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Energy Information Administration

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Short-Term Energy Outlook Model Documentation:
Regional Residential Heating Oil Price Model

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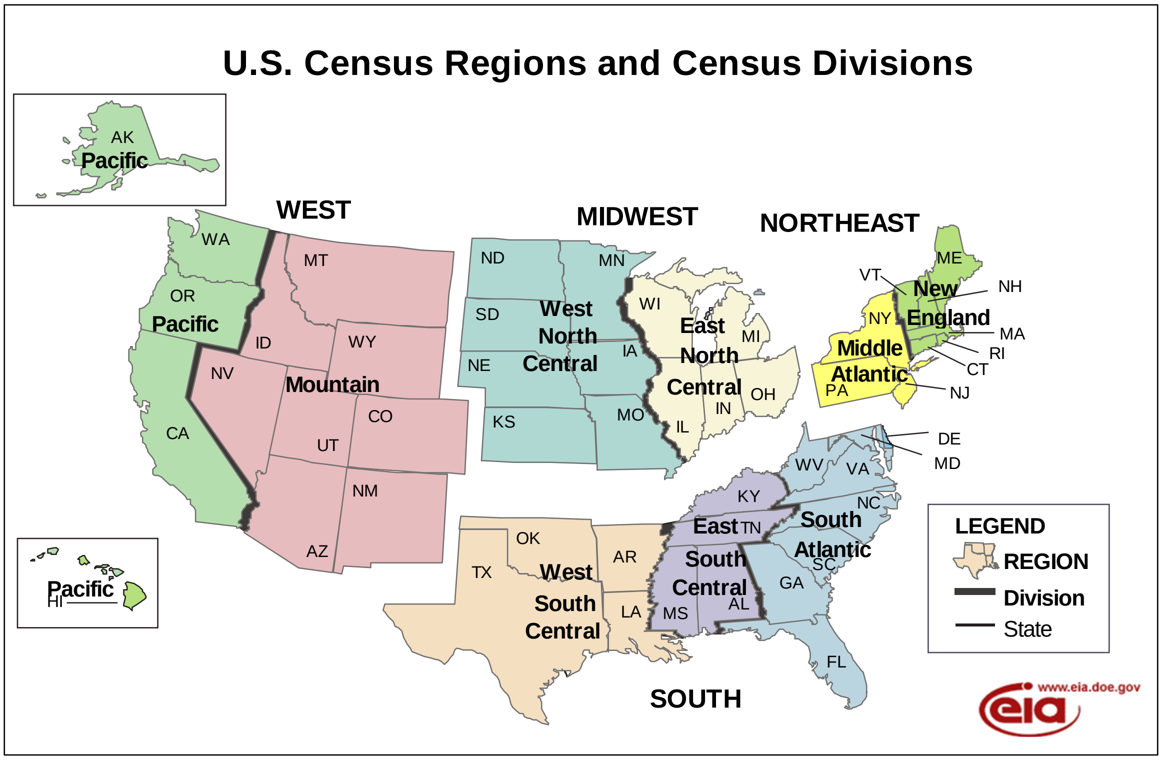
1. Overview of the Short-Term Heating Oil Model

The regional residential heating oil 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).

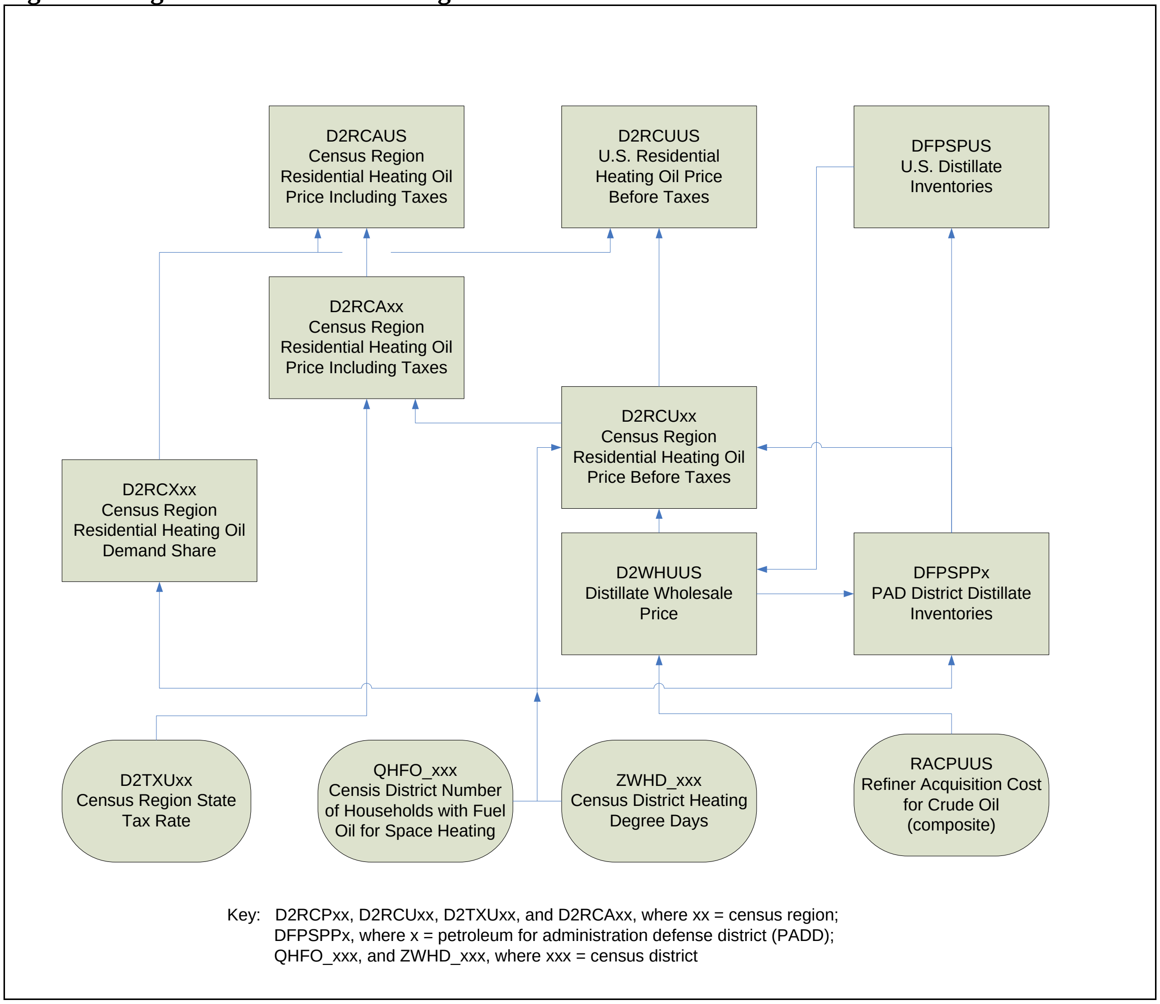
Figure 1. U.S. Census Regions and Census Divisions



The *STEO* model contains over 2,300 equations, of which about 450 are estimated regression equations. The regional residential heating oil 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 heating oil prices are estimated as a function of the heating oil wholesale price, regional stocks, and weather (Figure 2). Regional residential heating oil prices are aggregated to the U.S. level by weighting regional prices by estimated regional consumption shares.

Figure 2. Regional Residential Heating Oil Model



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

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

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

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

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

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

where,

f(.) = general linear function,

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

N_{jt} = distillate fuel oil inventory in Petroleum Administration for Defense District (PADD) *j* at end-of-month *t*, deviation from previous 4-year average,

P_t^r = average U.S. residential heating oil retail price during month *t*,

$P_{i,t}^r$ = average residential heating oil retail price in region *i* during month *t*,

P_t^w = average U.S. heating oil wholesale during month *t*,

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

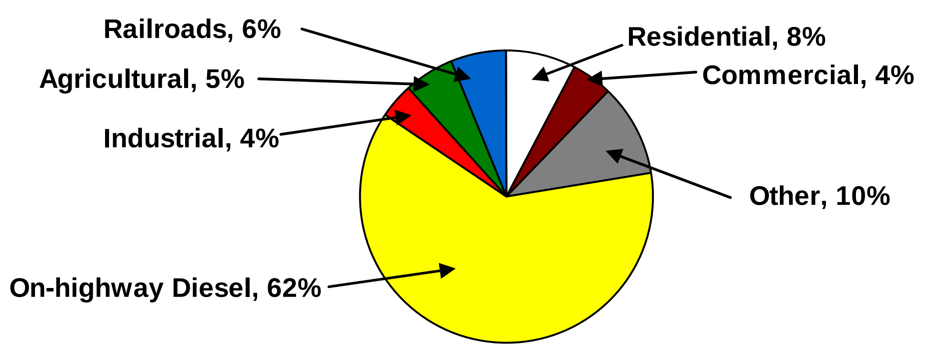
$S_{i,t}$ = region *i* share of U.S homes that use heating oil as primary space heating fuel during month *t*,

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

2. Overview of Residential Heating Oil Market

Distillate fuel oil is consumed in several different sectors, including on-highway transportation, residential, commercial, industrial, and agricultural (Figure 3). Other sectors, which account for the remainder of the distillate fuel consumption, include off-highway diesel, railroad, vessel bunkering, electric power, and oil company use.

Figure 3. Distillate Fuel Oil End-User Market Shares, 2007.



Source: Energy Information Administration, *Fuel Oil and Kerosene Sales 2007*, Table 13.

Distillate fuel oil is a general classification for one of the petroleum fractions produced in crude oil distillation operations. First, distillate fuel is classified as No. 1, No. 2, or No. 4 fuel oil where the higher number denotes a heavier or more viscous liquid. Heating oil used in the residential sector is primarily No. 2 distillate fuel oil (about 1.5 percent is No. 1 fuel oil). Second, distillate fuel is classified as diesel fuel or fuel oil. The most significant distinction between diesel fuel and fuel oil is that diesel fuel has a maximum allowed sulfur level as low as 15 parts per million while fuel oil has a maximum allowed sulfur level as high as 5,000 parts per million. Consequently, diesel fuel can be used as fuel oil but fuel oil generally cannot be used as diesel fuel. Heating oil used in the residential sector is fuel oil that has the higher sulfur limit.

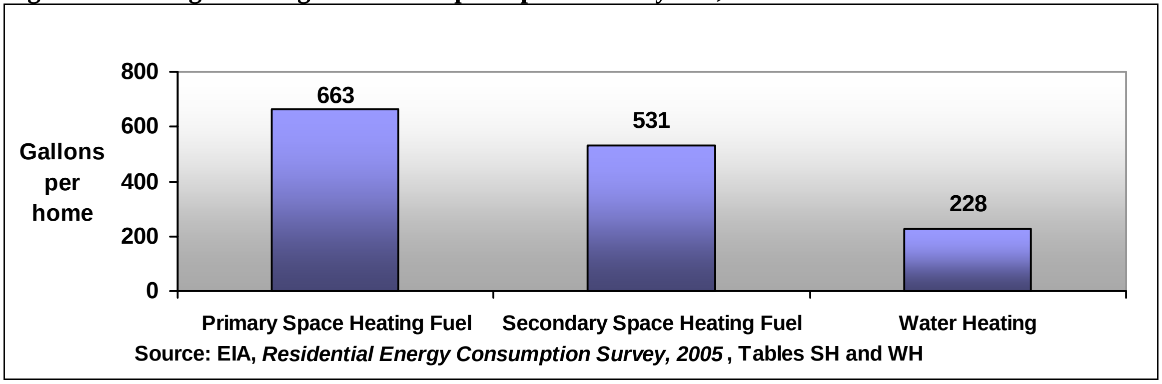
Heating oil ranks as the third most important source of residential energy in the Nation, with about 7.5 percent of all households using heating oil as their primary space heating fuel (U.S. Census Bureau, *2007 American Community Survey*).

Heating oil has two primary uses in the residential sector: space heating and water heating. Space heating makes up about 84 percent of total residential heating oil consumption with water heating making up the balance (EIA, *2005 Residential Energy Consumption Survey*, Tables US4, SH4).

Households that consume heating oil for space heating are further broken down by whether they consume heating oil as the primary or secondary space heating fuel. Homes that use heating oil as the primary space heating fuel consumed on average 663 gallons in

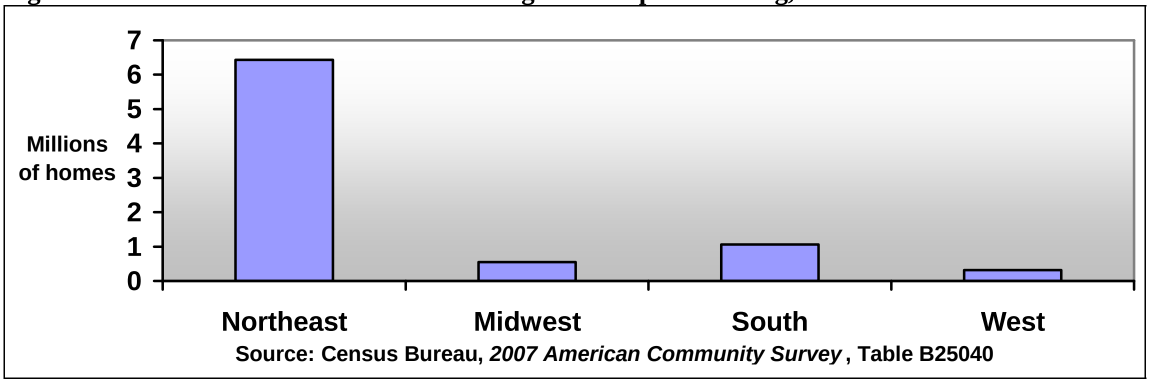
2005 (Figure 4). Consumption as the secondary space heating fuel averaged 531 gallons per home in 2005, and consumption for water heating averaged 228 gallons per home.

Figure 4. Average Heating Oil Consumption per Home by Use, 2005.



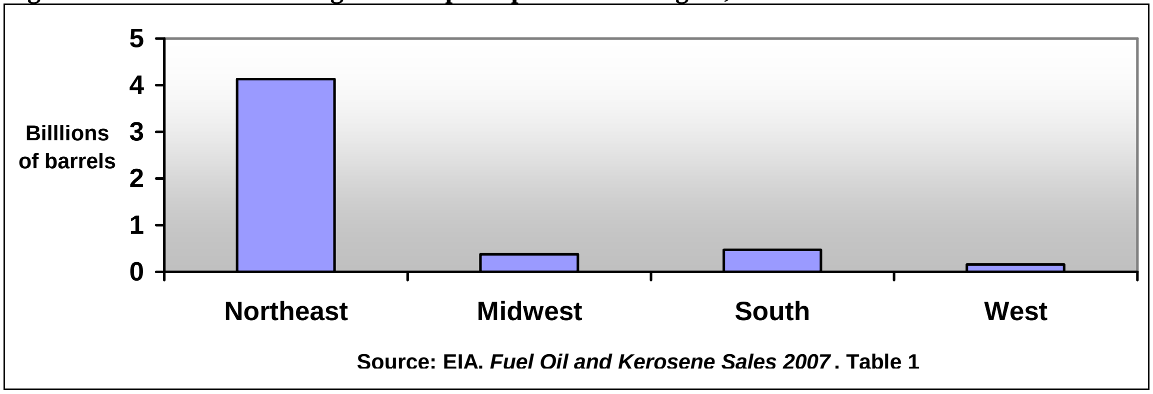
The Northeast is the largest regional residential market share for heating oil with 6.43 million homes in 2007, about 31 percent of all homes in the region, using heating oil as their primary space heating fuel (Figure 5). Market shares in the other regions are much smaller, ranging from 2.6 percent in the South down to 1.3 percent in the West in 2007. The number of homes by census division are provided in Appendix A.

Figure 5. Number of Homes That Use Heating Oil for Space Heating, 2007.



Total residential sector heating oil consumption is greatest in the Northeast because of the greater number of homes using heating oil for space heating in colder weather (Figure 6).

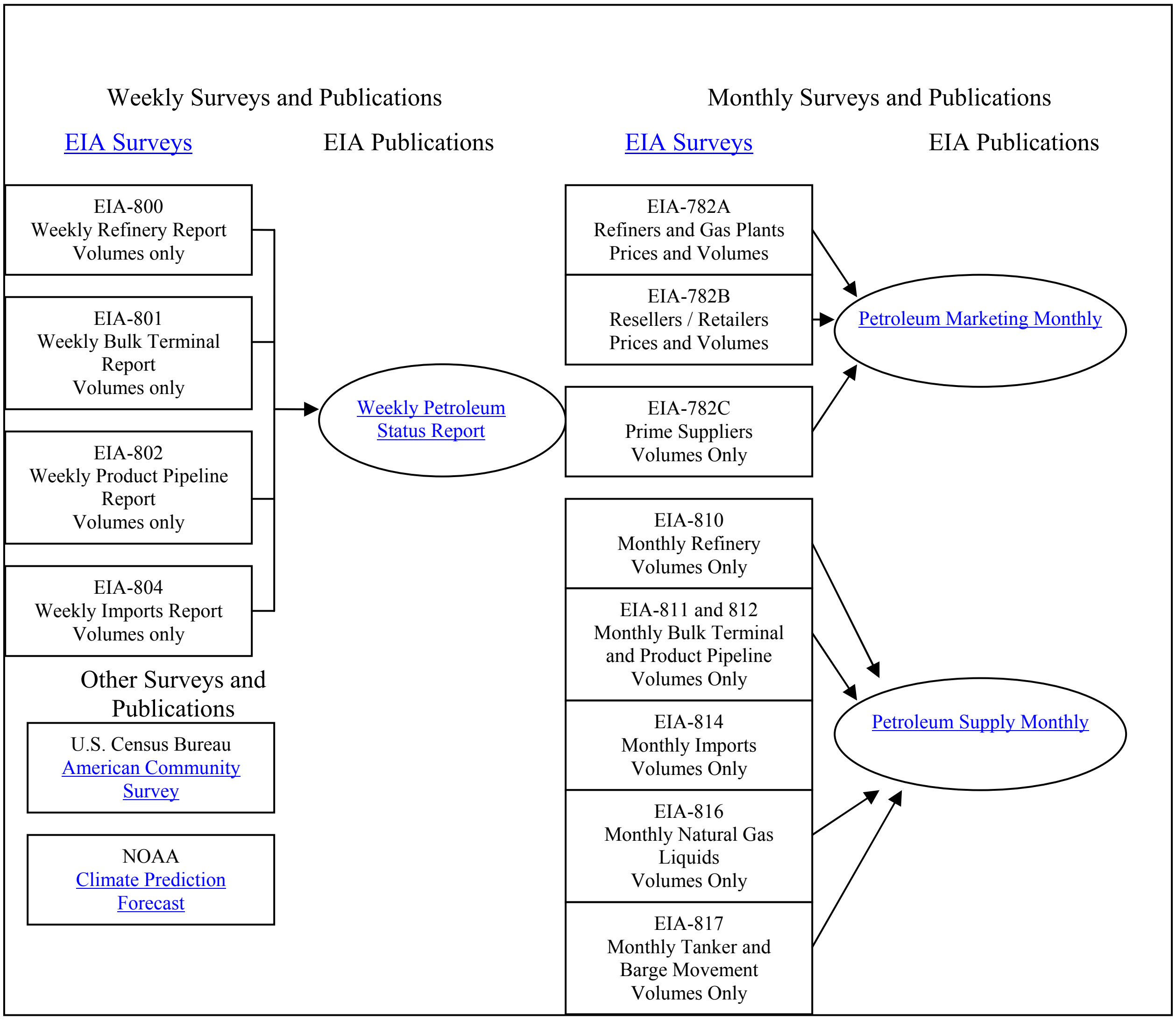
Figure 6. Residential Heating Consumption per Census Region, 2007.



3. Data Sources

The monthly volume and price data used in the regional heating oil model appear in two EIA publications: the *Petroleum Supply Monthly* (*PSM*) and *Petroleum Marketing Monthly* (*PMM*) (Figure 7). Weekly regional inventory data published in the *Weekly Petroleum Status Report* (*WPSR*) are used for the most recent two months where monthly data is not yet available.

Figure 7. EIA Heating Oil Surveys and Data Publications



The *PSM* includes volume data from surveys of primary suppliers such as refineries, 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 demand balance for residential heating oil. A U.S. supply-demand balance for distillate fuel is produced separately in the *STEO* model.

The average U.S. distillate (No. 2 fuel oil) wholesale price is published in the *PMM* Table 4. The census region residential heating oil retail prices are derived from State residential prices reported to EIA in the EIA-782A and 782B surveys and published in Table 35 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.

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

The number of households that burn heating oil 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 heating oil 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 forecasts of population-weighted regional heating degree-days up to 14 months out. 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	D2	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, D2RCUNE is the identifying code for heating oil (D2) 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:

DF = distillate fuel, including diesel fuel and heating oil
DS = diesel fuel
D2 = heating oil
QH = number of households
ZW = weather

Energy activity or consumption end-use sectors:

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

Type of data:

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

- The physical units for petroleum data series in the Short Term Integrated Forecast System (STIFS), 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

Dummy Variables:

Many equations include monthly dummy variables to capture the normal seasonality in the data series. For example, JAN equals 1 for every January in the time series and is equal to 0 in every other month.

Dummy variables for specific months 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).

Dummy variables for specific years are designated Dyy, where yy = the last two digits of the year. Thus a dummy variable for all months of 2002 would be D02 (i.e., D02= 1 if January through December 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.

5. Residential Heating Oil 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 is no published monthly data series for regional residential heating oil consumption. EIA does obtain volume data on residential heating oil sales in the monthly EIA-782A and 782B surveys but does not publish this volume data. The 782A and 782B surveys are designed to calculate State and regional average prices and are not designed or maintained to produce consistent or representative State consumption volumes.[1]

For the regional residential heating oil price model, 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 in 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 residential heating oil 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).

[1] Annual residential sector heating oil consumption is published in EIA's *Fuel Oil and Kerosene Sales* annual report.

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 residential heating oil price module includes residential sector heating oil consumption shares for the four census regions. The census region residential heating oil consumption share equations (EQ 6) are estimated as linear functions of regional heating degree-day deviations from normal, the region's share of U.S. households that consume heating oil 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.

$$
\begin{aligned}
D2RCXxx = \ & a_0 + a_1 \left\{ \begin{bmatrix} (QHFO\_xxx\,(ZWHD\_xxx - ZWHN\_xxx)/ZSAJQUS) + \\ (QHFO\_yyy\,(ZWHD\_yyy - ZWHN\_yyy)/ZSAJQUS) \end{bmatrix} / \atop (QHFO\_xxx + QHFO\_yyy) \right\} \\
+ \ & a_2 \left\{ \begin{bmatrix} (QHFO\_xxx(-1)(ZWHD\_xxx(-1) - ZWHN\_xxx(-1))/ZSAJQUS(-1)) \\ +(QHFO\_yyy(-1)(ZWHD\_yyy(-1) - ZWHN\_yyy(-1))/ZSAJQUS(-1)) \end{bmatrix} / \atop (QHFO\_xxx(-1) + QHFO\_yyy(-1)) \right\} \qquad \text{(EQ 6)} \\
+ \ & a_3\, D2RCXxx\_SF\,(QHFO\_xxx + QHFO\_yyy)/QHFO\_US \\
+ \ & a_4\, D2RCXxx(-1) + \sum_{i=5}^{15} a_i\, D_i
\end{aligned}
$$

where,

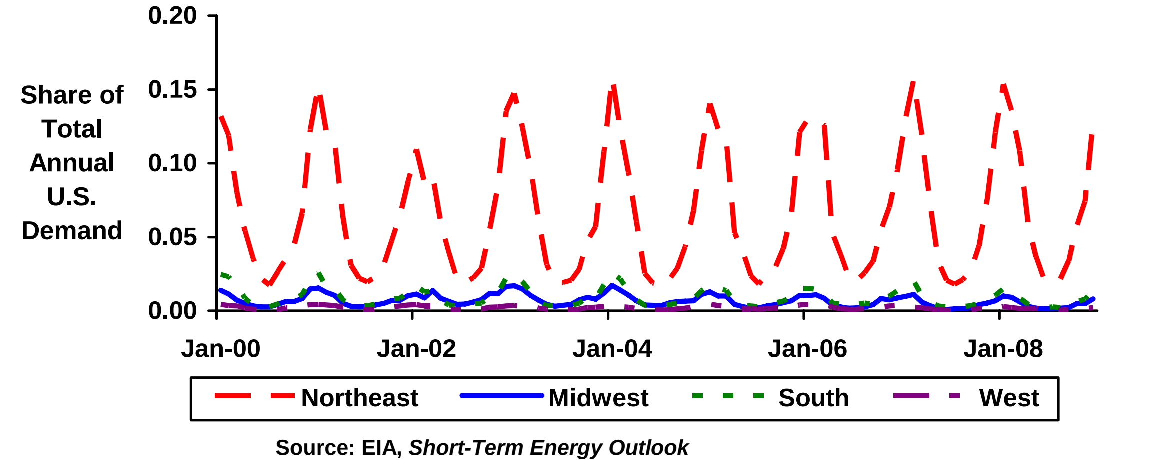
> D2RCX*xx* = monthly consumption in census region *xx* as a share of total annual U.S. consumption,
> D2RCX*xx*(-1) = dependent variable lagged one month,
> D2RCX*xx*_SF = seasonal factor for census region *xx* derived from Census X-11,
> ZWHD_*xxx* = total heating degree days in census division *xxx*,
> ZWHN_*xxx* = normal heating degree days in census division *xxx*, and
> ZSAJQUS = number of days in the month,
> QHFO_*xxx* = number of homes in census division *xxx* that use heating oil as the primary space heating fuel.
> QHFO_US = number of homes nationwide that use heating oil as primary space heating fuel
> D_i = monthly dummy variables for January through November.

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

1. Weather

Heating oil consumption in the residential sector is highly seasonal because of the weather-related space heating demand. Fuel consumption for space heating rises during the winter months and falls during the spring and summer. Consequently, monthly heating oil consumption as a share of total annual U.S. consumption is also highly seasonal as shown in Figure 8.

Figure 8. Heating Oil Consumption Shares by Census Region, 2000 – 2008.



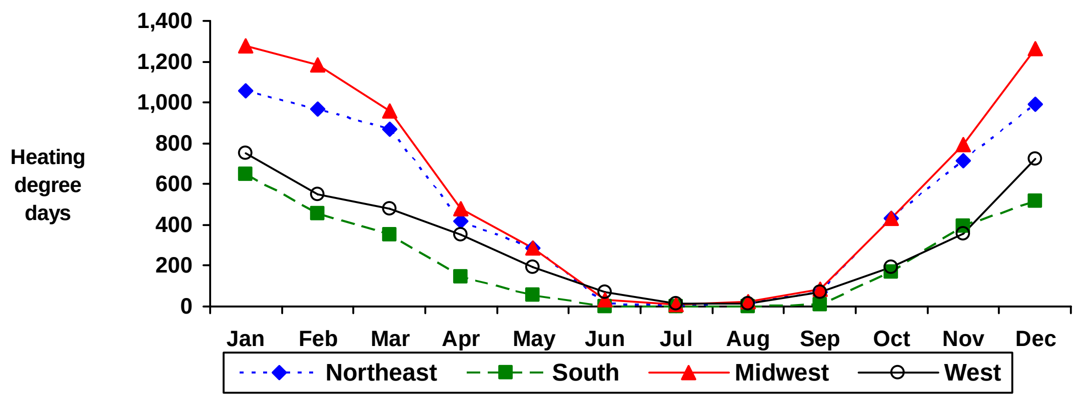
Heating degree-days is a useful indicator of the energy required for space heating. When the daily mean temperature is below 65 degrees F, most buildings require heat to maintain inside temperatures of 70 degrees. Heating degree-days are calculated by subtracting the daily mean temperature (the average 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 heating oil as the primary space heating fuel in each district. An example calculation of the heating oil-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 9.

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

Census District	Heating degree days		Number of homes with heating oil space heat (millions)		
New England	1110	x	2.536	=	2815.0
Middle Atlantic	976	x	3.932	=	3837.6
			6.468		6652.6
Divided by total number of homes				÷	6.468
Northeast census region Heating Oil-Weighted heating degree days				=	1029

Figure 9. Heating Degree Days by Census Region, 2008.



Source: EIA, *Short-Term Energy Outlook*

The residential heating oil consumption share equations include heating degree-day deviations from normal for both the current month and the previous month. If a region is colder than normal then we expect the consumption share for that region to be larger. Some of the residential demand impact of a cold month may not show up until the following month as residences get their heating oil 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 heating oil as the primary space heating fuel divided by the total number of homes in the United States that use heating oil. 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 residential heating oil 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 U.S. homes using heating oil as the primary space heating fuel as reported by the 2005 RECS has a 90-percent confidence interval around the estimate of plus or minus 1.55 million homes (20 percent). In contrast, the 90-percent confidence interval around the 2005 ACS estimate was plus or minus 0.04 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 heating oil as the primary space heating fuel ranges from plus or minus 24 percent in the Northeast to 70 percent in the South for the 2005 RECS. The same confidence intervals in the 2005 ACS are 0.5 percent and 1.2 percent, respectively.

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.

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

Survey	Number of Homes (millions)	90 Percent Confidence Interval
RECS	7.6	± 1.55 (20.4 percent)
ACS	8.9	± 0.04 (0.5 percent)

Note: RECS 90 percent confidence interval based on +/- 1.645 times the standard error.
Source: 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 heating oil 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 quadratic 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 monthly dummy variables for each individual month except December. 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 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 the different sample frames.

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 heating oil consumption shares are used to calculate monthly U.S. average prices and regional and U.S. quarterly and annual price averages. The historical regional heating oil 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 = *region i consumption in month 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

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

Distillate storage consists of three types: primary, secondary, and tertiary. Primary storage consists of refinery, pipeline, and bulk terminal stocks. Secondary storage consists primarily of large above ground tanks owned by heating oil retail distributors, while tertiary storage consists mainly of residential and commercial customers. Inventory survey data are available only at the primary storage level.

B. Regional Inventory Equations

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

The five PADD inventory series were tested for the presence of a unit root. A unit root was present in the distillate stock levels in PADD 4 (Mountain region). 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 demand.

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

where,

DFPSP*x*BLD = Inventory change (end of current month – end of previous month) in PADD *x*, million barrels,
DFPSPP*x* = distillate end-of-month inventory in PADD *x*, million barrels,
DFPSPP*x*(average) = prior 4-year average, [DFPSPP*x*(-1) + DFPSPP*x*(-13)+ DFPSPP*x*(-25)+DFPSPP*x*(-37)]/4, million barrels
ZWHD_*xxx* = total heating degree days in census division *xxx*,
ZWHN_*xxx* = normal heating degree days in census division *xxx*, and
ZSAJQUS = number of days in the month,
QHFO_*xxx* = number of homes in census division *xxx* that use heating oil as the primary space heating fuel.
QHFO_US = number of homes nationwide that use heating oil as primary space heating fuel
D_i = monthly dummy variables for January through November.

1. 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. In PADDs 2 through 5 a beginning-of-month inventory that is 1 million barrels above the previous four-year average reduces the month's normal stock change by 0.21 to 0.39 million barrels. The PADD 1 stock change response was much smaller at about 0.06 million barrels.

2. Weather

The distillate 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 divisions and PAD Districts is provided in Appendix A.

PAD District	Census Division
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 in PADDs 1, 2, and 3 are weighted by the number of households within each division that use heating oil 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, at least in PADD 1 (the Northeast). Cold weather may not have significant effects outside the Northeast because of the small market shares for space heating. The equations include heating degree-day deviations from normal for both the current month and the previous month. Some of the impact of a cold month may not show up until the following month as residences get their heating oil tanks refilled.

The estimated coefficients for both current and lagged weather are negative as expected and statistically significant in PADDs 1 and 2. Coefficients are insignificant in the other PADDs.

3. Dummy Variables

Dummy variables are included to reflect the seasonality in heating oil consumption shares 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 with December as the base case. 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 PADD 1 where the average stock change (relative to December) ranges from a 6 million barrel build in July to a 7 million barrel draw in January (the estimated coefficient is added to the regression equation's estimated constant term). The seasonality in stocks is much less pronounced in the other PADDs because of the smaller heating market shares.

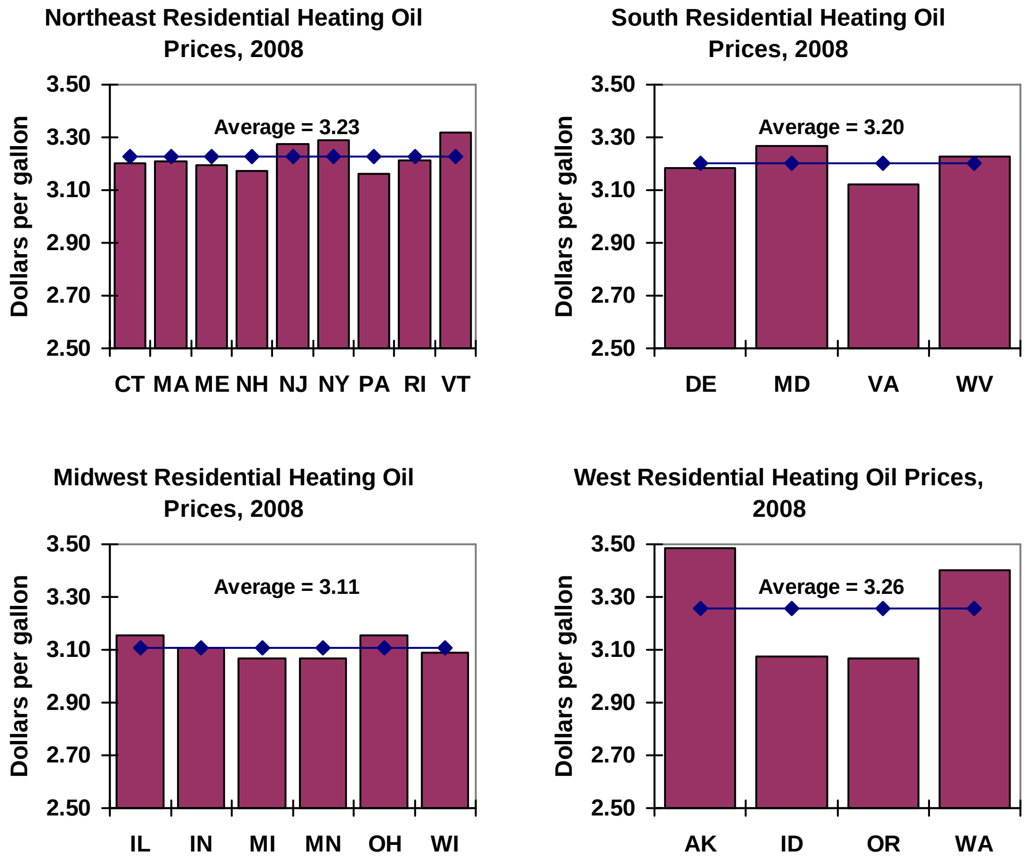
The second group of dummy variables control for nonrecurring events. Dummy variables are included for those months in which the absolute value of the estimated regression error was greater than 2 times the standard error of the regression (the standard error of the regression is a summary measure based 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. Heating Oil Prices

A. Introduction

Residential heating oil retail prices (excluding taxes) are variable within and across regions (Figure 10).

Figure 10. Regional Residential Heating Oil Prices, 2008.



Source: EIA, *Petroleum Marketing Monthly*, Table 35.

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

Unit roots were found in every price time series. The price series were transformed to stationary series by calculating price spreads. The left-hand side (dependent) variable in the distillate wholesale price equation is the difference between the average U.S. distillate wholesale price and the refiner average acquisition cost of crude oil (in cents per gallon).

For regional retail prices the dependent variable is the difference between the census region residential heating oil retail price and the average U.S. distillate wholesale price.

B. Distillate Wholesale Price

Since heating oil is a product of crude oil refining we assume the wholesale price is directly related to the spot price of crude oil. There are many measures of crude oil prices because of the many different grades of crude oil. The refiner average acquisition cost was selected as the crude oil price that is most strongly related to distillate prices.[2]

The difference between the average U.S. distillate wholesale price and the average cost of crude oil (converted from dollars per barrel to cents per gallon) is estimated as a function of the change in the cost of crude oil, weather, and inventories (EQ 13).

$$
\begin{aligned}
D2WHUUS - 100 * RACPUUS / 42 = {} & a_0 + a_1(RACPUUS - RACPUUS(-1)) \\
& + a_2 \left\{ \begin{array}{l} \left[\begin{array}{l} QHFO\_xxx(ZWHD\_xxx - ZWHN\_xxx)/ZSAJQUS + \\ QHFO\_yyy(ZWHD\_yyy - ZWHN\_yyy)/ZSAJQUS \end{array} \right] \\ /(QHFO\_US) \end{array} \right\} \\
& + a_3[DFPSPPx(-1) - DFPSPPx(average)] \\
& + a_4(D2WHUUS(-1) - 100 * RACPUUS(-1)/42) \\
& + \sum_{i=5}^{15} a_i D_i
\end{aligned}
\qquad \text{(EQ 13)}
$$

where,

D2WHUUS = average U.S. distillate wholesale price
RACPUUS = Refiner average acquisition cost of crude oil
ZWHD_*xxx* = total heating degree days in census division *xx*,
ZWHN_*xxx* = normal heating degree days in census division *xx*, and
ZSAJQUS = number of days in the month,
QHFO_xxx = number of homes in census division *xxx* that use heating oil as the primary space heating fuel
QHFO_US = number of homes nationwide that use heating oil as primary space heating fuel
DFPSPP*x* = distillate end-of-month inventory in PADD *x*, million barrels,
DFPSPP*x*(average) = prior 4-year average, [DFPSPP*x*(-13) + DFPSPP*x*(-25)+ DFPSPP*x*(-37)+DFPSPP*x*(-49)]/4, million barrels, and
D_i = monthly dummy variables for January through November.

---

[2] This assumption was tested in estimation of alternative models with different model structural specifications and different crude oil prices, such as the West Texas Intermediate (WTI) crude oil spot price.

1. Crude Oil Price Change

The change in the refiner acquisition cost of crude oil from the previous month is included. A change in the crude oil price is expected to feed forward to distillate wholesale prices, possibly with a short lag. Including the difference in the current and prior-month crude oil price as an explanatory variable allows for some delay in the price pass through.

2. Weather

The deviation in heating degree-days from normal is an additional mechanism for recognizing the price impact of demand shocks from cold weather. Colder weather is expected to increase consumption of heating oil thereby raising the wholesale – crude oil price spread. The estimated coefficient is positive as expected and statistically significant.

3. U.S. Inventories

The beginning of month (end of prior month) total U.S. distillate 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 distillate wholesale price. The estimated regression equation coefficient is not currently significant but is left in the model for further tracking and study.

4. Dummy Variables

Dummy variables are included to reflect the seasonality in distillate wholesale prices not captured by seasonality in the other variables and to eliminate the effects of certain events that are considered outliers in the data series.

The regression results for the monthly dummy variables generally conform to expectations with the wholesale-crude oil price spread lowest in the summer months and peaking near the start of the heating season. The observed seasonality in price provides an incentive for firms to build and hold heating oil inventories during the summer months for delivery during the winter heating season.

The second group of dummy variables control for nonrecurring events. 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 Heating Oil Prices Before State Taxes

The regional *STEO* model for residential heating oil includes residential sector heating oil retail prices for the four census regions. The difference between the census region residential heating oil retail price and the distillate wholesale price is estimated as a function of the distillate wholesale price change, regional inventories, regional weather, and dummy variables. The estimating equation for the residential propane prices is shown in equation (EQ 14), which is estimated using ordinary least squares:

$$\begin{aligned}
D2RCUxx - D2WHUUS &= a_0 + a_1(D2WHUUS - D2WHUUS(-1)) \\
&+ a_2 * DFPSPPx(average) \\
&+ a_3\left\{\begin{matrix}\left[\begin{matrix}QHFO_xxx(ZWHD_xxx - ZWHN_xxx)/ZSAJQUS \\ +(QHFO_yyy(ZWHD_yyy - ZWHN_yyy)/ZSAJQUS\end{matrix}\right] \\ /(QHFO_xxx + QHFO_yyy)\end{matrix}\right\} \\
&+ a_4(D2RCUxx(-1) - D2WHUUS(-1)) \\
&+ \sum_{i=5}^{15} a_i D_i
\end{aligned} \qquad \text{(EQ 14)}$$

where,

D2RCU*xx* = residential heating oil retail price in region *xx*
D2WHUUS = distillate wholesale price
DFPSPPx = distillate end-of-month inventory in PADD *x*, million barrels
DFPSPPx(average) = prior 4-year average, [DFPSPPx(-1) + DFPSPPx(-13) + DFPSPPx(-25) + DFPSPPx(-37)]/4, million barrels
ZWHD_*xxx* = total heating degree days in census division *xxx*,
ZWHN_*xxx* = normal heating degree days in census division *xxx*, and
ZSAJQUS = number of days in the month,
QHFO_*xxx* = number of homes in census division *xxx* that use heating oil as the primary space heating fuel.
D_i = monthly dummy variables for January through November.

1. Distillate Wholesale Price Change

A change in the distillate 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 distillate wholesale price as an explanatory variable allows for some delay in the price pass through.

2. Regional Inventories

While total U.S. inventories are included in the distillate wholesale 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 coefficients on inventories are negative as expected in all regions except the Northeast where the coefficient was insignificant. The greatest impact occurs in the West. When West region stocks are 1 million barrels lower than the average over the last four years, residential prices are higher by about 3.1 cents per gallon. Residential heating oil prices in the South region would be 0.2 cents higher.

3. Regional Weather

Regional heating degree-day deviations from normal are included to capture the possible impact of cold weather on the retail price markup over the wholesale price. These coefficients are currently insignificant but are left in the model. They have been significant in the past and may be again in the future.

4. Dummy Variables

Dummy variables are again included to reflect the seasonality in residential heating oil prices (or the markup over the wholesale price) not captured by seasonality in the wholesale price and inventory variables and to eliminate the effects of certain events that are considered outliers in the data series.

The regression results for the monthly dummy variables are lowest at the end of the summer and peak during the winter. 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 Heating Oil Prices After State Taxes

The Regional Short-Term Energy Model for residential heating oil includes residential sector heating oil retail prices including State taxes for the four census regions. The heating oil retail price including State taxes is calculated by multiplying each region's heating oil retail price excluding tax by a regional sales tax factor. For example, the Northeast region heating oil price including State taxes is calculated by:

D2RCANE = D2TXUNE * D2RCUNE

where,

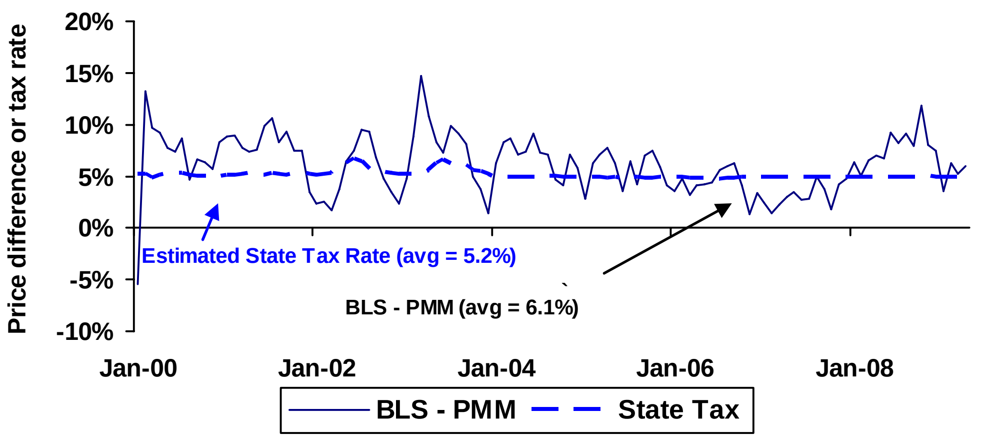
D2RCANE = Residential heating oil price after taxes, Northeast region
D2TXUNE = Region State sales tax factor (e.g., 1.05 = 5 percent tax rate)
D2RCUNE = Residential heating oil price before taxes, Northeast region

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 *State Expenditure and Price Reports*. 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 share of the total U.S. residential heating oil sales for each month.

We can check the efficacy of this method by comparing the difference between our before-tax prices and the Bureau of Labor Statistics (BLS) reports of after-tax residential heating oil prices as part of the monthly Consumer Price Index.

Figure 11 compares the percent differences between the STEO before-tax prices and the BLS after-tax prices. These price differences are compared with the estimated State tax rate. Since January 2000, the BLS price has averaged 6.1 percent higher than the before-tax price. The estimated State tax rate has averaged 5.2 percent (the State tax rate could be higher if the local sales tax option were included).

Figure 11. U.S. Heating Oil Price Differentials.



Sources: BLS: Bureau of Labor Statistics, Consumer price index survey after tax residential heating oil pirce; PMM: EIA, *Petroleum Marketing Monthly*

While the average before- and after-tax heating oil price differences are close to the calculated State tax rate, there can be large deviations in any one month. One fundamental difference between the two series that leads to the large variations is that the BLS residential prices are spot (or will-call) prices while the before-tax price represents an actual price paid by households. The actual average household price may be higher or lower than the spot price because many households lock in winter prices during the summer months. Consequently, during unexpected price increases during the winter, the average price actually paid by households may be significantly lower than the spot price. If spot prices fall then households could pay more. Because the objective of the Regional Short-Term Energy Model is to forecast average prices households actually pay we do not attempt to model spot residential prices. Consequently, some households may pay significantly more or less than regional prices estimated in this model not only because of price differences across States and regions but also because of the market pricing structure.

8. 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 heating oil 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	3.77	2.71	2.07	2.03	0.48	0.24	0.28	0.98	2.30	2.53	4.03
SO	2.85	2.40	1.94	1.21	0.72	0.06	0.01	0.02	0.33	1.14	2.29	3.44
MW	4.81	5.11	3.80	1.98	1.84	0.61	0.20	0.48	1.27	2.52	3.20	5.52
WE	2.59	1.25	2.52	1.49	0.81	0.51	0.22	0.12	0.39	1.24	2.41	1.40

If all other explanatory variables hold their forecasted values, one can see the likely range of heating oil consumption shares for each region given changes in heating-degree days by multiplying these standard deviations by the coefficients of the weather related variables. Figures 12 through 15 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 12. Heating Oil Consumption Share 2010, Northeast

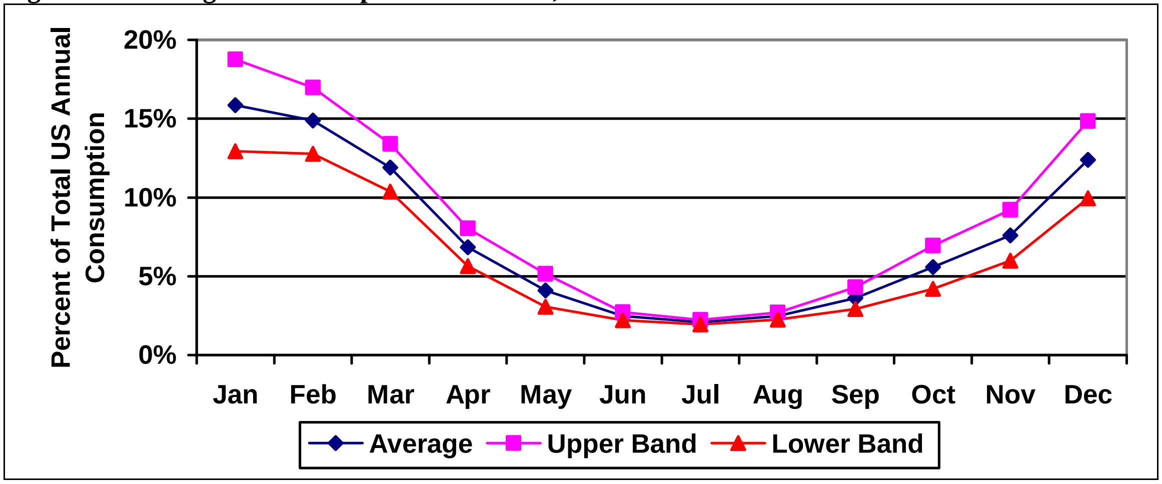


Figure 13. Heating Oil Consumption Share 2010, South

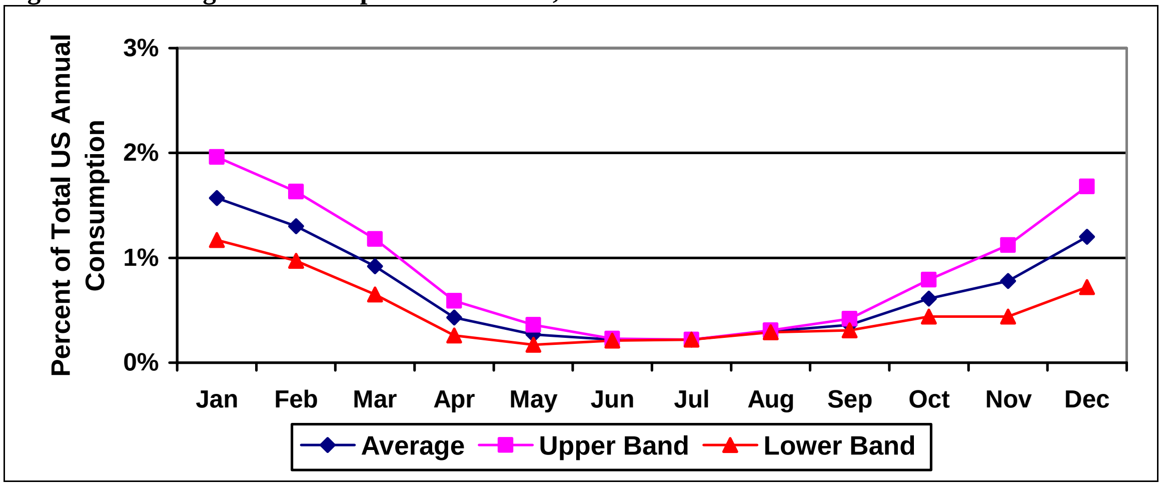


Figure 14. Heating Oil Consumption Share 2010, Midwest

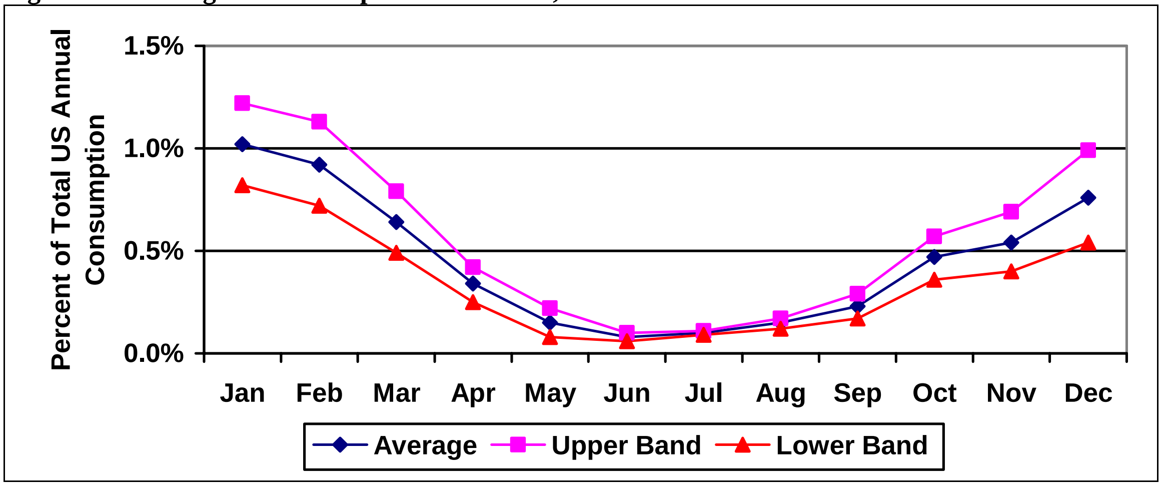
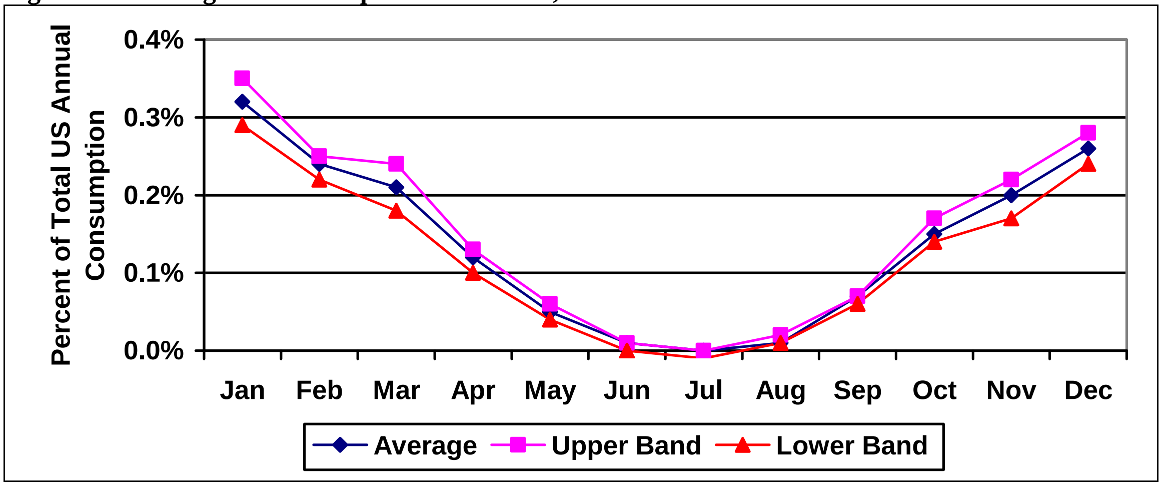


Figure 15. Heating Oil Consumption Share 2010, West



9. 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 16 reveals the differences between the forecast and actual consumption shares for each region for the years 2007 and 2008. The relatively large errors evident for the Northeast reflect the fact that the region accounts for such a large share of residential heating oil consumption. It is therefore much more likely to have bigger absolute errors (but much smaller errors in percentage terms).

Figure 16. Regional Consumption Shares Out-of-Sample Simulation Error.

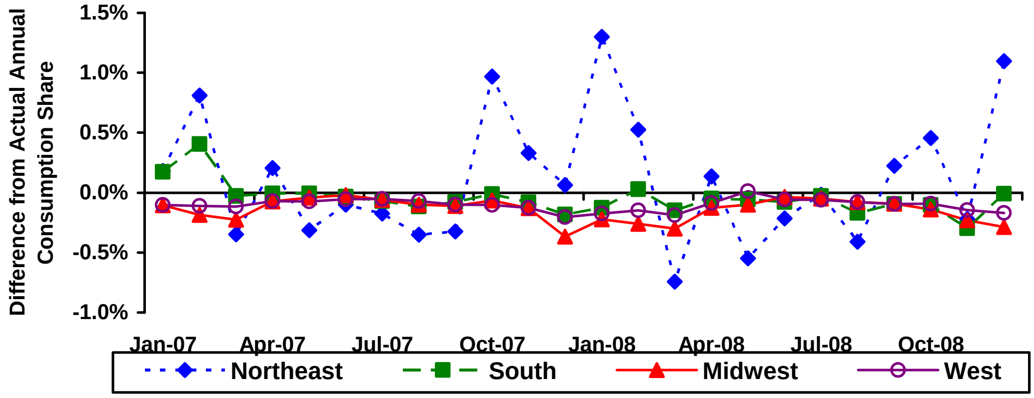


Table 5 lists the summary forecast error statistics. All Theil coefficients are fairly small, with the West being noticeably inferior likely because its overall residential heating oil consumption is so small. Relatively large swings in consumption can easily be missed. The Northeast and South, however, have far lower Theil coefficients as well as much lower bias proportions. The Midwest lies somewhere in between. The Theil coefficient is larger than in the Northeast, and the bias proportion is much more significant. Heating oil consumption share in the Midwest has been declining, but the trend accelerated during 2007 and 2008 causing the model to consistently over predict the region's share.

Table 5. Regional Consumption Share Out-of-Sample Simulation Error Statistics

	Northeast	South	Midwest	West
Root Mean Squared Error	0.01	0.00	0.00	0.00
Mean Absolute Error	0.00	0.00	0.00	0.00
Mean Absolute Percentage Error	7.70	18.81	36.31	94.84
Theil Inequality Coefficient	0.03	0.08	0.14	0.26
Bias Proportion	0.04	0.13	0.70	0.81
Variance Proportion	0.22	0.16	0.17	0.08
Covariance Proportion	0.74	0.71	0.13	0.10
Notes: Forecast period = Janurary 2007 – December 2008				

B. Inventories

Figure 17 reveals the differences between the forecast and actual stock changes in each PAD division. Stock changes from month to month are difficult to predict, but for PADD1, the largest division, bias was virtually non-existent as shown by Table 6. So while the difference from the actual value is sometimes relatively large, the errors tend to balance out over time for this forecast period. Bias is somewhat more significant for PADDs 2 and 5, but these are far smaller storage divisions.

Figure 17. PADD Inventories Out-of-Sample Simulation Errors.

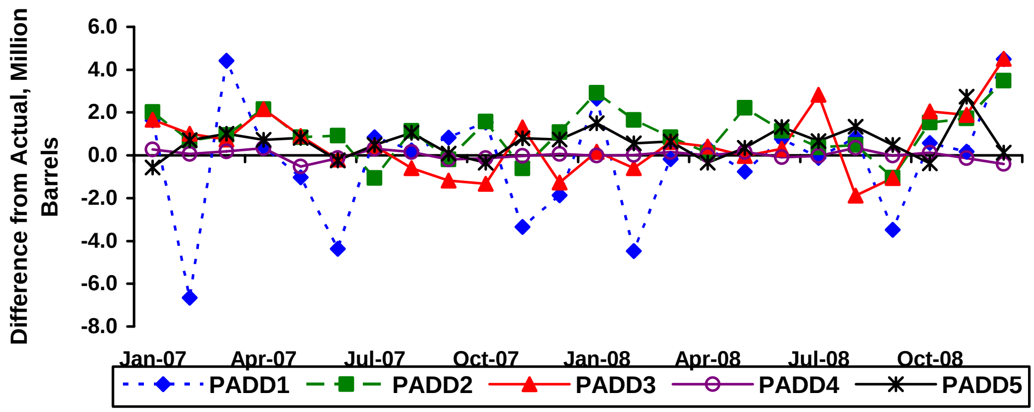


Table 6. Inventories Out-of-Sample Simulation Error Statistics

	PADD1	PADD2	PADD3	PADD4	PADD5
Root Mean Squared Error	2.636	1.516	1.562	0.209	0.928
Mean Absolute Error	1.914	1.279	1.211	0.160	0.746
Mean Absolute Percentage Error	63.554	300.433	221.591	213.865	145.879
Theil Inequality Coefficient	0.260	0.526	0.571	0.446	0.588
Bias Proportion	0.011	0.468	0.117	0.009	0.406
Variance Proportion	0.049	0.097	0.315	0.015	0.127
Covariance Proportion	0.940	0.436	0.568	0.976	0.467
Notes: Forecast period = Janurary 2007 – December 2008					

C. Wholesale and Regional Prices

Figure 18 shows the percent difference between the forecast and actual prices of heating oil in the four census regions and the national wholesale value. The forecasts are accurate overall but get noticeably worse towards the end of the period when actual crude oil and wholesale distillate prices experienced a large and rapid rise followed by a steep fall. Forecast errors tend to be higher during summer months because heating oil use is much lower. Likewise, errors are larger for the West region because heating oil use is miniscule leading to larger variations.

Figure 18. Wholesale and Regional Prices Out-of-Sample Simulation Errors

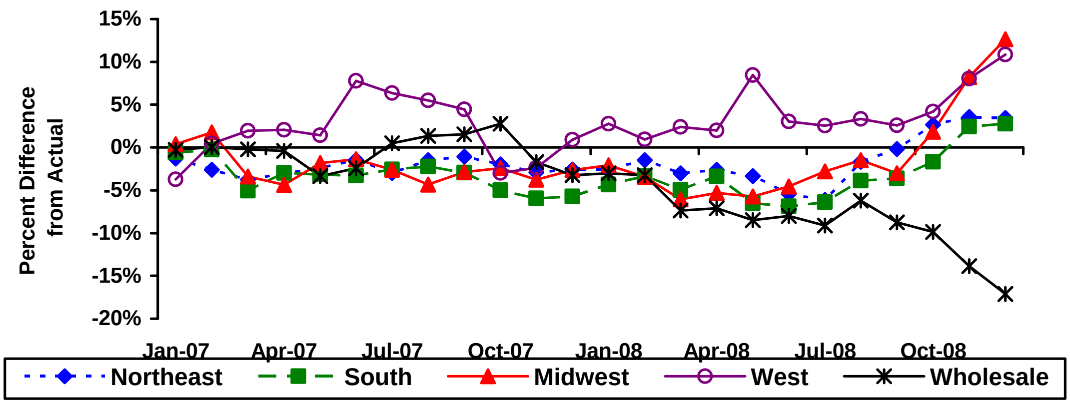


Table 7 shows the price regression equations to be strong. All Theil coefficients are close to zero, signaling a very accurate forecast. Unfortunately, the bias proportion is fairly large, but this is negated by having small errors. Add factors might be utilized to correct for this persistent bias in the regions and the U.S. wholesale value.

Table 7. Wholesale and Regional Prices Out-of-Sample Simulation Error Statistics

	Northeast	South	Midwest	West	Wholesale
Root Mean Squared Error	10.12	14.16	12.98	13.63	17.65
Mean Absolute Error	8.40	12.05	11.03	11.47	13.30
Mean Absolute Percentage Error	2.65	3.75	3.71	3.80	5.00
Theil Inequality Coefficient	0.02	0.02	0.02	0.02	0.04
Bias Proportion	0.37	0.59	0.23	0.46	0.48
Variance Proportion	0.16	0.22	0.26	0.02	0.19
Covariance Proportion	0.47	0.18	0.51	0.51	0.33
Notes: Forecast period = Janurary 2007 – December 2008					

10. 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 heating oil model that have been suggested and may be implemented in the future.

A. Weather Variable Improvements

Current measures of heating degree days by region are somewhat flawed. Homes using heating oil as their primary heating fuel are not evenly distributed geographically across census divisions (particularly in the South and West), and 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 using heating oil.

B. Refinery Capacity Constraints

Residential heating oil can be subject to price spikes due to especially cold winters in the Northeast or unexpected high distillate consumption from non-residential sectors. Refineries can vary the amount of distillate they produce from inputs, but distillate may still be undersupplied over the short term. An additional explanatory variable representing the amount of spare domestic refining capacity could reveal the market's ability to increase distillate production. Low spare capacity would be expected to result in larger price increases because of the limited ability to buffer unexpected demand shocks. Unfortunately, there are currently no reliable measures of actual refinery operating capacity or utilization rates. Planned and unplanned refinery outages, which reduce available capacity, are not reported to EIA in any survey. Consequently, the reported refinery capacity data and calculated utilization rates do not provide a reliable measure of available capacity and may bias the estimated regression results.

C. Price Effects of Consumption Shares and Inventories

Changes in prices will naturally influence long term consumption shares as well as inventory builds and draws from month to month. The relationship between prices and consumption has become increasingly complex, however, as we have recently witnessed quickly rising and falling crude prices and an even more pronounced rise and fall in the price of distillates. For these reasons, price variables were not behaving as helpful explanatory variables and were removed. In the future, these will likely be reintroduced when crude and distillate prices are less volatile or when the relationship is better understood.

D. Other Distillate Consumption

As shown in Figure 3, residential use of heating oil accounts for a significant but not dominant share of total distillate consumption. Since refiners have some flexibility in producing diesel, residential heating oil and other products as a share of their total distillate output, diesel consumption and prices are potential explanatory variables.

Presumably, increased consumption of diesel fuel will limit the heating oil produced, thus driving up prices and reducing residential consumption.

E. 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.

F. 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.

G. 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.

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					2.52
		ME	X					
		MA	X					
		NH	X					
		RI	X					
		VT	X					
	Middle Atlantic	NJ	X					3.91
		NY	X					
		PA	X					
South	South Atlantic	DE	X					0.99
		DC	X					
		FL	X					
		GA	X					
		MD	X					
		NC	X					
		SC	X					
		VA	X					
		WV	X					
	East South Central	AL			X			0.05
		KY		X				
		MS			X			
		TN		X				
	West South Central	AK			X			0.02
		LA			X			
		OK		X				
		TX			X			
Midwest	East North Central	IL		X				0.4
		IN		X				
		MI		X				
		OH		X				
		WI		X				
	West North Central	IA		X				0.15
		KS		X				

		MN	X				
		MO	X				
		NE	X				
		ND	X				
		SD	X				
West	Mountain	AZ				X	0.04
		CO			X		
		ID			X		
		MT			X		
		NV				X	
		NM		X			
		UT			X		
		WY			X		
	Pacific	AK				X	0.28
		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		
D0002	Integer	= 1 if February 2000, 0 otherwise		
D01ON	Integer	= 1 if January 2000 or later, 0 otherwise		
D0101	Integer	= 1 if January 2001, 0 otherwise		
D01ON	Integer	= 1 if January 2001 or later, 0 otherwise		
D0302	Integer	= 1 if February 2003, 0 otherwise		
D0303	Integer	= 1 if March 2003, 0 otherwise		
D0305	Integer	= 1 if May 2003, 0 otherwise		
D0306	Integer	= 1 if June 2003, 0 otherwise		
D0403	Integer	= 1 if March 2004, 0 otherwise		
D0409	Integer	= 1 if September 2004, 0 otherwise		
D0410	Integer	= 1 if October 2004, 0 otherwise		
D0411	Integer	= 1 if November 2004, 0 otherwise		
D0412	Integer	= 1 if December 2004, 0 otherwise		
D0501	Integer	= 1 if January 2005, 0 otherwise		
D0502	Integer	= 1 if February 2005, 0 otherwise		
D2RCAMW	CPG	Residential heating oil price after taxes, Midwest census region, all sellers	STF	STF
D2RCANE	CPG	Residential heating oil price after taxes, Northeast census region, all sellers	STF	STF
D2RCASO	CPG	Residential heating oil price after taxes, South census region, all sellers	STF	STF
D2RCAUS	CPG	Residential heating oil price after taxes, U.S., all sellers	STF	STF
D2RCAWE	CPG	Residential heating oil price after taxes, West census region, all sellers	STF	STF
D2RCUMW	CPG	Residential heating oil price before taxes, Midwest census region, all sellers	PMM	STF
D2RCUNE	CPG	Residential heating oil price before taxes, Northeast census region, all sellers	PMM	STF
D2RCUSO	CPG	Residential heating oil price before taxes, South census region, all sellers	PMM	STF
D2RCUUS	CPG	Residential heating oil price before taxes, U.S., all sellers	PMM	STF
D2RCUWE	CPG	Residential heating oil price before taxes, West census region, all sellers	PMM	STF
D2RCXMW	Index	Residential heating oil demand share, Midwest census region	PMM	STF
D2RCXNE	Index	Residential heating oil demand share, Northeast census region	PMM	STF
D2RCXSO	Index	Residential heating oil demand share, South census region	PMM	STF
D2RCXUS	Index	Residential heating oil demand share, U.S.	PMM	STF
D2RCXWE	Index	Residential heating oil demand share, West census region	PMM	STF
D2TXUMW	Index	Heating oil State sales tax factor, Midwest census region	STF	ROT
D2TXUNE	Index	Heating oil State sales tax factor, Northeast census region	STF	ROT
D2TXUSO	Index	Heating oil State sales tax factor, South census region	STF	ROT
D2TXUWE	Index	Heating oil State sales tax factor, West census region	STF	ROT
D2WHUUS	CPG	Distillate fuel oil wholesale price	PMM	STF
D9912	Integer	= 1 if December 1999, 0 otherwise		
DFPSPP1BLD	MMB	Distillate stock change, PADD 1	PSM	STF
DFPSPP2BLD	MMB	Distillate stock change, PADD 2	PSM	STF
DFPSPP3BLD	MMB	Distillate stock change, PADD 3	PSM	STF
DFPSPP4BLD	MMB	Distillate stock change, PADD 4	PSM	STF
DFPSPP5BLD	MMB	Distillate stock change, PADD 5	PSM	STF
DFPSPP1	MMB	Distillate end-of-month stocks, PADD 1	PSM	STF
DFPSPP2	MMB	Distillate end-of-month stocks, PADD 2	PSM	STF
DFPSPP3	MMB	Distillate end-of-month stocks, PADD 3	PSM	STF
DFPSPP4	MMB	Distillate end-of-month stocks, PADD 4	PSM	STF
DFPSPP5	MMB	Distillate end-of-month stocks, PADD 5	PSM	STF
DFPSPUS	MMB	Distillate end-of-month stocks, U.S.	PSM	STF

DFTCPUS	MMBD	Total U.S. distillate demand	PSM	STF
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		
NOV	Integer	= 1 if November, 0 otherwise		
OCT	Integer	= 1 if October, 0 otherwise		
QHFO_ENC	MM	Number of homes with heating oil as primary space heating fuel, E. North Central census division	ACS	STF
QHFO_ESC	MM	Number of homes with heating oil as primary space heating fuel, E. South Central census division	ACS	STF
QHFO_MAC	MM	Number of homes with heating oil as primary space heating fuel, Middle Atlantic census division	ACS	STF
QHFO_MTN	MM	Number of homes with heating oil as primary space heating fuel, Mountain census division	ACS	STF
QHFO_MW	MM	Number of homes with heating oil as primary space heating fuel, Midwest census region (QHFORECS_ENC + QHFORECS_WNC)	ACS	STF
QHFO_NE	MM	Number of homes with heating oil as primary space heating fuel, Northeast census region (QHFORECS_NEC + QHFORECS_MAC)	ACS	STF
QHFO_NEC	MM	Number of homes with heating oil as primary space heating fuel, New England census division	ACS	STF
QHFO_PAC	MM	Number of homes with heating oil as primary space heating fuel, Pacific census division	ACS	STF
QHFO_SAC	MM	Number of homes with heating oil as primary space heating fuel, South Atlantic census division	ACS	STF
QHFO_SO	MM	Number of homes with heating oil as primary space heating fuel, South census region (QHFORECS_ESC + QHFORECS_SAC + QHFORECS_WSC)	ACS	STF
QHFO_WE	MM	Number of homes with heating oil as primary space heating fuel, Northeast census region (QHFORECS_PAC + QHFORECS_MTN)	ACS	STF
QHFO_WNC	MM	Number of homes with heating oil as primary space heating fuel, W. North Central census division	ACS	STF
QHFO_WSC	MM	Number of homes with heating oil as primary space heating fuel, W. South Central census division	ACS	STF
SEP	Integer	= 1 if September, 0 otherwise		
WTIPUUS	DBBL	Spot price WTI crude oil	PMM	EXO
ZSAJQUS	Integer	Number of days in a month		
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
ZWHDPSA	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
ZWHNPSA	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	Census Bureau American Community Survey
ROT	Rule-of-thumb
STF	STIFS Model

Appendix C. EViews Model Program File

```
'--------- Residential heating oil demand sharess  ---------

:EQ_D2RCXNE
:EQ_D2RCXSO
:EQ_D2RCXMW
:EQ_D2RCXWE

@IDENTITY d2rcxus  = d2rcxne  + d2rcxso  + d2rcxmw  + d2rcxwe

' --------  Distillate Stocks ---------

:EQ_DFPSP1BLD
:EQ_DFPSP2BLD
:EQ_DFPSP3BLD
:EQ_DFPSP4BLD
:EQ_DFPSP5BLD

@IDENTITY dfpspp1  = dfpspp1(-1)  + dfpsp1bld
@IDENTITY dfpspp2  = dfpspp2(-1)  + dfpsp2bld
@IDENTITY dfpspp3  = dfpspp3(-1)  + dfpsp3bld
@IDENTITY dfpspp4  = dfpspp4(-1)  + dfpsp4bld
@IDENTITY dfpspp5  = dfpspp5(-1)  + dfpsp5bld

@IDENTITY dfpspus  = dfpspp1  + dfpspp2  + dfpspp3  + dfpspp4  + dfpspp5

' --------  Residential Heating Oil Prices ---------

:EQ_D2WHUUS
:EQ_D2RCUNE
:EQ_D2RCUSO
:EQ_D2RCUMW
:EQ_D2RCUWE

@IDENTITY d2rcuus  = (d2rcxne  * d2rcune  + d2rcxso  * d2rcuso  + d2rcxmw  * d2rcumw  +
d2rcxwe  * d2rcuwe)  / d2rcxus

' ----------  Add state sales taxes to PMM price series ----------

@IDENTITY d2rcane  = d2rcune  * d2txune
@IDENTITY d2rcaso  = d2rcuso  * d2txuso
@IDENTITY d2rcamw  = d2rcumw  * d2txumw
@IDENTITY d2rcawe  = d2rcuwe  * d2txuwe

@IDENTITY d2rcaus  = (d2rcxne  * d2rcane  + d2rcxso  * d2rcaso  + d2rcxmw  * d2rcamw  +
d2rcxwe  * d2rcawe)  / d2rcxus
```

Appendix D. Regression Results

Regression 1. D2RCXNE, Heating oil consumption share, Northeast region

Dependent Variable: D2RCXNE
Method: Least Squares
Date: 06/02/09 Time: 15:54
Sample (adjusted): 2000M02 2008M12
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.043040	0.028406	-1.515151	0.1333
((QHFO_MAC*(ZWHD_MAC-ZWHN_MAC)/ZSAJQUS)+(QHFO_NEC*(ZWHD_NEC-ZWHN_NEC)/ZSAJQUS))/(QHFO_MAC+QHFO_NEC)	0.002456	0.000221	11.08952	0.0000
((QHFO_MAC(-1)*(ZWHD_MAC(-1)-ZWHN_MAC(-1))/ZSAJQUS(-1))+(QHFO_NEC(-1)*(ZWHD_NEC(-1)-ZWHN_NEC(-1))/ZSAJQUS(-1)))/(QHFO_MAC(-1)+QHFO_NEC(-1))	0.000457	0.000340	1.346188	0.1817
D2RCXNE_SF*(QHFO_MAC+QHFO_NEC)/QHFO_US	0.115412	0.023776	4.854119	0.0000
D05ON+D0410+D0411+D0412	0.000593	0.001617	0.366798	0.7146
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	-0.001190	0.001589	-0.748461	0.4562
JAN	-0.007252	0.006445	-1.125196	0.2635
FEB	-0.007599	0.006614	-1.148871	0.2537
MAR	-0.006468	0.006744	-0.959112	0.3401
APR	0.010421	0.015686	0.664346	0.5082
MAY	0.026783	0.021569	1.241705	0.2176
JUN	0.033565	0.024097	1.392908	0.1671
JUL	0.035169	0.024493	1.435848	0.1546
AUG	0.034707	0.023312	1.488796	0.1401
SEP	0.035680	0.021579	1.653480	0.1018
OCT	0.029157	0.017284	1.686980	0.0951
NOV	0.019492	0.011849	1.644977	0.1035
D2RCXNE(-1)	0.117047	0.095191	1.229608	0.2221

R-squared	0.985824	Mean dependent var	0.065006
Adjusted R-squared	0.983117	S.D. dependent var	0.043136
S.E. of regression	0.005605	Akaike info criterion	-7.378096
Sum squared resid	0.002796	Schwarz criterion	-6.928461
Log likelihood	412.7281	Hannan-Quinn criter.	-7.195820
F-statistic	364.0802	Durbin-Watson stat	1.703665
Prob(F-statistic)	0.000000		

Regression 2. D2RCXSO, Heating oil consumption share, South region

Dependent Variable: D2RCXSO
Method: Least Squares
Date: 06/02/09 Time: 16:00
Sample (adjusted): 2000M02 2008M12
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000297	0.003000	-0.098916	0.9214
((QHFO_ESC*(ZWHD_ESC-ZWHN_ESC)/ZSAJQUS+QHFO_WSC*(ZWHD_WSC-ZWHN_WSC)/ZSAJQUS+QHFO_SAC*(ZWHD_SAC-ZWHN_SAC)/ZSAJQUS))/(QHFO_ESC+QHFO_WSC+QHFO_SAC)	0.000644	6.49E-05	9.931852	0.0000
((QHFO_ESC(-1)*(ZWHD_ESC(-1)-ZWHN_ESC(-1))/ZSAJQUS(-1)+QHFO_WSC(-1)*(ZWHD_WSC(-1)-ZWHN_WSC(-1))/ZSAJQUS(-1)+QHFO_SAC(-1)*(ZWHD_SAC(-1)-ZWHN_SAC(-1))/ZSAJQUS(-1)))/(QHFO_ESC(-1)+QHFO_WSC(-1)+QHFO_SAC(-1))	6.29E-05	7.61E-05	0.827156	0.4104
D2RCXSO_SF*(QHFO_ESC+QHFO_WSC+QHFO_SAC)/QHFO_US	0.048525	0.012180	3.984007	0.0001
D05ON+D0410+D0411+D0412	0.000242	0.000366	0.660421	0.5107
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	0.000909	0.000311	2.922205	0.0044
D0002	0.007096	0.001198	5.924021	0.0000
JAN	-0.000982	0.000937	-1.047196	0.2979
FEB	-0.003359	0.000853	-3.938534	0.0002
MAR	-0.003206	0.001004	-3.192149	0.0020
APR	-0.003055	0.001893	-1.613487	0.1102
MAY	-0.001497	0.002236	-0.669687	0.5048
JUN	-0.000747	0.002318	-0.322022	0.7482
JUL	-0.000605	0.002299	-0.263261	0.7930
AUG	-0.000490	0.002119	-0.231221	0.8177
SEP	-0.000480	0.001960	-0.244923	0.8071
OCT	0.000152	0.001502	0.100874	0.9199
NOV	-0.000643	0.001169	-0.550119	0.5836
D2RCXSO(-1)	0.382948	0.067983	5.632973	0.0000

R-squared	0.974180	Mean dependent var	0.008773
Adjusted R-squared	0.968898	S.D. dependent var	0.006018
S.E. of regression	0.001061	Akaike info criterion	-10.69895
Sum squared resid	9.91E-05	Schwarz criterion	-10.22434
Log likelihood	591.3939	Hannan-Quinn criter.	-10.50655
F-statistic	184.4539	Durbin-Watson stat	1.850863
Prob(F-statistic)	0.000000		

Regression 3. D2RCXMW, Heating oil consumption share, Midwest region

Dependent Variable: D2RCXMW
Method: Least Squares
Date: 06/02/09 Time: 16:02
Sample (adjusted): 2000M02 2008M12
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000466	0.000293	-1.587827	0.1155
((QHFO_ENC*(ZWHD_ENC-ZWHN_ENC)/ZSAJQUS)+(QHFO_WNC*(ZWHD_WNC-ZWHN_WNC)/ZSAJQUS))/(QHFO_ENC+QHFO_WNC)	0.000175	3.10E-05	5.646385	0.0000
((QHFO_ENC(-1)*(ZWHD_ENC(-1)-ZWHN_ENC(-1))/ZSAJQUS(-1))+(QHFO_WNC(-1)*(ZWHD_WNC(-1)-ZWHN_WNC(-1))/ZSAJQUS(-1)))/(QHFO_ENC(-1)+QHFO_WNC(-1))	3.21E-05	3.28E-05	0.980430	0.3292
D2RCXMW_SF*(QHFO_ENC+QHFO_WNC)/QHFO_US	0.084743	0.004200	20.17691	0.0000
D05ON+D0410+D0411+D0412	-0.000180	0.000250	-0.720920	0.4726
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	0.002181	0.000291	7.487432	0.0000
D2RCXMW(-1)	0.054931	0.045036	1.219719	0.2254

R-squared	0.941165	Mean dependent var	0.006686
Adjusted R-squared	0.937635	S.D. dependent var	0.004004
S.E. of regression	0.001000	Akaike info criterion	-10.91449
Sum squared resid	0.000100	Schwarz criterion	-10.73963
Log likelihood	590.9253	Hannan-Quinn criter.	-10.84361
F-statistic	266.6106	Durbin-Watson stat	0.925707
Prob(F-statistic)	0.000000		

Regression 4. D2RCXWE, Heating oil consumption share, West region

Dependent Variable: D2RCXWE
Method: Least Squares
Date: 06/02/09 Time: 16:04
Sample (adjusted): 2000M02 2008M12
Included observations: 107 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000565	0.001035	0.546128	0.5864
((QHFO_MTN*(ZWHD_MTN-ZWHN_MTN)/ZSAJQUS)+(QHFO_PAC*(ZWHD_PAC-ZWHN_PAC)/ZSAJQUS))/(QHFO_MTN+QHFO_PAC)	4.91E-05	1.94E-05	2.532799	0.0131
((QHFO_MTN(-1)*(ZWHD_MTN(-1)-ZWHN_MTN(-1))/ZSAJQUS(-1))+(QHFO_PAC(-1)*(ZWHD_PAC(-1)-ZWHN_PAC(-1))/ZSAJQUS(-1)))/(QHFO_MTN(-1)+QHFO_PAC(-1))	8.41E-06	1.99E-05	0.422867	0.6734
D2RCXWE_SF*(QHFO_MTN+QHFO_PAC)/QHFO_US	0.027976	0.015719	1.779784	0.0786
D05ON+D0410+D0411+D0412	7.28E-05	7.86E-05	0.926742	0.3566
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	-0.000242	8.58E-05	-2.815403	0.0060
D07ON	-0.000695	0.000115	-6.037424	0.0000
D0805	0.001145	0.000304	3.765519	0.0003
JAN	8.67E-05	0.000228	0.379950	0.7049
FEB	-0.000509	0.000192	-2.645891	0.0097
MAR	-0.000325	0.000220	-1.477708	0.1431
APR	-0.000659	0.000480	-1.373257	0.1732
MAY	-0.000538	0.000686	-0.784898	0.4346
JUN	-0.000507	0.000802	-0.631665	0.5293
JUL	-0.000378	0.000859	-0.440101	0.6610
AUG	-0.000276	0.000801	-0.344277	0.7315
SEP	-3.14E-05	0.000662	-0.047531	0.9622
OCT	-5.95E-05	0.000359	-0.165840	0.8687
NOV	-5.72E-05	0.000251	-0.227865	0.8203
D2RCXWE(-1)	0.398302	0.086312	4.614678	0.0000

R-squared	0.953850	Mean dependent var	0.002020
Adjusted R-squared	0.943771	S.D. dependent var	0.001183
S.E. of regression	0.000281	Akaike info criterion	-13.35285
Sum squared resid	6.85E-06	Schwarz criterion	-12.85325
Log likelihood	734.3772	Hannan-Quinn criter.	-13.15032
F-statistic	94.63919	Durbin-Watson stat	1.921309
Prob(F-statistic)	0.000000		

Regression 5. DFPSP1BLD, Distillate Fuel Oil Stock Change, PADD 1 (East)

Dependent Variable: DFPSP1BLD
Method: Least Squares
Date: 06/02/09 Time: 16:05
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.984490	0.819462	-1.201386	0.2328
(QHFO_NEC*(ZWHD_NEC-ZWHN_NEC)+QHFO_MAC*(ZWHD_MAC-ZWHN_MAC)+QHFO_SAC*(ZWHD_SAC-ZWHN_SAC))/(QHFO_NEC+QHFO_MAC+QHFO_SAC)	-0.013407	0.003577	-3.748402	0.0003
DFPSPP1(-1)-((DFPSPP1(-13)+DFPSPP1(-25)+DFPSPP1(-37)+DFPSPP1(-49))/4)	-0.064634	0.031271	-2.066882	0.0417
D9912+D0001	-9.780269	2.838334	-3.445778	0.0009
D0002	8.427604	2.904363	2.901705	0.0047
D0101	11.33571	2.686151	4.220059	0.0001
D0303	6.461482	2.650000	2.438295	0.0168
D0601	8.623875	2.741260	3.145954	0.0023
JAN	-6.754246	1.304290	-5.178484	0.0000
FEB	-6.161891	1.295479	-4.756459	0.0000
MAR	-5.271770	1.322244	-3.986988	0.0001
APR	-0.854455	1.288042	-0.663375	0.5088
MAY	4.401502	1.170044	3.761825	0.0003
JUN	5.959393	1.153824	5.164906	0.0000
JUL	5.971787	1.186072	5.034929	0.0000
AUG	4.987769	1.182962	4.216340	0.0001
SEP	1.268746	1.169559	1.084807	0.2810
OCT	1.000386	1.147134	0.872074	0.3855
NOV	1.802182	1.150753	1.566089	0.1209
DFPSP1BLD(-1)	0.038989	0.079935	0.487763	0.6269

R-squared	0.829150	Mean dependent var	0.076806
Adjusted R-squared	0.792262	S.D. dependent var	5.317341
S.E. of regression	2.423553	Akaike info criterion	4.773922
Sum squared resid	516.8776	Schwarz criterion	5.270613
Log likelihood	-237.7918	Hannan-Quinn criter.	4.975312
F-statistic	22.47746	Durbin-Watson stat	1.802472
Prob(F-statistic)	0.000000		

Regression 6. DFPSP2BLD, Distillate Fuel Oil Stock Change, PADD 2 (Midwest)

Dependent Variable: DFPSP2BLD
Method: Least Squares
Date: 06/02/09 Time: 16:05
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.303730	0.469590	4.905836	0.0000
((QHFO_ENC*(ZWHD_ENC-ZWHN_ENC))+(QHFO_WNC*(ZWHD_WNC-ZWHN_WNC)))/(QHFO_ENC+QHFO_WNC)	-0.005078	0.001444	-3.516563	0.0007
DFPSPP2(-1)-((DFPSPP2(-13)+DFPSPP2(-25)+DFPSPP2(-37)+DFPSPP2(-49))/4)	-0.387667	0.072921	-5.316290	0.0000
D0604	-4.144832	1.433446	-2.891516	0.0048
JAN	-3.441073	0.658067	-5.229060	0.0000
FEB	-2.739401	0.640895	-4.274338	0.0000
MAR	-4.365684	0.649200	-6.724715	0.0000
APR	-1.920340	0.713943	-2.689767	0.0085
MAY	-1.687277	0.641385	-2.630676	0.0100
JUN	-2.327184	0.631694	-3.684035	0.0004
JUL	-2.203927	0.636010	-3.465243	0.0008
AUG	-2.738443	0.635186	-4.311243	0.0000
SEP	-3.340560	0.643064	-5.194758	0.0000
OCT	-5.162100	0.652205	-7.914840	0.0000
NOV	-1.108512	0.726216	-1.526423	0.1303
DFPSP2BLD(-1)	0.179930	0.089303	2.014821	0.0468

R-squared	0.639134	Mean dependent var	0.005037
Adjusted R-squared	0.580297	S.D. dependent var	2.056091
S.E. of regression	1.332027	Akaike info criterion	3.547235
Sum squared resid	163.2353	Schwarz criterion	3.944588
Log likelihood	-175.5507	Hannan-Quinn criter.	3.708347
F-statistic	10.86283	Durbin-Watson stat	2.040434
Prob(F-statistic)	0.000000		

Regression 7. DFPSP3BLD, Distillate Fuel Oil Stock Change, PADD 3 (Southwest)

Dependent Variable: DFPSP3BLD
Method: Least Squares
Date: 06/02/09 Time: 16:07
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.404770	0.544472	0.743418	0.4591
((QHFO_ESC*(ZWHD_ESC-ZWHN_ESC))+(QHFO_WSC*(ZWHD_WSC-ZWHN_WSC)))/(QHFO_ESC+QHFO_WSC)	0.001135	0.002466	0.460173	0.6465
DFPSPP3(-1)-((DFPSPP3(-13)+DFPSPP3(-25)+DFPSPP3(-37)+DFPSPP3(-49))/4)	-0.205065	0.073725	-2.781503	0.0066
D0509	-6.294421	1.704869	-3.692025	0.0004
JAN	-1.697174	0.778770	-2.179301	0.0319
FEB	-0.798237	0.787222	-1.013992	0.3132
MAR	-0.742604	0.769432	-0.965133	0.3370
APR	0.465389	0.773629	0.601566	0.5489
MAY	0.807688	0.757242	1.066618	0.2889
JUN	-0.171904	0.752747	-0.228369	0.8199
JUL	2.007999	0.761160	2.638077	0.0098
AUG	-0.604859	0.758706	-0.797224	0.4274
SEP	-1.069961	0.803761	-1.331192	0.1864
OCT	-0.257781	0.803160	-0.320959	0.7490
NOV	0.983871	0.767595	1.281758	0.2031
DFPSP3BLD(-1)	-0.107983	0.098315	-1.098332	0.2749

R-squared	0.457429	Mean dependent var	0.093287
Adjusted R-squared	0.368967	S.D. dependent var	1.999519
S.E. of regression	1.588370	Akaike info criterion	3.899247
Sum squared resid	232.1084	Schwarz criterion	4.296600
Log likelihood	-194.5593	Hannan-Quinn criter.	4.060359
F-statistic	5.170881	Durbin-Watson stat	1.876298
Prob(F-statistic)	0.000000		

Regression 8. DFPSP4BLD, Distillate Fuel Oil Stock Change, PADD 4 (Mountain)

Dependent Variable: DFPSP4BLD
Method: Least Squares
Date: 06/02/09 Time: 16:07
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.195649	0.080832	2.420433	0.0175
ZWHD_MTN-ZWHN_MTN	0.000318	0.000383	0.828746	0.4094
DFPSPP4(-1)-((DFPSPP4(-13)+DFPSPP4(-25)+DFPSPP4(-37)+DFPSPP4(-49))/4)	-0.258323	0.074777	-3.454553	0.0008
D0305	-0.640891	0.234775	-2.729815	0.0076
D0506	-0.832984	0.229979	-3.622005	0.0005
D0608	0.692676	0.234183	2.957835	0.0040
JAN	-0.232002	0.103172	-2.248693	0.0270
FEB	-0.328919	0.111850	-2.940716	0.0042
MAR	-0.246812	0.113393	-2.176605	0.0321
APR	-0.305878	0.111471	-2.744009	0.0073
MAY	0.176766	0.117587	1.503270	0.1363
JUN	-0.089391	0.106477	-0.839538	0.4034
JUL	-0.371853	0.109187	-3.405641	0.0010
AUG	-0.493499	0.117760	-4.190722	0.0001
SEP	-0.151705	0.117916	-1.286554	0.2015
OCT	-0.130346	0.107325	-1.214502	0.2277
NOV	0.218703	0.107164	2.040832	0.0442
DFPSP4BLD(-1)	-0.010799	0.094418	-0.114372	0.9092

R-squared	0.587981	Mean dependent var	-0.002898
Adjusted R-squared	0.510156	S.D. dependent var	0.309236
S.E. of regression	0.216431	Akaike info criterion	-0.072077
Sum squared resid	4.215819	Schwarz criterion	0.374945
Log likelihood	21.89216	Hannan-Quinn criter.	0.109174
F-statistic	7.555099	Durbin-Watson stat	1.933535
Prob(F-statistic)	0.000000		

Regression 9. DFPSP5BLD, Distillate Fuel Oil Stock Change, PADD 5 (Pacific)

Dependent Variable: DFPSP5BLD
Method: Least Squares
Date: 06/02/09 Time: 16:07
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.681643	3.104313	0.863844	0.3899
ZWHD_PAC-ZWHN_PAC	-0.001084	0.001680	-0.645264	0.5203
DFPSPP5(-1)-((DFPSPP5(-13)+DFPSPP5(-25)+DFPSPP5(-37)+DFPSPP5(-49))/4)	-0.297571	0.233440	-1.274724	0.2056
JAN	-1.216596	0.402655	-3.021438	0.0032
FEB	-1.633442	0.366701	-4.454425	0.0000
MAR	-1.152156	0.355557	-3.240428	0.0017
APR	-0.558171	0.361604	-1.543597	0.1261
MAY	-0.779732	0.359594	-2.168369	0.0327
JUN	-1.417494	0.368630	-3.845307	0.0002
JUL	-1.038108	0.354966	-2.924530	0.0043
AUG	-1.098103	0.365767	-3.002190	0.0034
SEP	-1.054923	0.375420	-2.809985	0.0060
OCT	-1.076196	0.358924	-2.998399	0.0035
NOV	-0.895470	0.356014	-2.515268	0.0136
DFPSPP5(-1)	-0.137233	0.263525	-0.520759	0.6038

R-squared	0.427039	Mean dependent var	0.016843
Adjusted R-squared	0.340787	S.D. dependent var	0.918235
S.E. of regression	0.745533	Akaike info criterion	2.378812
Sum squared resid	51.69125	Schwarz criterion	2.751330
Log likelihood	-113.4559	Hannan-Quinn criter.	2.529855
F-statistic	4.951047	Durbin-Watson stat	2.118146
Prob(F-statistic)	0.000001		

Regression 10. D2WHUUS – RACPUUS, Heating Oil Wholesale – Crude Oil Wholesale

Dependent Variable: D2WHUUS-(100*RACPUUS/42)
Method: Least Squares
Date: 06/02/09 Time: 16:08
Sample: 2001M01 2008M10
Included observations: 94

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.882691	2.329614	1.666667	0.1000
RACPUUS-RACPUUS(-1)	0.324915	0.104267	3.116195	0.0026
DFPSPUS(-1)-(DFPSPUS(-13)+DFPSPUS(-25)+DFPSPUS(-37)+DFPSPUS(-49))/4	0.006046	0.069762	0.086666	0.9312
(QHFO_NEC*(ZWHD_NEC-ZWHN_NEC)+QHFO_MAC*(ZWHD_MAC-ZWHN_MAC)+QHFO_SAC*(ZWHD_SAC-ZWHN_SAC)+QHFO_ENC*(ZWHD_ENC-ZWHN_ENC)+QHFO_ESC*(ZWHD_ESC-ZWHN_ESC)+QHFO_WNC*(ZWHD_WNC-ZWHN_WNC)+QHFO_WSC*(ZWHD_WSC-ZWHN_WSC)+QHFO_MTN*(ZWHD_MTN-ZWHN_MTN)+QHFO_PAC*(ZWHD_PAC-ZWHN_PAC))/(QHFO_NEC+QHFO_MAC+QHFO_SAC+QHFO_ENC+QHFO_ESC+QHFO_WNC+QHFO_WSC+QHFO_MTN+QHFO_PAC)	0.019211	0.006796	2.826762	0.0061
D0302+D0303	9.376389	3.527382	2.658172	0.0097
D0407+D0408+D0409+D0410+D0411+D0412+D0501+D0502	3.767058	1.995725	1.887564	0.0632
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	-1.459081	1.413945	-1.031922	0.3056
D05ON-D0501-D0502	4.061358	2.652664	1.531049	0.1302
D0509	14.56181	4.522205	3.220069	0.0019
D0510	14.69536	4.533500	3.241504	0.0018
D0511	-17.05559	4.774435	-3.572274	0.0006
JAN	-2.399108	2.171624	-1.104753	0.2730
FEB	-3.374203	2.284955	-1.476704	0.1442
MAR	-0.728965	2.258778	-0.322726	0.7479
APR	-0.381833	2.188926	-0.174439	0.8620
MAY	-2.306808	2.202762	-1.047234	0.2985
JUN	-2.088682	2.192868	-0.952489	0.3441
JUL	-4.400192	2.185753	-2.013124	0.0479
AUG	-1.228791	2.196029	-0.559551	0.5775
SEP	2.444271	2.283452	1.070428	0.2881
OCT	2.285740	2.261811	1.010580	0.3156
NOV	2.075201	2.331923	0.889910	0.3765
D2WHUUS(-1)-(100*RACPUUS(-1)/42)	0.861457	0.068545	12.56774	0.0000

R-squared	0.955607	Mean dependent var	33.18303
Adjusted R-squared	0.941852	S.D. dependent var	17.28556
S.E. of regression	4.168219	Akaike info criterion	5.901602
Sum squared resid	1233.558	Schwarz criterion	6.523897
Log likelihood	-254.3753	Hannan-Quinn criter.	6.152964
F-statistic	69.47128	Durbin-Watson stat	1.894918
Prob(F-statistic)	0.000000		

Regression 11. D2RCUNE - D2WHUUS, Heating oil retail - wholesale price spread, Northeast region

Dependent Variable: D2RCUNE-D2WHUUS
Method: Least Squares
Date: 06/02/09 Time: 16:08
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.48355	2.196023	7.961462	0.0000
D2WHUUS-D2WHUUS(-1)	-0.289950	0.021027	-13.78956	0.0000
DFPSPP1(-1)-(DFPSPP1(-13)+DFPSPP1(-25)+DFPSPP1(-37)+DFPSPP1(-49))/4	0.007369	0.041863	0.176026	0.8607
((QHFO_MAC*(ZWHD_MAC-ZWHN_MAC)/ZSAJQUS)+(QHFO_NEC*(ZWHD_NEC-ZWHD_NEC)/ZSAJQUS))/(QHFO_MAC+QHFO_NEC)	-0.027140	0.172620	-0.157223	0.8754
D05ON+D0410+D0411+D0412	3.976054	0.843020	4.716443	0.0000
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	0.307417	0.833583	0.368790	0.7132
D0001+D0002	8.628261	2.103351	4.102151	0.0001
D0003	-10.93182	2.938115	-3.720692	0.0004
D0510	-11.15126	2.860964	-3.897727	0.0002
JAN	-0.393534	1.284673	-0.306330	0.7601
FEB	-0.061264	1.294031	-0.047344	0.9623
MAR	-1.853120	1.332730	-1.390469	0.1679
APR	-5.353860	1.270233	-4.214864	0.0001
MAY	-4.161531	1.273626	-3.267469	0.0016
JUN	-4.072504	1.280475	-3.180463	0.0020
JUL	-5.673957	1.285966	-4.412215	0.0000
AUG	-7.394498	1.303761	-5.671667	0.0000
SEP	-2.303112	1.329696	-1.732059	0.0868
OCT	-2.806449	1.333668	-2.104308	0.0382
NOV	0.571617	1.298232	0.440304	0.6608
D2RCUNE(-1)-D2WHUUS(-1)	0.668632	0.037874	17.65400	0.0000

R-squared	0.950585	Mean dependent var	48.36472
Adjusted R-squared	0.939226	S.D. dependent var	10.78849
S.E. of regression	2.659627	Akaike info criterion	4.966915
Sum squared resid	615.4046	Schwarz criterion	5.488440
Log likelihood	-247.2134	Hannan-Quinn criter.	5.178374
F-statistic	83.68058	Durbin-Watson stat	1.563202
Prob(F-statistic)	0.000000		

Regression 12. D2RCUSO - D2WHUUS, Heating oil retail - wholesale price spread, South region

Dependent Variable: D2RCUSO-D2WHUUS
Method: Least Squares
Date: 06/02/09 Time: 16:09
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.32253	2.363517	6.482935	0.0000
D2WHUUS-D2WHUUS(-1)	-0.250970	0.024636	-10.18716	0.0000
DFPSPP1(-1)-(DFPSPP1(-13)+DFPSPP1(-25)+DFPSPP1(-37)+DFPSPP1(-49))/4	-0.186585	0.043978	-4.242682	0.0001
((QHFO_ESC*(ZWHD_ESC-ZWHN_ESC)/ZSAJQUS+QHFO_WSC*(ZWHD_WSC-ZWHN_WSC)/ZSAJQUS+QHFO_SAC*(ZWHD_SAC-ZWHN_SAC)/ZSAJQUS))/(QHFO_ESC+QHFO_WSC+QHFO_SAC)	-0.201141	0.175560	-1.145707	0.2551
D05ON+D0410+D0411+D0412	4.904049	0.975276	5.028372	0.0000
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	2.397198	0.912772	2.626284	0.0102
D0508	7.012883	3.232613	2.169416	0.0328
D0509	10.74626	3.283611	3.272696	0.0015
D0609	11.48875	3.500481	3.282049	0.0015
D0703	9.363929	3.232254	2.897028	0.0048
JAN	0.752412	1.439248	0.522781	0.6025
FEB	0.896294	1.447698	0.619116	0.5375
MAR	-3.447255	1.506715	-2.287927	0.0246
APR	-6.277470	1.444551	-4.345619	0.0000
MAY	-8.347535	1.440998	-5.792886	0.0000
JUN	-8.459418	1.482563	-5.705942	0.0000
JUL	-6.940617	1.531977	-4.530496	0.0000
AUG	-7.423450	1.596343	-4.650284	0.0000
SEP	-4.043687	1.608324	-2.514225	0.0138
OCT	-2.659277	1.490132	-1.784592	0.0779
NOV	0.081706	1.460948	0.055927	0.9555
D2RCUSO(-1)-D2WHUUS(-1)	0.679150	0.043945	15.45445	0.0000

R-squared	0.944132	Mean dependent var	45.76919
Adjusted R-squared	0.930490	S.D. dependent var	11.40263
S.E. of regression	3.006276	Akaike info criterion	5.218905
Sum squared resid	777.2419	Schwarz criterion	5.765265
Log likelihood	-259.8209	Hannan-Quinn criter.	5.440434
F-statistic	69.20687	Durbin-Watson stat	1.625000
Prob(F-statistic)	0.000000		

Regression 13. D2RCUMW - D2WHUUS, Heating oil retail - wholesale price spread, Midwest region

Dependent Variable: D2RCUMW-D2WHUUS
Method: Least Squares
Date: 06/02/09 Time: 16:10
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.652418	2.538059	2.621066	0.0103
D2WHUUS-D2WHUUS(-1)	-0.094741	0.026924	-3.518882	0.0007
DFPSPP2(-1)-(DFPSPP2(-13)+DFPSPP2(-25)+DFPSPP2(-37)+DFPSPP2(-49))/4	-0.614340	0.206875	-2.969621	0.0039
((QHFO_ENC*(ZWHD_ENC-ZWHN_ENC)/ZSAJQUS)+(QHFO_WNC*(ZWHD_WNC-ZWHN_WNC)/ZSAJQUS))/(QHFO_ENC+QHFO_WNC)	0.062917	0.125397	0.501745	0.6171
D05ON+D0410+D0411+D0412	3.891949	1.116619	3.485476	0.0008
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	-0.422525	1.024980	-0.412228	0.6812
D0607	8.611068	4.156735	2.071594	0.0413
D0609	-14.73469	4.183199	-3.522348	0.0007
D0703	9.645646	4.045810	2.384108	0.0193
JAN	0.248802	1.822289	0.136533	0.8917
FEB	4.282040	1.798270	2.381200	0.0194
MAR	3.658996	1.849594	1.978270	0.0511
APR	1.564417	1.802212	0.868053	0.3878
MAY	0.996875	1.786931	0.557870	0.5784
JUN	0.322447	1.797656	0.179371	0.8581
JUL	-1.336720	1.883319	-0.709768	0.4797
AUG	3.880697	1.832119	2.118146	0.0370
SEP	6.863022	1.887952	3.635168	0.0005
OCT	4.127803	1.780209	2.318718	0.0228
NOV	4.229404	1.803127	2.345594	0.0213
D2RCUMW(-1)-D2WHUUS(-1)	0.728732	0.053413	13.64345	0.0000

R-squared	0.886692	Mean dependent var	40.23761
Adjusted R-squared	0.860644	S.D. dependent var	9.991243
S.E. of regression	3.729772	Akaike info criterion	5.643237
Sum squared resid	1210.275	Schwarz criterion	6.164763
Log likelihood	-283.7348	Hannan-Quinn criter.	5.854697
F-statistic	34.04089	Durbin-Watson stat	1.563457
Prob(F-statistic)	0.000000		

Regression 14. D2RCUWE - D2WHUUS, Heating oil retail - wholesale price spread, West region

Dependent Variable: D2RCUWE-D2WHUUS
Method: Least Squares
Date: 06/02/09 Time: 16:10
Sample: 2000M01 2008M12
Included observations: 108

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-16.41708	15.04079	-1.091504	0.2782
D2WHUUS-D2WHUUS(-1)	-0.209651	0.037764	-5.551686	0.0000
DFPSPP5(-1)-(DFPSPP5(-13)+DFPSPP5(-25)+DFPSPP5(-37)+DFPSPP5(-49))/4	-3.116190	0.743287	-4.192446	0.0001
((QHFO_MTN*(ZWHD_MTN-ZWHN_MTN)/ZSAJQUS+QHFO_PAC*(ZWHD_PAC-ZWHN_PAC)/ZSAJQUS))/(QHFO_MTN+QHFO_PAC)	0.391288	0.356394	1.097907	0.2754
TIME	0.126590	0.051216	2.471662	0.0155
D05ON+D0410+D0411+D0412	2.681254	3.470985	0.772476	0.4420
D02+D03+D04-D0201-D0202-D0410-D0411-D0412	-5.053943	2.190583	-2.307123	0.0235
D0106+D0107	9.842017	4.135126	2.380101	0.0196
D0506+D0507	-13.67428	4.128249	-3.312367	0.0014
D0611+D0612	16.11991	4.181280	3.855258	0.0002
D0706	-14.25386	5.655617	-2.520302	0.0136
D0710	18.57932	5.661033	3.281967	0.0015
JAN	1.190119	2.522059	0.471884	0.6382
FEB	6.266714	2.579066	2.429839	0.0172
MAR	13.15282	2.542896	5.172378	0.0000
APR	10.02745	2.548961	3.933936	0.0002
MAY	7.073593	2.551061	2.772804	0.0068
JUN	6.743191	2.718620	2.480372	0.0151
JUL	4.720321	2.623334	1.799360	0.0756
AUG	5.597980	2.544250	2.200248	0.0305
SEP	6.347908	2.537615	2.501525	0.0143
OCT	3.468815	2.583298	1.342786	0.1830
NOV	4.605634	2.467706	1.866362	0.0655
D2RCUWE(-1)-D2WHUUS(-1)	0.408632	0.065788	6.211303	0.0000

R-squared	0.855611	Mean dependent var	56.46301
Adjusted R-squared	0.816076	S.D. dependent var	12.15814
S.E. of regression	5.214186	Akaike info criterion	6.333773
Sum squared resid	2283.770	Schwarz criterion	6.929802
Log likelihood	-318.0237	Hannan-Quinn criter.	6.575441
F-statistic	21.64180	Durbin-Watson stat	2.061739
Prob(F-statistic)	0.000000		