
QHLP_xxx = number of homes in census division xxx that use propane as the primary space heating fuel and
D_i = monthly dummy variables for January through November.

1. Propane Wholesale Price Change

A change in the propane wholesale price is expected to feed forward to residential retail prices, possibly with a short lag. Including the difference in the current and prior-month propane wholesale price as an explanatory variable allows for some delay in the price pass through.

2. Regional Weather

Regional heating degree-day deviations from normal are included to capture the impact of cold weather on retail prices. Colder-than-normal weather is expected to raise the residential propane retail price with all other variables held constant. The estimated coefficients are not statistically significant in any region except for the West, where the coefficient is positive as expected.

The reason for this seemingly weak relationship is that weather influences residential prices through the wholesale price, which is affected by weather through the price of natural gas (weather in the wholesale propane price equation was not statistically significant and was excluded).

3. Regional Inventories

While total U.S. inventories are included in the wholesale propane price regression equation, regional inventory levels are included in the residential price equations. Inventories are entered as the difference in beginning-of-month stocks from the prior four year average.

Inventory data are not available by census region. Inventories by Petroleum Administration for Defense (PAD) District are used for census regions as shown below. A more detailed description of the correspondence between census regions and PAD Districts is provided in Appendix A.

Census Region	PAD District
Northeast	1
South	1
Midwest	2
West	5

The estimated coefficient on inventories is only significant in the Northeast at the 90 percent confidence level where it is negative as expected. Most of the impact of inventories on prices is on wholesale prices. Although the estimated coefficients are not all statistically significant at the regional level, we leave them in the regression equations for information purposes and their impact may change as the equations may be revised.

4. Dummy Variables

Dummy variables are included to reflect the seasonality in the markup of residential propane prices over the wholesale price and to eliminate the effects of certain events that are considered outliers in the data series.

First, we have dummy variables for each individual month except December. For example, JAN equals 1 for every January in the time series and is equal to 0 in every other month. These individual monthly dummy variables are intended to capture normal wholesale price seasonality as deviations from the December price. In other words, if the estimated coefficient for JAN is 1.00, then the wholesale price in January is expected to be 1.0 cent per gallon higher than in December with all other variables held constant.

The regression results for the monthly dummy variables are lowest during the summer and peak during the winter for all regions except the Northeast. However, the expected seasonal pattern in the retail-wholesale price difference is ambiguous. Higher price differences in the winter may provide incentive for local storage of propane during the summer to meet peak winter demand. On the other hand, lower consumption volumes during the summer can increase price differences because of higher per-unit distribution costs.

A second group of dummy variables control for outliers. Dummy variables are included for those months in which the absolute value of the estimated regression error was greater than 2 times the standard error of the regression (the standard error of the regression is a summary measure based on the estimated variance of the residuals). No attempt was made to identify market or survey factors that may have contributed to the identified outliers.

D. Residential Propane Prices After State Taxes

The regional residential propane price module includes residential sector propane prices including State taxes for the four census regions. The propane price including State taxes is calculated by multiplying each region's propane price excluding taxes by a regional sales tax factor. For example, the Northeast region propane price including State taxes is calculated by:

PRRCANE = PRTXUNE * PRRCUNE

where,

PRRCANE = Residential propane price after taxes, Northeast region
PRTXUNE = Region State sales tax factor (e.g., 1.05 = 5 percent tax rate)
PRRCUNE = Residential propane price before taxes, Northeast region

The regional sales tax factors used in the model are approximations of the actual average sales tax. We apply the same State tax rates used in EIA's estimation of State residential petroleum product prices including taxes published in the annual EIA *State Expenditure and Price Reports* (http://www.eia.doe.gov/emeu/states/_seds.html). The State tax rate includes the State's portion of the sales tax and excludes any local options for additional sales tax. The census region tax rate is calculated by weighting each State's tax rate by the volume of residential propane sales in that State for each month.

7. Sensitivity Analysis

A. Weather

The coefficients of the weather related variables are important in the regressions, but so is the variance of the weather itself. All else equal, the model will be better able to forecast propane consumption, stocks, and prices for months and regions with less variability in weighted heating degree-days. Table 4 compares the standard deviations of the heating degree-days difference from average for each region from 2000 through 2008. As expected, the standard deviation is very small for each region during the summer months when heating degree-days are rare and peaks in December or January.

Table 4. Standard Deviations of Weighted Heating Degree-Days Difference from Average, 2000-2008

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NE	5.23	3.79	2.72	2.07	2.04	0.47	0.23	0.28	0.98	2.32	2.54	4.04
SO	2.82	2.62	2.19	1.31	0.56	0.05	0.01	0.02	0.29	1.02	2.27	3.29
MW	4.72	5.10	3.87	2.06	1.77	0.60	0.19	0.49	1.24	2.49	3.28	5.61
WE	2.91	1.39	2.46	1.31	0.75	0.49	0.18	0.12	0.37	1.34	2.68	1.33

If all other explanatory variables hold their forecasted values, one can see the likely range of propane consumption for each region given changes in heating-degree days by multiplying these standard deviations by the coefficients of the weather related variables. Figures 16 through 19 show the likely ranges for each region's consumption share determined by two standard deviations in either direction based on the June 2009 STEO forecast. (Note: These ranges were calculated prior to 2010; they are meant to be representative of possible future deviations from forecast expectations)

Figure 15. Northeast Region Propane Consumption Share and Weather Sensitivity, 2010

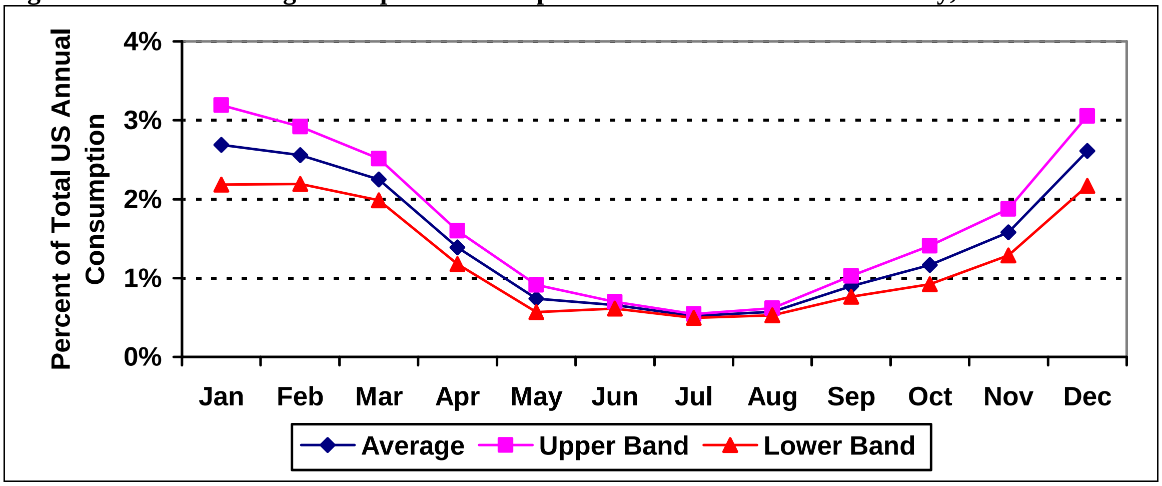


Figure 16. South Region Propane Consumption Share and Weather Sensitivity, 2010

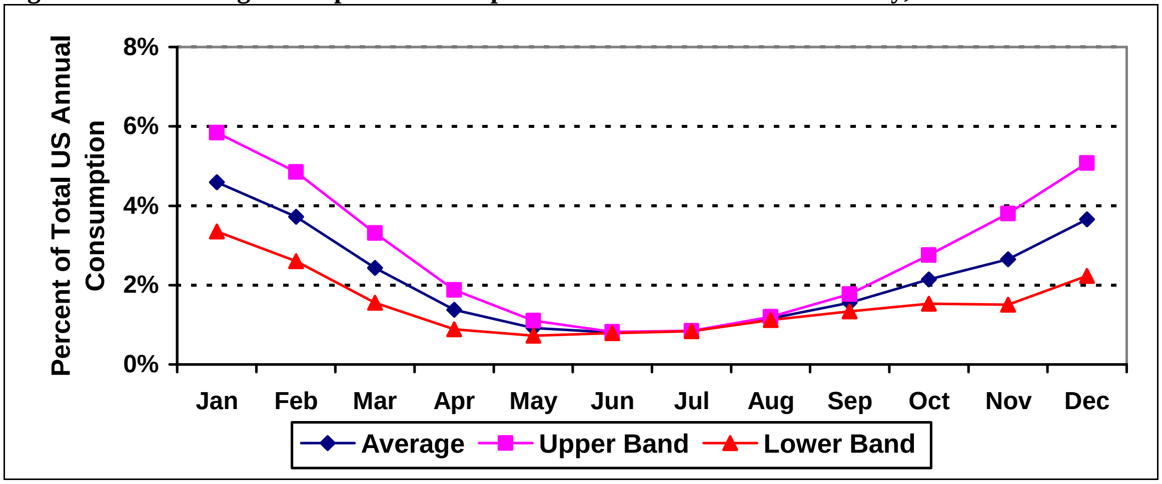


Figure 17. Midwest Region Propane Consumption Share and Weather Sensitivity, 2010

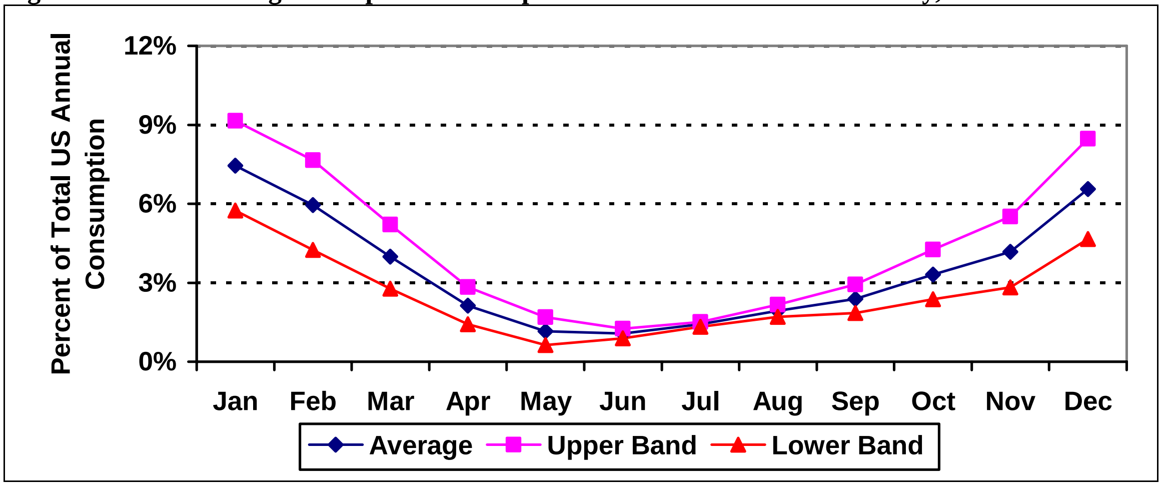
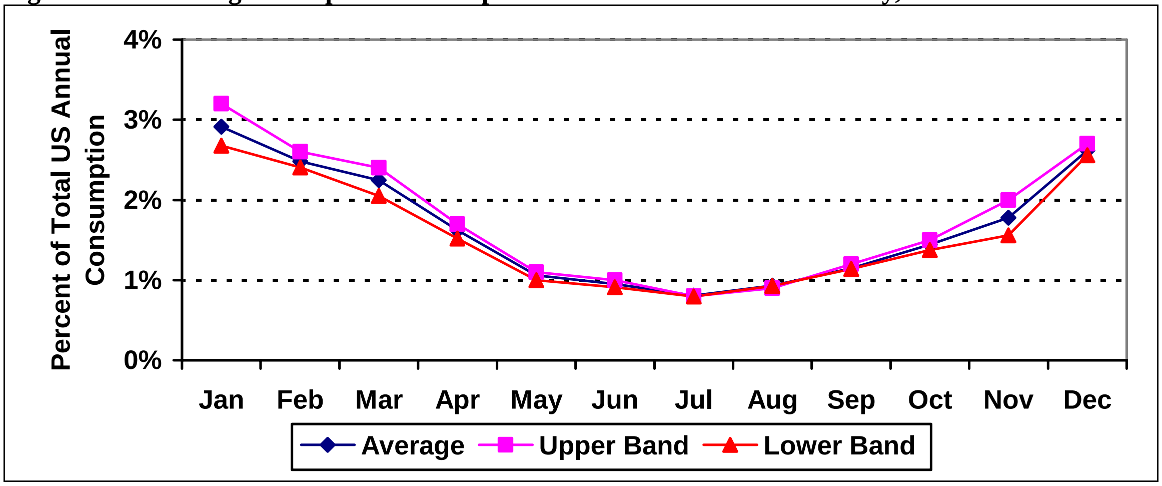


Figure 18. West Region Propane Consumption Share and Weather Sensitivity, 2010



B. Stocks

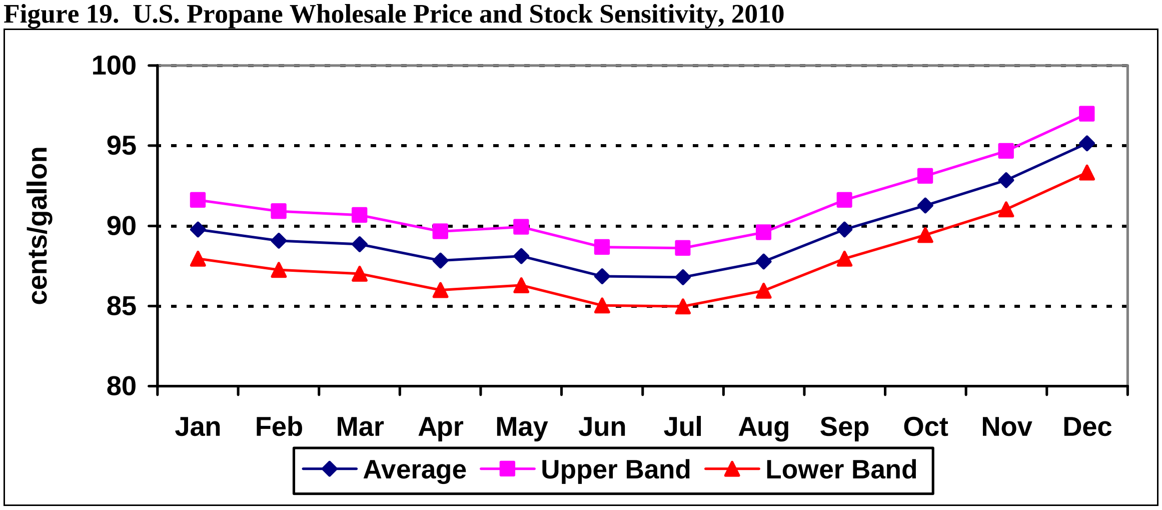
Variability in stocks can have a significant influence on wholesale propane prices. Table 5 shows the standard deviation of the difference in total US propane stocks from the previous 4-year average for each month. Price uncertainty will tend to be higher for months with more stock variability. Typically, these are the winter months when there is a possibility of prolonged periods of cold weather that can quickly draw down stocks and raise prices.

Figure 19 shows the likely range for wholesale propane determined by two standard deviations in both directions based on the June 2009 STEO forecast.

Table 5. Standard Deviation of US Propane Stocks, 2000-2008

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
US	7.70	8.65	7.05	5.68	6.66	4.62	4.62	4.90	4.17	4.96	5.33	5.70

Figure 19. U.S. Propane Wholesale Price and Stock Sensitivity, 2010



8. Forecast Evaluations

In order to evaluate the reliability of the forecasts, we generated out-of-sample forecasts and calculated forecast errors. Each regional consumption share, inventory, and price equation was estimated over the period January 2000 through December 2006 using the June 2009 STEO. Dynamic forecasts were then generated for the period January 2007 through December 2008 using each regression equation.

Dynamic forecasts of each equation are forecasts generated using the actual values of the exogenous variables on the right-hand side of the regression equations (e.g., weather and the number of households) but simulated values of the lagged dependent variable. Consequently, the calculated forecast error is not the same as a calculated regression error, which uses the actual value of the lagged dependent variable.

Summary forecast error statistics are reported for each regression equation. The *Root Mean Squared Error* and the *Mean Absolute Error* depend on the scale of the dependent variable. These are generally used as relative measures to compare forecasts for the same series using different models; the smaller the error, the better the forecasting ability of that model.

The *Mean Absolute Percentage Error* (MAPE) and the *Theil Inequality Coefficient* are invariant to scale. The smaller the values the better the model fit. The Theil inequality coefficient always lies between zero and one, where zero indicates a perfect fit. The Theil inequality coefficient is broken out into bias, variance, and covariance proportions, which sum to 1. The bias proportion indicates how far the mean of the forecast is from the mean of the actual series signaling systematic error. The variance proportion indicates how far the variation of the forecast is from the variation of the actual series. This will be high if the actual data fluctuates significantly but the forecast fails to track these variations from the mean. The covariance proportion measures the remaining unsystematic forecasting errors. For a “good” forecast the bias and variance proportions should be small with most of the forecast error concentrated in the covariance proportion.

It should be remembered that these models are not static. They are followed by analysts who can utilize add factors to follow changing trends that would likely be missed by a typical model relying on historical data.

A. Regional Consumption Shares

Figure 20 reveals the differences between the forecast and actual consumption shares for each census region in 2007 and 2008. During the summer months, the consumption of fuels for residential space heating is greatly reduced making the relative forecast errors generally larger. The relatively large errors evident for the Midwest reflect the fact that the region accounts for such a large share of residential propane consumption. It is therefore much more likely to have bigger absolute errors (but much smaller errors in percentage terms).

Figure 20. Residential Propane Regional Consumption Shares Out-of-Sample Simulation Error

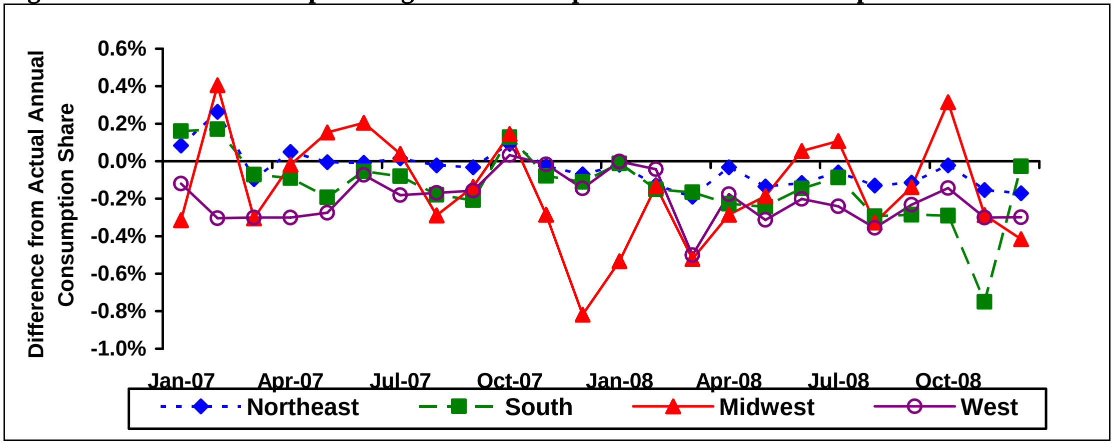


Table 6 shows the simulation statistics for residential propane regional shares. All regions have a low Theil Coefficient but the bias varies greatly with a low value in the Northeast but a very high value in the West.

Table 6. Residential Propane Consumption Shares Out-of-Sample Simulation Error Statistics

	Northeast	South	Midwest	West
Root Mean Squared Error	0.001	0.002	0.003	0.002
Mean Absolute Error	0.001	0.002	0.003	0.002
Mean Absolute Percentage Error	7.15	12.02	9.14	17.06
Theil Inequality Coefficient	0.03	0.05	0.04	0.07
Bias Proportion	0.16	0.37	0.21	0.72
Variance Proportion	0.00	0.07	0.13	0.01
Covariance Proportion	0.84	0.56	0.65	0.27
Notes: Forecast period = January 2007 – December 2008				

B. Inventories

Forecast errors for inventory builds and draws are quite large by comparison to errors for regional consumption share and prices. However, the calculated inventory variables reflect not total levels but changes in the level of inventories for distillates from month to month. Changes in inventories are often very small over a one month period, and therefore, the percentage error is likely to be large.

Figure 21 reveals the percentage differences between the forecast and actual levels of inventories in each PAD division. The forecast of total inventory levels are calculated by adding or subtracting the predicted stock build each month, starting with a base month (December 2005) immediately before the forecast period.

The forecasts for inventory levels are generally close to the actual values. The spike in PADD 1 is due to an uncharacteristically sharp drop in the actual inventory level in PADD 1. Between January and February 2007 there was significantly warmer than normal temperatures in the three census regions comprising PADD 1 followed by much colder than normal temperatures in March. The model predicted a significant stock draw, but the actual stock draw was even larger with the total inventory reduced by over 60 percent.

There is also some bias present with the forecasts for PADDs 1, 3, and 4 consistently above the actual values.

Figure 21. Propane Inventories Out-of-Sample Simulation Error

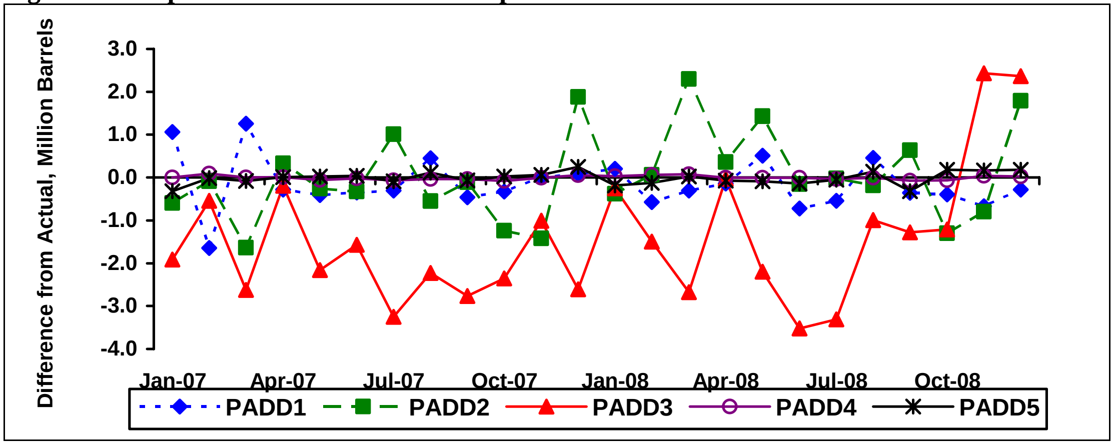


Table 7. Propane Inventories Out-of-Sample Simulation Error Statistics

	PADD1	PADD2	PADD3	PADD4	PADD5
Root Mean Squared Error	0.61	1.03	2.12	0.05	0.14
Mean Absolute Error	0.49	0.79	1.87	0.04	0.11
Mean Absolute Percentage Error	169.59	94.43	90.45	637.62	115.59
Theil Inequality Coefficient	0.41	0.16	0.29	0.50	0.18
Bias Proportion	0.07	0.00	0.48	0.01	0.01
Variance Proportion	0.13	0.00	0.03	0.16	0.01
Covariance Proportion	0.81	1.00	0.49	0.82	0.98
Notes: Forecast period = January 2007 – December 2008					

C. Propane Prices

Figure 22 shows the percent difference between the forecast and actual prices of propane in the four census regions and the national wholesale value. The forecasts are very accurate overall with small Theil Coefficients. The wholesale price forecast is considerably less towards the very end of the forecast period as a dramatic fall in the actual value caused the model to overestimate the wholesale price. Forecast errors tend to be higher during summer months because propane use is much lower.

Figure 22. Propane Wholesale and Residential Prices Simulation Error

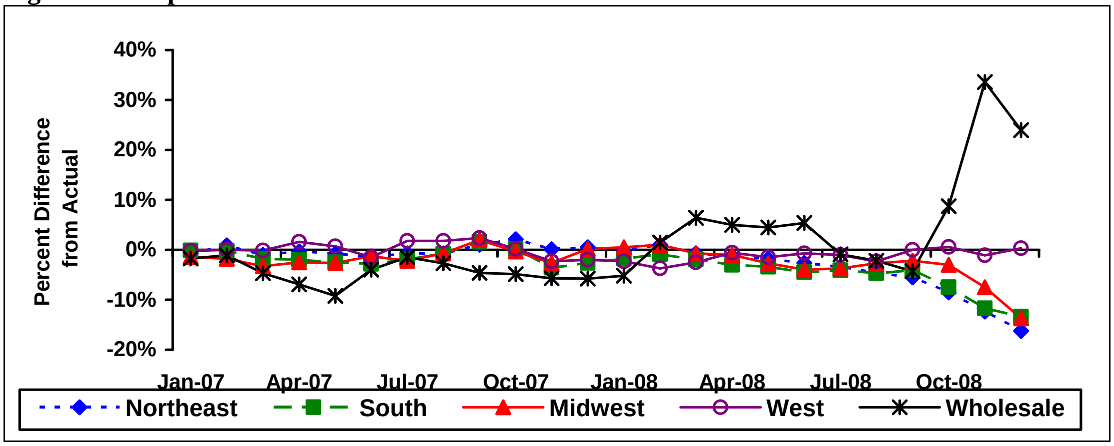


Table 7 reveals mixed results for the forecast error statistics. On the positive side, the mean absolute percentage errors and Theil coefficients are extremely low. Unfortunately, the bias component is significant for all five forecast equations.

Table 6. Propane Wholesale and Residential Prices Simulation Error Statistics

	Northeast	South	Midwest	West	Wholesale
Root Mean Squared Error	11.88	8.24	3.29	3.27	19.35
Mean Absolute Error	11.27	7.52	2.62	2.72	16.64
Mean Absolute Percentage Error	4.89	3.60	1.56	1.33	14.64
Theil Inequality Coefficient	0.03	0.02	0.01	0.01	0.08
Bias Proportion	0.90	0.79	0.38	0.21	0.74
Variance Proportion	0.01	0.00	0.04	0.02	0.20
Covariance Proportion	0.09	0.21	0.58	0.77	0.06
Notes: Forecast period = Janurary 2007 – December 2008					

9. Future Model Development

Regression equations can nearly always be improved. The current equations represent an ongoing process aiming for the best possible equation utilizing current available data. However, data can improve and market relationships can change over time. The following are possible additions and modifications to the residential propane model that have been suggested and may be implemented in the future.

A. Propane to Natural Gas Price Relationship

More study of the statistical relationship between propane and natural gas prices is needed. Normally, propane along with other liquefied petroleum gases (LPGs) such as ethane are extracted from natural gas because they have a higher market price. However, if the price of natural gas spikes relative to the price of LPGs, producers could extract a smaller amount of LPGs from the natural gas stream. Therefore, the price effects of natural gas on propane could be significant at certain price levels but insignificant at others.

B. Regional Weather Variable Improvements

Current measures of heating degree days by region are imperfectly related to the propane market. Homes using propane as their primary heating fuel are not evenly distributed geographically across census divisions, tending to be in rural areas. Weather patterns vary significantly within the divisions. A more accurate heating degree day calculation would be determined using state or county level heating degree data weighted by the number of homes in each state or county.

C. Stock Deviations

Explanatory variables based on the previous 4 years' average stock levels are currently used in the inventory and price regression equations. These variables implicitly assume that there is a normal or target stock level for each region and month. All else equal, when stocks deviate from this target level, we should expect them to move back towards the target level. A future design of this variable could seek to give more weight to recent years to better capture any trends that may be occurring.

D. System of Equations

Regional consumption share equations must meet the restriction that all shares over all regions must sum to one over the course of the year. Therefore, the equations for the regions are not independent of each other and could be solved as a system of equations. For example, unusually cold weather in one region would increase that region's consumption share, but it would also decrease the share of the other regions.

E. Asymmetric Pass-through Behavior

These equations assume symmetric pass-through price behavior from explanatory variables. For example, if wholesale prices rise 10 cents, it will affect retail prices by the same magnitude (but the opposite direction) as if wholesale prices had fallen 10 cents. It may be the case that these changes do not pass-through equally. The 10 cent rise may cause a disproportionately large (or small) increase in retail margins.

Appendix A. Number of Households and Correspondence Between Census Divisions and Petroleum Administration for Defense Districts.

Census Region	Census Division		Petroleum Administration for Defense District (PADD) 1	2	3	4	5	Households with Heating Oil Space Heating, 2007 (mllions) Total
Northeast	New England	CT	X					0.23
		ME	X					
		MA	X					
		NH	X					
		RI	X					
		VT	X					
	Middle Atlantic	NJ	X					0.46
		NY	X					
		PA	X					
South	South Atlantic	DE	X					1.15
		DC	X					
		FL	X					
		GA	X					
		MD	X					
		NC	X					
		SC	X					
		VA	X					
		WV	X					
	East South Central	AL			X			0.61
		KY		X				
		MS			X			
		TN		X				
	West South Central	AK			X			0.62
		LA			X			
		OK		X				
		TX			X			
Midwest	East North Central	IL		X				1.27
		IN		X				
		MI		X				
		OH		X				
		WI		X				
	West North Central	IA		X				0.9
		KS		X				
		MN		X				

		MO	X				
		NE	X				
		ND	X				
		SD	X				
West	Mountain	AZ				X	0.41
		CO			X		
		ID			X		
		MT			X		
		NV				X	
		NM		X			
		UT			X		
		WY			X		
	Pacific	AK				X	0.52
		CA				X	
		HI				X	
		OR				X	
		WA				X	

Source: US Census Bureau, 2007 American Community Survey

Appendix B. Variable Definitions, Units, and Sources

Table B1. Variable Definitions, Units and Sources

Variable Name	Units	Definition	Sources History	Sources Forecast
APR	Integer	= 1 if April, 0 otherwise		
AUG	Integer	= 1 if August, 0 otherwise		
D0001	Integer	= 1 if January 2000, 0 otherwise		
D0012	Integer	= 1 if December 2000, 0 otherwise		
D0101	Integer	= 1 if January 2001, 0 otherwise		
D0109	Integer	= 1 if September 2001, 0 otherwise		
D0202	Integer	= 1 if February 2002, 0 otherwise		
D0303	Integer	= 1 if March 2003, 0 otherwise		
D0401	Integer	= 1 if January 2004, 0 otherwise		
D0409	Integer	= 1 if September 2004, 0 otherwise		
D95	Integer	= 1 if 1995 or later, 0 otherwise		
D96	Integer	= 1 if 1996, 0 otherwise		
D9611	Integer	= 1 if November 1996, 0 otherwise		
D9612	Integer	= 1 if December 1996, 0 otherwise		
D9708	Integer	= 1 if August 1998, 0 otherwise		
D99	Integer	= 1 if 1999, 0 otherwise		
FEB	Integer	= 1 if February, 0 otherwise		
JAN	Integer	= 1 if January, 0 otherwise		
JUL	Integer	= 1 if July, 0 otherwise		
JUN	Integer	= 1 if June, 0 otherwise		
MAR	Integer	= 1 if March, 0 otherwise		
MAY	Integer	= 1 if May, 0 otherwise		
NGHHUUS	DMMB	Henry Hub natural gas spot wellhead price	NGM	STF
NOV	Integer	= 1 if November, 0 otherwise		
OCT	Integer	= 1 if October, 0 otherwise		
PRPCUUS	CPG	Propane price to petrochemical plants, all sellers	PMM	STF
PRPSPP1BLD	MMB	Propane stock change, PADD 1	PSM	STF
PRPSPP2BLD	MMB	Propane stock change, PADD 2	PSM	STF
PRPSPP3BLD	MMB	Propane stock change, PADD 3	PSM	STF
PRPSPP4BLD	MMB	Propane stock change, PADD 4	PSM	STF
PRPSPP5BLD	MMB	Propane stock change, PADD 5	PSM	STF
PRPSPP1	MMB	Propane end-of-month stocks, PADD 1	PSM	STF
PRPSPP2	MMB	Propane end-of-month stocks, PADD 2	PSM	STF
PRPSPP3	MMB	Propane end-of-month stocks, PADD 3	PSM	STF
PRPSPP4	MMB	Propane end-of-month stocks, PADD 4	PSM	STF
PRPSPP5	MMB	Propane end-of-month stocks, PADD 5	PSM	STF
PRPSPUS	MMB	Propane end-of-month stocks, U.S.	PSM	STF
PRRCAMW	CPG	Residential propane price after taxes, Midwest census region, all sellers	STF	STF
PRRCANE	CPG	Residential propane price after taxes, Northeast census region, all sellers	STF	STF
PRRCASO	CPG	Residential propane price after taxes, South census region, all sellers	STF	STF
PRRCAUS	CPG	Residential propane price after taxes, U.S., all sellers	STF	STF
PRRCAWE	CPG	Residential propane price after taxes, West census region, all sellers	STF	STF
PRRCUMW	CPG	Residential propane price before taxes, Midwest census region, all sellers	PMM	STF
PRRCUNE	CPG	Residential propane price before taxes, Northeast census region, all sellers	PMM	STF
PRRCUSO	CPG	Residential propane price before taxes, South census region, all sellers	PMM	STF
PRRCUUS	CPG	Residential propane price before taxes, U.S., all sellers	PMM	STF
PRRCUWE	CPG	Residential propane price before taxes, West census region, all sellers	PMM	STF
PRRCXMW	MMBD	Propane residential consumption share, Midwest census region	PMM	STF
PRRCXNE	MMBD	Propane residential consumption share, Northeast census region	PMM	STF
PRRCXSO	MMBD	Propane residential consumption share, South census region	PMM	STF

PRRCXUS	MMBD	Propane residential consumption share, U.S.	PMM	STF
PRRCXWE	MMBD	Propane residential consumption share, West census region	PMM	STF
PRTXUMW	Index	Propane State sales tax factor, Midwest census region	STF	ROT
PRTXUNE	Index	Propane State sales tax factor, Northeast census region	STF	ROT
PRTXUSO	Index	Propane State sales tax factor, South census region	STF	ROT
PRTXUWE	Index	Propane State sales tax factor, West census region	STF	ROT
QHLP_ENC	MM	No. homes with LPG as space heating fuel, E. North Central census div.	ACS	ROT
QHLP_ESC	MM	No. homes with LPG as space heating fuel, E. South Central census div.	ACS	ROT
QHLP_MAC	MM	No. homes with LPG as space heating fuel, Middle Atlantic census div.	ACS	ROT
QHLP_MTN	MM	No. homes with LPG as space heating fuel, Mountain census div.	ACS	ROT
QHLP_NEC	MM	No. homes with LPG as space heating fuel, New England census div.	ACS	ROT
QHLP_PAC	MM	No. homes with LPG as space heating fuel, Pacific census div.	ACS	ROT
QHLP_SAC	MM	No. homes with LPG as space heating fuel, South Atlantic census div.	ACS	ROT
QHLP_WNC	MM	No. homes with LPG as space heating fuel, W. North Central census div.	ACS	ROT
QHLP_WSC	MM	No. homes with LPG as space heating fuel, W. South Central census div.	ACS	ROT
RACPUUS	DBBL	Refiner average crude oil acquisition cost	PMM	EXO
SEP	Integer	= 1 if September, 0 otherwise		
TIME	Integer	= 1 to n, where n = number of observation		
ZO28IUS	Index	industrial production index for the chemical sector (SIC-28)	BLS	DRI
ZWHDENC	HDD	Heating degree-days, East North Central census division	NOAA	NOAA
ZWHDESC	HDD	Heating degree-days, East South Central census division	NOAA	NOAA
ZWHDMTN	HDD	Heating degree-days, Mountain census division	NOAA	NOAA
ZWHDPAC	HDD	Heating degree-days, Pacific census division	NOAA	NOAA
ZWHDPMA	HDD	Heating degree-days, Middle Atlantic census division	NOAA	NOAA
ZWHDPNE	HDD	Heating degree-days, New England census division	NOAA	NOAA
ZWHDSAC	HDD	Heating degree-days, South Atlantic census division	NOAA	NOAA
ZWHDWNC	HDD	Heating degree-days, West. North Central census division	NOAA	NOAA
ZWHDWSC	HDD	Heating degree-days, West South Central census division	NOAA	NOAA
ZWHNENC	HDD	Heating degree-days normal, East North Central census division	NOAA	NOAA
ZWHNESC	HDD	Heating degree-days normal, East South Central census division	NOAA	NOAA
ZWHNMTN	HDD	Heating degree-days normal, Mountain census division	NOAA	NOAA
ZWHNPAC	HDD	Heating degree-days normal, Pacific census division	NOAA	NOAA
ZWHNPMA	HDD	Heating degree-days normal, Middle Atlantic census division	NOAA	NOAA
ZWHNPNE	HDD	Heating degree-days normal, New England census division	NOAA	NOAA
ZWHNSAC	HDD	Heating degree-days normal, South Atlantic census division	NOAA	NOAA
ZWHNWNC	HDD	Heating degree-days normal, West. North Central census division	NOAA	NOAA
ZWHNWSC	HDD	Heating degree-days normal, West South Central census division	NOAA	NOAA

Table B2. Units Key

CPG	Cents per gallon
DBBL	Dollars per barrel
DMMB	Dollars per million Btu
HDD	Heating degree-days
Index	Index value
MM	Millions
MMB	Million barrels
MMBD	Million barrels per day

Table B3. Sources Key

BLS	Bureau of Labor Statistics
DRI	Global Insight DRI-WEFA
EXO	Exogenous
NGM	Natural Gas Monthly
NOAA	National Oceanic and Atmospheric Organization
PMM	Petroleum Marketing Monthly
PSM	Petroleum Supply Monthly
ACS	American Community Survey
ROT	Rule-of-thumb
STF	STIFS Model

Appendix C. EViews Model Program File

```
'--------- Residential propane consumption shares ---------

:EQ_PRRCXNE
:EQ_PRRCXSO
:EQ_PRRCXMW
:EQ_PRRCXWE
@IDENTITY prrcxus  = prrcxne  + prrcxso  + prrcxmw  + prrcxwe

' --------  Propane Stocks ---------

:EQ_PRPSP1BLD
:EQ_PRPSP2BLD
:EQ_PRPSP3BLD
:EQ_PRPSP4BLD
:EQ_PRPSP5BLD

@IDENTITY prpspp1  = prpspp1(-1)  + prpsp1bld
@IDENTITY prpspp2  = prpspp2(-1)  + prpsp2bld
@IDENTITY prpspp3  = prpspp3(-1)  + prpsp3bld
@IDENTITY prpspp4  = prpspp4(-1)  + prpsp4bld
@IDENTITY prpspp5  = prpspp5(-1)  + prpsp5bld
@IDENTITY prpspus  = prpspp1  + prpspp2  + prpspp3  + prpspp4  + prpspp5

' --------  Propane price to petrochemical plants, all sellers ---------

:EQ_PRPCUUS

' --------  Residential Propane Retail Prices Excluding State Taxes ---------

:EQ_PRRCUNE
:EQ_PRRCUSO
:EQ_PRRCUMW
:EQ_PRRCUWE
@IDENTITY prrcuus  = (prrcxne  * prrcune  + prrcxso  * prrcuso  + prrcxmw  * prrcumw  +
prrcxwe  * prrcuwe)  / prrcxus

' ----------  Residential Propane Retail Prices Including State Taxes ---------

@IDENTITY prtxune  = prtxune(-12)
@IDENTITY prtxuso  = prtxuso(-12)
@IDENTITY prtxumw  = prtxumw(-12)
@IDENTITY prtxuwe  = prtxuwe(-12)

@IDENTITY prrcane  = prrcune  * prtxune
@IDENTITY prrcaso  = prrcuso  * prtxuso
@IDENTITY prrcamw  = prrcumw  * prtxumw
@IDENTITY prrcawe  = prrcuwe  * prtxuwe

@IDENTITY prrcaus  = (prrcxne  * prrcane  + prrcxso  * prrcaso  + prrcxmw  * prrcamw  +
prrcxwe  * prrcawe)  / prrcxus
```

Appendix D. Regression Results

D1. PRRCXNE, Residential Propane Consumption Share Northeast Census Region
D2. PRRCXSO, Residential Propane Consumption Share South Census Region
D3. PRRCXMW, Residential Propane Consumption Share Midwest Census Region
D4. PRRCXWE, Residential Propane Consumption Share West Census Region
D5. PRPSP1BLD, Propane Stock Build (Draw) PADD 1
D6. PRPSP2BLD, Propane Stock Build (Draw) PADD 2
D7. PRPSP3BLD, Propane Stock Build (Draw) PADD 3
D8. PRPSP4BLD, Propane Stock Build (Draw) PADD 4
D9. PRPSP5BLD, Propane Stock Build (Draw) PADD 5
D10. PRPCUUS, Propane Wholesale Price to Petrochemical Industry
D11. PRRCUNE, Propane Retail Residential Price excluding taxes, Northeast Census Region
D12. PRRCUSO, Propane Retail Residential Price excluding taxes, South Census Region
D13. PRRCUMW, Propane Retail Residential Price excluding taxes, Midwest Census Region
D14. PRRCUWE, Propane Retail Residential Price excluding taxes, West Census Region

Regression 1. PRRCXNE, Propane Residential Consumption Share, Northeast Region

Dependent Variable: PRRCXNE
Method: Least Squares
Date: 05/28/09 Time: 10:48
Sample (adjusted): 2000M02 2008M12
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005308	0.001903	2.789071	0.0065
(QHLP_MAC*(ZWHD_MAC-ZWHN_MAC)/ZSAJQUS+QHLP_NEC*(ZWHD_NEC-ZWHN_NEC)/ZSAJQUS)/(QHLP_MAC+QHLP_NEC)	0.000396	3.54E-05	11.19573	0.0000
(QHLP_MAC(-1)*(ZWHD_MAC(-1)-ZWHN_MAC(-1))/ZSAJQUS(-1)+QHLP_NEC(-1)*(ZWHD_NEC(-1)-ZWHN_NEC(-1))/ZSAJQUS(-1))/(QHLP_MAC(-1)+QHLP_NEC(-1))	0.000117	4.93E-05	2.369852	0.0200
PRRCXNE_SF*(QHLP_MAC+QHLP_NEC)/QHLP_US	0.087924	0.012486	7.041838	0.0000
D05ON+D0410+D0411+D0412	0.000713	0.000330	2.162587	0.0333
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	0.001059	0.000264	4.008744	0.0001
JAN	0.000768	0.000685	1.120566	0.2655
FEB	0.000117	0.000885	0.132484	0.8949
MAR	-0.001627	0.000802	-2.027733	0.0456
APR	-0.003328	0.001211	-2.748457	0.0072
MAY	-0.004042	0.001316	-3.071172	0.0028
JUN	-0.004269	0.001404	-3.040551	0.0031
JUL	-0.004608	0.001502	-3.068376	0.0029
AUG	-0.004352	0.001467	-2.967386	0.0039
SEP	-0.003198	0.001282	-2.493436	0.0145
OCT	-0.002521	0.001111	-2.268678	0.0257
NOV	-0.001609	0.000848	-1.896121	0.0612
PRRCXNE(-1)	0.039702	0.081256	0.488606	0.6263

R-squared	0.984061	Mean dependent var	0.012633
Adjusted R-squared	0.981017	S.D. dependent var	0.006514
S.E. of regression	0.000898	Akaike info criterion	-11.04160
Sum squared resid	7.17E-05	Schwarz criterion	-10.59197
Log likelihood	608.7258	Hannan-Quinn criter.	-10.85933
F-statistic	323.2242	Durbin-Watson stat	1.510260
Prob(F-statistic)	0.000000		

Regression 2. PRRCXSO, Propane Residential Consumption Share, South Region

Dependent Variable: PRRCXSO
Method: Least Squares
Date: 05/28/09 Time: 10:48
Sample (adjusted): 2000M02 2008M12
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004143	0.006308	0.656713	0.5131
(QHLP_ESC*(ZWHD_ESC-ZWHN_ESC)/ZSAJQUS+QHLP_WSC*(ZWHD_WSC-ZWHN_WSC)/ZSAJQUS+QHLP_SAC*(ZWHD_SAC-ZWHN_SAC)/ZSAJQUS)/(QHLP_ESC+QHLP_WSC+QHLP_SAC)	0.001637	0.000120	13.60155	0.0000
(QHLP_ESC(-1)*(ZWHD_ESC(-1)-ZWHN_ESC(-1))/ZSAJQUS(-1)+QHLP_WSC(-1)*(ZWHD_WSC(-1)-ZWHN_WSC(-1))/ZSAJQUS(-1)+QHLP_SAC(-1)*(ZWHD_SAC(-1)-ZWHN_SAC(-1))/ZSAJQUS(-1))/(QHLP_ESC(-1)+QHLP_WSC(-1)+QHLP_SAC(-1))	0.000610	0.000166	3.683429	0.0004
PRRCXSO_SF*(QHLP_ESC+QHLP_WSC+QHLP_SAC)/QHLP_US	0.049064	0.007935	6.183659	0.0000
D0002	0.013445	0.002112	6.364472	0.0000
D05ON+D0410+D0411+D0412	-0.000465	0.000607	-0.766151	0.4456
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	-0.000669	0.000546	-1.225043	0.2238
JAN	0.002738	0.001543	1.773936	0.0795
FEB	0.000318	0.002328	0.136695	0.8916
MAR	-0.002009	0.002865	-0.701229	0.4850
APR	-0.001796	0.004548	-0.395041	0.6938
MAY	-0.002233	0.004973	-0.449033	0.6545
JUN	-0.002686	0.005010	-0.536043	0.5933
JUL	-0.002899	0.004917	-0.589630	0.5569
AUG	-0.002305	0.004315	-0.534269	0.5945
SEP	-0.001527	0.003766	-0.405572	0.6860
OCT	-0.000309	0.003210	-0.096167	0.9236
NOV	0.000174	0.002592	0.067079	0.9467
PRRCXSO(-1)	0.039778	0.075614	0.526072	0.6002

R-squared	0.985857	Mean dependent var	0.022992
Adjusted R-squared	0.982964	S.D. dependent var	0.014560
S.E. of regression	0.001900	Akaike info criterion	-9.533838
Sum squared resid	0.000318	Schwarz criterion	-9.059224
Log likelihood	529.0603	Hannan-Quinn criter.	-9.341436
F-statistic	340.7832	Durbin-Watson stat	1.850131
Prob(F-statistic)	0.000000		

Regression 3. PRRCXMW, Propane Residential Consumption Share, Midwest Region

Dependent Variable: PRRCXMW
Method: Least Squares
Date: 05/28/09 Time: 10:48
Sample (adjusted): 2000M02 2008M12
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.041071	0.014325	2.867149	0.0052
(QHLP_ENC*(ZWHD_ENC-ZWHN_ENC)/ZSAJQUS+QHLP_WNC*(ZWHD_WNC-ZWHN_WNC)/ZSAJQUS)/(QHLP_ENC+QHLP_WNC)	0.001362	9.84E-05	13.84363	0.0000
(QHLP_ENC(-1)*(ZWHD_ENC(-1)-ZWHN_ENC(-1))/ZSAJQUS(-1)+QHLP_WNC(-1)*(ZWHD_WNC(-1)-ZWHN_WNC(-1))/ZSAJQUS(-1))/(QHLP_ENC(-1)+QHLP_WNC(-1))	0.000404	9.56E-05	4.229976	0.0001
PRRCXMW_SF*(QHLP_ENC+QHLP_WNC)/QHLP_US	0.040379	0.022810	1.770189	0.0801
D0002	0.012075	0.003518	3.432139	0.0009
JAN	0.006414	0.002216	2.894309	0.0048
FEB	-0.003992	0.001804	-2.212596	0.0295
MAR	-0.015133	0.004719	-3.206692	0.0019
APR	-0.025695	0.010092	-2.545960	0.0126
MAY	-0.031862	0.011790	-2.702572	0.0082
JUN	-0.032733	0.011894	-2.752040	0.0072
JUL	-0.030664	0.011078	-2.767952	0.0069
AUG	-0.026472	0.009760	-2.712207	0.0080
SEP	-0.023501	0.008909	-2.638033	0.0098
OCT	-0.018495	0.007325	-2.524931	0.0133
NOV	-0.012916	0.006158	-2.097515	0.0388
D05ON+D0410+D0411+D0412	-0.002742	0.000767	-3.573943	0.0006
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	0.000529	0.000807	0.655485	0.5138

R-squared	0.983223	Mean dependent var	0.034091
Adjusted R-squared	0.980019	S.D. dependent var	0.020634
S.E. of regression	0.002917	Akaike info criterion	-8.684499
Sum squared resid	0.000757	Schwarz criterion	-8.234864
Log likelihood	482.6207	Hannan-Quinn criter.	-8.502223
F-statistic	306.8243	Durbin-Watson stat	1.743728
Prob(F-statistic)	0.000000		

Regression 4. PRRCXWE, Propane Residential Consumption Share, West Region

Dependent Variable: PRRCXWE
Method: Least Squares
Date: 05/28/09 Time: 10:48
Sample (adjusted): 2000M02 2008M12
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.012033	0.005029	-2.392588	0.0188
(QHLP_MTN*(ZWHD_MTN-ZWHN_MTN)/ZSAJQUS+QHLP_PAC*(ZWHD_PAC-ZWHN_PAC)/ZSAJQUS)/(QHLP_MTN+QHLP_PAC)	0.000456	7.65E-05	5.958785	0.0000
(QHLP_MTN(-1)*(ZWHD_MTN(-1)-ZWHN_MTN(-1))/ZSAJQUS(-1)+QHLP_PAC(-1)*(ZWHD_PAC(-1)-ZWHN_PAC(-1))/ZSAJQUS(-1))/(QHLP_MTN(-1)+QHLP_PAC(-1))	-0.000104	8.68E-05	-1.196321	0.2347
PRRCXWE_SF*(QHLP_MTN+QHLP_PAC)/QHLP_US	0.105689	0.022124	4.777125	0.0000
D05ON+D0410+D0411+D0412	0.000752	0.000423	1.778340	0.0788
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	-0.000473	0.000347	-1.365301	0.1756
JAN	-0.003842	0.000741	-5.187341	0.0000
FEB	-0.003312	0.001383	-2.394556	0.0187
MAR	-4.75E-05	0.001587	-0.029892	0.9762
APR	0.000759	0.002644	0.287291	0.7746
MAY	0.004688	0.003309	1.416533	0.1601
JUN	0.006354	0.003540	1.795041	0.0760
JUL	0.006850	0.003704	1.849181	0.0678
AUG	0.006970	0.003343	2.084816	0.0400
SEP	0.006023	0.002880	2.091117	0.0394
OCT	0.004843	0.002613	1.853412	0.0671
NOV	0.003583	0.001810	1.979335	0.0509
PRRCXWE(-1)	0.513696	0.073901	6.951103	0.0000

R-squared	0.968707	Mean dependent var	0.012898
Adjusted R-squared	0.962729	S.D. dependent var	0.005995
S.E. of regression	0.001157	Akaike info criterion	-10.53318
Sum squared resid	0.000119	Schwarz criterion	-10.08354
Log likelihood	581.5249	Hannan-Quinn criter.	-10.35090
F-statistic	162.0623	Durbin-Watson stat	1.842417
Prob(F-statistic)	0.000000		

Regression 5. PRPSP1BLD, Propane Stock Change, PADD 1

Dependent Variable: PRPSP1BLD
Method: Least Squares
Date: 05/28/09 Time: 10:47
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.673993	0.127728	-5.276779	0.0000
(QHLP_NEC*(ZWHD_NEC-ZWHN_NEC)/ZSAJQUS+QHLP_MAC*(ZWHD_MAC-ZWHN_MAC)/ZSAJQUS+QHLP_SAC*(ZWHD_SAC-ZWHD_SAC)/ZSAJQUS)/(QHLP_NEC+QHLP_MAC+QHLP_SAC)	-0.275685	0.045754	-6.025408	0.0000
PRPSPP1(-1)-((PRPSPP1(-13)+PRPSPP1(-25)+PRPSPP1(-37)+PRPSPP1(-49))/4)	-0.263833	0.057195	-4.612904	0.0000
D0002	-1.129754	0.408395	-2.766325	0.0069
D0404	-1.061088	0.404318	-2.624390	0.0102
D0701	1.053951	0.410106	2.569944	0.0118
D0702	-1.630332	0.438514	-3.717858	0.0004
D0703	1.308268	0.406756	3.216345	0.0018
JAN	-0.792652	0.185459	-4.273991	0.0000
FEB	0.265672	0.192697	1.378708	0.1714
MAR	0.451379	0.186074	2.425797	0.0173
APR	0.932534	0.185676	5.022372	0.0000
MAY	1.396863	0.180027	7.759195	0.0000
JUN	1.067418	0.180385	5.917455	0.0000
JUL	1.252226	0.180004	6.956645	0.0000
AUG	0.843849	0.179466	4.701996	0.0000
SEP	0.458418	0.180269	2.542965	0.0127
OCT	0.769374	0.179767	4.279839	0.0000
NOV	0.638666	0.180016	3.547838	0.0006

R-squared	0.807344	Mean dependent var	-0.015269
Adjusted R-squared	0.768380	S.D. dependent var	0.790498
S.E. of regression	0.380442	Akaike info criterion	1.063393
Sum squared resid	12.88154	Schwarz criterion	1.535250
Log likelihood	-38.42323	Hannan-Quinn criter.	1.254714
F-statistic	20.72021	Durbin-Watson stat	1.994880
Prob(F-statistic)	0.000000		

Regression 6. PRPSP2BLD, Propane Stock Change, PADD 2

Dependent Variable: PRPSP2BLD
Method: Least Squares
Date: 05/28/09 Time: 10:47
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.671945	0.270784	-13.56042	0.0000
(QHLP_ENC*(ZWHD_ENC-ZWHN_ENC)/ZSAJQUS+QHLP_WNC*(ZWHD_WNC-ZWHN_WNC)/ZSAJQUS)/(QHLP_ENC+QHLP_WNC)	-0.259938	0.024928	-10.42765	0.0000
PRPSPP2(-1)-((PRPSPP2(-13)+PRPSPP2(-25)+PRPSPP2(-37)+PRPSPP2(-49))/4)	-0.122659	0.026519	-4.625281	0.0000
D0001+D0002	-2.383376	0.582208	-4.093687	0.0001
D0411	-2.138436	0.811512	-2.635126	0.0099
D0712	1.608741	0.810831	1.984065	0.0503
JAN	-2.288558	0.383499	-5.967567	0.0000
FEB	-0.246219	0.377781	-0.651752	0.5162
MAR	2.463514	0.371030	6.639665	0.0000
APR	5.319584	0.373523	14.24165	0.0000
MAY	6.565126	0.371249	17.68388	0.0000
JUN	6.714102	0.371213	18.08693	0.0000
JUL	6.351147	0.371280	17.10606	0.0000
AUG	5.781985	0.371435	15.56660	0.0000
SEP	4.605237	0.372782	12.35369	0.0000
OCT	2.918038	0.372173	7.840539	0.0000
NOV	2.884866	0.386063	7.472528	0.0000

R-squared	0.949470	Mean dependent var	-0.001574
Adjusted R-squared	0.940585	S.D. dependent var	3.132351
S.E. of regression	0.763516	Akaike info criterion	2.441777
Sum squared resid	53.04904	Schwarz criterion	2.863965
Log likelihood	-114.8560	Hannan-Quinn criter.	2.612959
F-statistic	106.8685	Durbin-Watson stat	1.762369
Prob(F-statistic)	0.000000		

Regression 7. PRPSP3BLD, Propane Stock Change, PADD 3

Dependent Variable: PRPSP3BLD
Method: Least Squares
Date: 05/28/09 Time: 10:47
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.492824	0.566864	-7.925750	0.0000
(QHLP_ESC*(ZWHD_ESC-ZWHN_ESC)/ZSAJQUS+QHLP_WSC*(ZWHD_WSC-ZWHD_WSC)/ZSAJQUS)/(QHLP_ESC+QHLP_WSC)	-0.305194	0.142183	-2.146483	0.0344
PRPSPP3(-1)-((PRPSPP3(-13)+PRPSPP3(-25)+PRPSPP3(-37)+PRPSPP3(-49))/4)	-0.200212	0.038619	-5.184222	0.0000
JAN	0.263282	0.903245	0.291484	0.7713
FEB	2.297266	0.903867	2.541599	0.0127
MAR	4.912234	0.848525	5.789143	0.0000
APR	6.832608	0.796266	8.580815	0.0000
MAY	7.800952	0.837680	9.312564	0.0000
JUN	6.971038	0.905575	7.697918	0.0000
JUL	6.376420	0.893881	7.133407	0.0000
AUG	5.738331	0.866328	6.623739	0.0000
SEP	6.084963	0.836702	7.272556	0.0000
OCT	4.647511	0.840763	5.527732	0.0000
NOV	3.355570	0.804945	4.168694	0.0001
PRPSP3BLD(-1)	0.318856	0.087156	3.658462	0.0004

R-squared	0.852763	Mean dependent var	0.128231
Adjusted R-squared	0.830598	S.D. dependent var	4.007980
S.E. of regression	1.649623	Akaike info criterion	3.967216
Sum squared resid	253.0767	Schwarz criterion	4.339734
Log likelihood	-199.2297	Hannan-Quinn criter.	4.118259
F-statistic	38.47387	Durbin-Watson stat	1.901988
Prob(F-statistic)	0.000000		

Regression 8. PRPSP4BLD, Propane Stock Change, PADD 4

Dependent Variable: PRPSP4BLD
Method: Least Squares
Date: 05/28/09 Time: 10:47
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.049814	0.015067	-3.306116	0.0014
(ZWHD_MTN-ZWHN_MTN)/ZSAJQUS	-0.004078	0.002128	-1.916469	0.0584
PRPSPP4(-1)-((PRPSPP4(-13)+PRPSPP4(-25)+PRPSPP4(-37)+PRPSPP4(-49))/4)	-0.158075	0.045498	-3.474352	0.0008
D0512	-0.125957	0.042399	-2.970773	0.0038
JAN	-0.031039	0.019354	-1.603816	0.1122
FEB	0.017344	0.019401	0.893981	0.3737
MAR	0.055515	0.019285	2.878746	0.0050
APR	0.054035	0.019368	2.789965	0.0064
MAY	0.122749	0.019320	6.353539	0.0000
JUN	0.098186	0.019280	5.092650	0.0000
JUL	0.098887	0.019287	5.127007	0.0000
AUG	0.099219	0.019289	5.143865	0.0000
SEP	0.111531	0.019275	5.786191	0.0000
OCT	0.099999	0.019298	5.181823	0.0000
NOV	0.024875	0.019330	1.286892	0.2014
D05ON+D0410+D0411+D0412	-0.036169	0.011961	-3.023777	0.0032

R-squared	0.678024	Mean dependent var	-0.001463
Adjusted R-squared	0.625528	S.D. dependent var	0.064800
S.E. of regression	0.039654	Akaike info criterion	-3.481309
Sum squared resid	0.144663	Schwarz criterion	-3.083956
Log likelihood	203.9907	Hannan-Quinn criter.	-3.320197
F-statistic	12.91573	Durbin-Watson stat	1.636476
Prob(F-statistic)	0.000000		

Regression 9. PRPSP5BLD, Propane Stock Change, PADD 5

Dependent Variable: PRPSP5BLD
Method: Least Squares
Date: 05/28/09 Time: 10:47
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.527113	0.047570	-11.08081	0.0000
ZWHD_PAC-ZWHN_PAC	-0.000921	0.000318	-2.892190	0.0048
PRPSPP5(-1)-((PRPSPP5(-13)+PRPSPP5(-25)+PRPSPP5(-37)+PRPSPP5(-49))/4)	-0.096759	0.040248	-2.404037	0.0182
JAN	-0.090211	0.066407	-1.358454	0.1776
FEB	0.113534	0.067102	1.691945	0.0940
MAR	0.370332	0.066561	5.563830	0.0000
APR	0.626977	0.066751	9.392782	0.0000
MAY	0.803396	0.066523	12.07699	0.0000
JUN	0.901206	0.066491	13.55376	0.0000
JUL	1.014958	0.066537	15.25407	0.0000
AUG	0.913913	0.066558	13.73113	0.0000
SEP	0.880036	0.066563	13.22109	0.0000
OCT	0.541242	0.066464	8.143440	0.0000
NOV	0.319937	0.066401	4.818279	0.0000
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	-0.062348	0.030477	-2.045737	0.0436

R-squared	0.890616	Mean dependent var	0.004417
Adjusted R-squared	0.874150	S.D. dependent var	0.397006
S.E. of regression	0.140839	Akaike info criterion	-0.954149
Sum squared resid	1.844720	Schwarz criterion	-0.581630
Log likelihood	66.52403	Hannan-Quinn criter.	-0.803106
F-statistic	54.08692	Durbin-Watson stat	1.660944
Prob(F-statistic)	0.000000		

Regression 10. PRPCUUS, Propane Wholesale Price

Dependent Variable: PRPCUUS
Method: Least Squares
Date: 05/28/09 Time: 10:46
Sample: 1998M01 2008M12
Included observations: 132

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.598301	9.746254	-0.677009	0.4998
100*RACPUUS/42	0.562711	0.066982	8.400986	0.0000
(100*RACPUUS/42)^2	-2.87E-05	0.000132	-0.217215	0.8285
NGHHUUS	1.439052	0.381110	3.775947	0.0003
PRPCUUS(-1)-100*RACPUUS(-1)/42	0.387197	0.043495	8.902036	0.0000
PRPCUUS(-1)-9.1*NGHHUUS(-1)	0.082360	0.043193	1.906789	0.0592
PRPSPUS(-1)-(PRPSPUS(-13)+PRPSPUS(-25)+PRPSPUS(-37)+PRPSPUS(-49))/4	-0.118634	0.055464	-2.138940	0.0347
ZO28IUS	0.113437	0.118629	0.956233	0.3411
D0101	15.42021	3.830899	4.025220	0.0001
D0401	8.044069	3.648445	2.204794	0.0296
D0506+D0507+D0508	-5.304758	2.226595	-2.382453	0.0189
D0609	6.633804	3.786156	1.752121	0.0826
JAN	-0.942447	1.620915	-0.581429	0.5622
FEB	-1.908407	1.509274	-1.264454	0.2088
MAR	-2.579685	1.541505	-1.673485	0.0971
APR	-2.317343	1.530234	-1.514371	0.1329
MAY	-2.566079	1.564067	-1.640645	0.1038
JUN	-1.870482	1.575609	-1.187149	0.2378
JUL	-0.982251	1.655905	-0.593181	0.5543
AUG	0.603508	1.604712	0.376085	0.7076
SEP	0.750575	1.616641	0.464281	0.6434
OCT	0.352210	1.499564	0.234875	0.8148
NOV	0.286319	1.498355	0.191089	0.8488
PRPCUUS(-1)	0.189725	0.046420	4.087137	0.0001

R-squared	0.993362	Mean dependent var	71.06364
Adjusted R-squared	0.991948	S.D. dependent var	38.17810
S.E. of regression	3.425751	Akaike info criterion	5.463484
Sum squared resid	1267.463	Schwarz criterion	5.987630
Log likelihood	-336.5900	Hannan-Quinn criter.	5.676473
F-statistic	702.6967	Durbin-Watson stat	1.464986
Prob(F-statistic)	0.000000		

Regression 11. PRRCUNE-PRPCUUS, Propane Price Spread, Northeast Region

Dependent Variable: (PRRCUNE-PRPCUUS)/(GDPDIUS/100)
Method: Least Squares
Date: 05/28/09 Time: 10:47
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	19.68241	3.531938	5.572695	0.0000
PRPCUUS-PRPCUUS(-1)	-0.460746	0.035141	-13.11124	0.0000
PRPSPP1(-1)-(PRPSPP1(-13)+PRPSPP1(-25)+PRPSPP1(-37)+PRPSPP1(-49))/4	-0.699079	0.371297	-1.882805	0.0631
((QHLP_MAC*(ZWHD_MAC-ZWHN_MAC)/ZSAJQUS)+(QHLP_NEC*(ZWHD_NEC-ZWHN_NEC)/ZSAJQUS))/(QHLP_MAC+QHLP_NEC)	0.092518	0.096313	0.960603	0.3394
D0303	13.95753	2.719187	5.132978	0.0000
D0509	4.109056	2.768345	1.484301	0.1413
D06ON	3.525583	0.927086	3.802863	0.0003
JAN	2.681786	1.201134	2.232712	0.0281
FEB	3.226842	1.201820	2.684962	0.0087
MAR	0.770062	1.212679	0.635009	0.5271
APR	1.229953	1.174092	1.047578	0.2977
MAY	3.345810	1.173317	2.851583	0.0054
JUN	3.005578	1.177311	2.552918	0.0124
JUL	2.029692	1.174997	1.727402	0.0876
AUG	-0.276307	1.168660	-0.236431	0.8137
SEP	0.964572	1.217080	0.792529	0.4302
OCT	1.401433	1.170500	1.197294	0.2344
NOV	0.291050	1.170238	0.248710	0.8042
(PRRCUNE(-1)-PRPCUUS(-1))/(GDPDIUS(-1)/100)	0.777745	0.035603	21.84493	0.0000
D05ON+D0410+D0411+D0412	-0.000762	0.839690	-0.000907	0.9993
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	-1.215894	0.685546	-1.773615	0.0796

R-squared	0.965662	Mean dependent var	97.10528
Adjusted R-squared	0.957768	S.D. dependent var	12.00109
S.E. of regression	2.466263	Akaike info criterion	4.815951
Sum squared resid	529.1732	Schwarz criterion	5.337476
Log likelihood	-239.0613	Hannan-Quinn criter.	5.027410
F-statistic	122.3325	Durbin-Watson stat	1.525143
Prob(F-statistic)	0.000000		

Regression 12. PRRCUSO-PRPCUUS, Propane Price Spread, South Region

Dependent Variable: (PRRCUSO-PRPCUUS)/(GDPDIUS/100)
Method: Least Squares
Date: 05/28/09 Time: 10:47
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.59825	2.490995	6.663298	0.0000
PRPCUUS-PRPCUUS(-1)	-0.497138	0.030291	-16.41215	0.0000
PRPSPP1(-1)-(PRPSPP1(-13)+PRPSPP1(-25)+PRPSPP1(-37)+PRPSPP1(-49))/4	-0.514251	0.344115	-1.494415	0.1388
((QHLP_ESC*(ZWHD_ESC-ZWHN_ESC)/ZSAJQUS)+(QHLP_WSC*(ZWHD_WSC-ZWHN_WSC)/ZSAJQUS)+(QHLP_SAC*(ZWHD_SAC-ZWHN_SAC)/ZSAJQUS))/(QHLP_ESC+QHLP_WSC+QHLP_SAC)	-0.022669	0.141481	-0.160225	0.8731
D0012+D0101	18.00814	1.908749	9.434527	0.0000
D0102+D0103	-9.204498	1.808615	-5.089253	0.0000
D0111	-5.909631	2.420670	-2.441320	0.0167
D0303	9.565897	2.423290	3.947483	0.0002
D0711	8.247141	2.407598	3.425464	0.0009
JAN	2.004504	1.062658	1.886311	0.0627
FEB	1.571489	1.080807	1.453995	0.1496
MAR	-2.805809	1.122165	-2.500353	0.0143
APR	-3.696227	1.066529	-3.465659	0.0008
MAY	-3.744907	1.057239	-3.542158	0.0006
JUN	-5.059655	1.057887	-4.782795	0.0000
JUL	-6.433239	1.066893	-6.029884	0.0000
AUG	-7.155559	1.098128	-6.516141	0.0000
SEP	-0.213573	1.134816	-0.188200	0.8512
OCT	1.549628	1.112050	1.393488	0.1671
NOV	0.721948	1.133663	0.636827	0.5259
(PRRCUSO(-1)-PRPCUUS(-1))/(GDPDIUS(-1)/100)	0.803646	0.030315	26.50963	0.0000
D05ON+D0410+D0411+D0412	2.813604	0.657259	4.280812	0.0000
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	0.717488	0.637741	1.125047	0.2637

R-squared	0.976816	Mean dependent var	80.75644
Adjusted R-squared	0.970816	S.D. dependent var	12.78189
S.E. of regression	2.183571	Akaike info criterion	4.586246
Sum squared resid	405.2784	Schwarz criterion	5.157441
Log likelihood	-224.6573	Hannan-Quinn criter.	4.817845
F-statistic	162.7908	Durbin-Watson stat	1.406621
Prob(F-statistic)	0.000000		

Regression 13. PRRCUMW-PRPCUUS, Propane Price Spread, Midwest Region

Dependent Variable: (PRRCUMW-PRPCUUS)/(GDPDIUS/100)
Method: Least Squares
Date: 05/28/09 Time: 10:47
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.453280	1.605528	5.265108	0.0000
PRPCUUS-PRPCUUS(-1)	-0.553213	0.026301	-21.03419	0.0000
PRPSPP2(-1)-(PRPSPP2(-13)+PRPSPP2(-25)+PRPSPP2(-37)+PRPSPP2(-49))/4	-0.006079	0.078973	-0.076979	0.9388
((QHLP_ENC*(ZWHD_ENC-ZWHN_ENC)/ZSAJQUS)+(QHLP_WNC*(ZWHD_WNC-ZWHN_WNC)/ZSAJQUS))/(QHLP_ENC+QHLP_WNC)	0.009937	0.071594	0.138790	0.8899
D0009	7.094986	2.235915	3.173191	0.0021
D0012+D0101	9.044265	1.703163	5.310275	0.0000
JAN	-0.649669	1.000939	-0.649059	0.5180
FEB	-0.840506	0.999338	-0.841063	0.4026
MAR	-2.999908	0.986574	-3.040732	0.0031
APR	-3.920650	0.988823	-3.964966	0.0001
MAY	-2.707450	0.990385	-2.733735	0.0076
JUN	-5.984526	0.992453	-6.030037	0.0000
JUL	-5.401951	1.007068	-5.364038	0.0000
AUG	-3.775806	1.024358	-3.686021	0.0004
SEP	-2.022355	1.053087	-1.920406	0.0580
OCT	-0.789729	1.016714	-0.776746	0.4394
NOV	1.346863	1.001379	1.345009	0.1821
(PRRCUMW(-1)-PRPCUUS(-1))/(GDPDIUS/100)	0.865604	0.024957	34.68384	0.0000
D05ON+D0410+D0411+D0412	1.732237	0.566645	3.057007	0.0030
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	0.419352	0.603121	0.695303	0.4887

R-squared	0.974698	Mean dependent var	48.39243
Adjusted R-squared	0.969235	S.D. dependent var	11.67753
S.E. of regression	2.048236	Akaike info criterion	4.437411
Sum squared resid	369.1839	Schwarz criterion	4.934102
Log likelihood	-219.6202	Hannan-Quinn criter.	4.638801
F-statistic	178.4195	Durbin-Watson stat	1.702567
Prob(F-statistic)	0.000000		

Regression 14. PRRCUWE-PRPCUUS, Propane Price Spread, West Region

Dependent Variable: (PRRCUWE-PRPCUUS)/(GDPDIUS/100)
Method: Least Squares
Date: 05/28/09 Time: 10:47
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	21.77818	2.604012	8.363319	0.0000
PRPCUUS-PRPCUUS(-1)	-0.493996	0.031097	-15.88543	0.0000
PRPSPP5(-1)-(PRPSPP5(-13)+PRPSPP5(-25)+PRPSPP5(-37)+PRPSPP5(-49))/4	1.045357	0.733670	1.424833	0.1578
((QHLP_MTN*(ZWHD_MTN-ZWHN_MTN)/ZSAJQUS)+(QHLP_PAC*(ZWHD_PAC-ZWHN_PAC)/ZSAJQUS))/(QHLP_MTN+QHLP_PAC)	0.362499	0.164940	2.197768	0.0306
D0012	15.20708	2.710882	5.609644	0.0000
D0203	-10.16377	2.777674	-3.659095	0.0004
D0303	10.21958	2.697094	3.789108	0.0003
JAN	1.365502	1.207382	1.130961	0.2612
FEB	-0.998426	1.212469	-0.823465	0.4125
MAR	-3.156553	1.292012	-2.443130	0.0166
APR	-5.747528	1.199834	-4.790269	0.0000
MAY	-5.687379	1.208395	-4.706558	0.0000
JUN	-8.476396	1.223310	-6.929067	0.0000
JUL	-10.59653	1.267858	-8.357819	0.0000
AUG	-7.444071	1.342237	-5.546019	0.0000
SEP	-0.853387	1.354053	-0.630246	0.5302
OCT	1.778081	1.293257	1.374886	0.1727
NOV	0.568169	1.218399	0.466324	0.6421
(PRRCUWE(-1)-PRPCUUS(-1))/(GDPDIUS(-1)/100)	0.741856	0.030808	24.07993	0.0000
D05ON+D0410+D0411+D0412	2.915128	0.656724	4.438892	0.0000
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	0.617871	0.685116	0.901849	0.3696

R-squared	0.970746	Mean dependent var	75.20767
Adjusted R-squared	0.964021	S.D. dependent var	12.93204
S.E. of regression	2.452967	Akaike info criterion	4.805139
Sum squared resid	523.4829	Schwarz criterion	5.326665
Log likelihood	-238.4775	Hannan-Quinn criter.	5.016599
F-statistic	144.3479	Durbin-Watson stat	1.945915
Prob(F-statistic)	0.000000		