Table of Contents

1. Overview ................................................................................................................................. 2
2. Data sources ............................................................................................................................. 4
3. Variable naming convention ..................................................................................................... 4
4. Other petroleum product consumption module equations ..................................................... 6
   A. Asphalt and road oil .............................................................................................................. 6
   B. Petrochemical feedstocks ..................................................................................................... 8
   C. Miscellaneous other petroleum products .......................................................................... 9
   D. Petroleum coke .................................................................................................................... 11
   E. Still gas ................................................................................................................................ 13
   F. Unfinished oils ...................................................................................................................... 14
5. Forecast evaluations .................................................................................................................. 15
Appendix A. Variable definitions, units, and sources ................................................................. 21
Appendix B. EViews model program file .................................................................................... 22
Appendix C. Regression results .................................................................................................. 23
1. Overview

Most discussion of petroleum product consumption focuses on the five major petroleum products used: motor gasoline, jet fuel, distillate fuel, residual fuel, and liquefied petroleum gas. However, the third largest category of product consumption is "other" petroleum products, which represented about 11 percent of total petroleum product consumption in 2010.

The "other" petroleum product consumption module of the Short-Term Energy Outlook (STEO) model provides petroleum product consumption forecasts for the United States for 6 petroleum product categories (Table 1). 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).

<table>
<thead>
<tr>
<th>Product</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt and road oil</td>
<td>0.521</td>
<td>0.494</td>
<td>0.417</td>
<td>0.360</td>
<td>0.362</td>
</tr>
<tr>
<td>Petrochemical feedstocks</td>
<td>0.700</td>
<td>0.644</td>
<td>0.552</td>
<td>0.446</td>
<td>0.469</td>
</tr>
<tr>
<td>Petroleum coke</td>
<td>0.522</td>
<td>0.490</td>
<td>0.464</td>
<td>0.427</td>
<td>0.376</td>
</tr>
<tr>
<td>Still gas</td>
<td>0.709</td>
<td>0.697</td>
<td>0.670</td>
<td>0.664</td>
<td>0.670</td>
</tr>
<tr>
<td>Unfinished oils</td>
<td>0.033</td>
<td>0.031</td>
<td>-0.025</td>
<td>-0.037</td>
<td>0.022</td>
</tr>
<tr>
<td>Remaining miscellaneous products (1)</td>
<td><strong>0.323</strong></td>
<td><strong>0.306</strong></td>
<td><strong>0.281</strong></td>
<td><strong>0.252</strong></td>
<td><strong>0.262</strong></td>
</tr>
<tr>
<td>Total other petroleum products</td>
<td>2.808</td>
<td>2.663</td>
<td>2.359</td>
<td>2.112</td>
<td>2.161</td>
</tr>
</tbody>
</table>

Note: (1) Remaining miscellaneous products includes finished aviation gasoline, kerosene, special naphthas, lubricating oils, waxes, and miscellaneous products.

The STEO model contains over 2,000 equations, of which about 450 are estimated regression equations. The regression equations are estimated and the forecast models are solved using EViews Econometric Software (Quantitative Micro Software, LLC).

The other petroleum products consumption module, which is documented in this report, contains 7 equations, of which 6 are estimated regression equations. Some input variables to the other petroleum products consumption module are exogenous, coming from other modules in the STEO model or forecasts.
produced by other organizations (e.g., weather forecasts from the National Oceanic and Atmospheric Administration).

Consumption of other petroleum products reflects a variety of end uses. Consumption may be estimated as a function of crude oil refinery inputs (still gas consumption), overall economic activity measured by real GDP (asphalt and road oil), or industrial production indices (Figure 1).

**Figure 1. Flow chart of other petroleum products consumption.**
2. Data sources

The monthly volume data used in the other petroleum products consumption module appear in the EIA Petroleum Supply Monthly (PSM). The PSM includes volume data from surveys of primary suppliers such as refineries, pipelines, and bulk terminals. The PSM reports "products supplied", which approximately represents consumption of petroleum products because it measures the disappearance of these products from primary sources. In general, product supplied of each product in any given period is computed as follows: refinery production, plus imports, minus stock build, minus refinery inputs, and minus exports.

The other petroleum products consumption module uses macroeconomic variables such as real gross domestic product (GDP), wholesale price index, and industrial production indices as explanatory variables in the generation of forecasts. The macroeconomic forecasts are generated by models developed by IHS Global Insight Inc. (GI). GI updates its national macroeconomic forecasts monthly using its model of the U.S. economy. EIA re-runs the GI model to produce macroeconomic forecasts that are consistent with the STEO energy price forecasts.

Historical data for 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” values may be used. NOAA reports normal heating degree-days as the average of the 30-year period 1971-2000. However, the STEO model uses a corrected degree-day normal that adjusts for the warming trend that began around 1965 (The Impact of Temperature Trends on Short-Term Energy Demand).

3. Variable naming convention

Over 2,000 variables are used in the STEO model for estimation, simulation, and report writing. Most of these variables follow a similar naming convention. The
following table shows an example of this convention using total consumption of other petroleum products:

<table>
<thead>
<tr>
<th>Characters</th>
<th>PS</th>
<th>TC</th>
<th>P</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positions</td>
<td>1 and 2</td>
<td>3 and 4</td>
<td>5</td>
<td>6 and 7</td>
</tr>
<tr>
<td>Identity</td>
<td>Type of energy</td>
<td>Energy activity or consumption end-use sector</td>
<td>Type of data</td>
<td>Geographic area or special equation factor</td>
</tr>
</tbody>
</table>

In this example, PSTCPUS is the identifying code for other petroleum products (PS) total consumption (TC) physical units (P) in the United States (US).

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

Type of energy categories:
- AR = asphalt and road oil
- D2 = distillate fuel oil
- FE = petrochemical feedstock
- MZ = miscellaneous other petroleum products
- PC = petroleum coke
- PR = propane
- PS = total other petroleum products
- SG = still gas
- UO = unfinished oils
- ZO = industrial output
- ZW = weather

Energy activity or consumption end-use sectors:
- HD = heating degree-days
- MN = manufacturing sector
- PC = petrochemicals sector
- TC = total consumption
- 28 = chemicals and products sector (SIC 28)

Type of data:
- D = deviations from normal (e.g., heating degree days)
- P = data in physical units (e.g., barrels or barrels per day)

Geographic identification or special equation factor:
US = United States

Regression equations generally 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 may also be included in regression equations because the observed data may be outliers because of infrequent and unpredictable events such as hurricanes, survey error, or other factors. Generally, dummy variables are introduced when the absolute value of the estimated regression error is 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 the market or survey factors that may have contributed to the identified outliers.

Dummy variables for specific months are generally designated Dyyym, 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). A dummy variable might also be included in an equation to show a structural shift in the relationship between two time periods. Generally, these type of shifts are modeled using dummy variables designated DxxON, where xx = the last two digits of the years at the beginning of the latter shift period. For example, D03ON = 1 for January 2003 and all months after that date, = 0 for all months prior to 2003.

4. Other petroleum product consumption module equations

A. Asphalt and road oil

The heaviest fraction of many crude oils includes natural bitumens or asphaltenes, and is generally called asphalt. Asphalt and road oil consumption is highly seasonal but has been relatively stable until the last 5 years (Figure 2).
Since the 2005, asphalt and road oil consumption has been on a relatively steady decline, particularly during the peak summer months.

**Figure 2. Asphalt and road oil consumption, January 1981 - December 2010**

![Graph showing asphalt and road oil consumption, January 1981 - December 2010](image)

Asphalt and road oil consumption is a function of real GDP growth, the real price of crude oil, and heating degree-day deviations from normal per day (equation 1). A trend variable is included to capture the decline in consumption over the last few years, which may be due to growing State government budget constraints. Introducing a trend variable in place of a missing variable does introduce significant uncertainty into a forecast of asphalt and road oil consumption.

\[
ARTCPUS = a0 + a1 \times GDPQXUS\_PCT \\
+ a2 \times RACPUUS / WPCPIUS \\
+ a3 \times ZWHDDUS / ZSAJQUS \\
+ a4 \times @TREND(2005:12)*D06on \\
+ \text{monthly dummy variables}
\]  

(1)

where,

\begin{align*}
ARTCPUS & = \text{asphalt and road oil consumption, million barrels per day} \\
GDPQXUS\_PCT & = \text{change in real GDP from prior year, percent} \\
RACPUUS & = \text{U.S. refiner average acquisition cost of crude oil, dollars per barrel}
\end{align*}
WPCPIUS = wholesale price index
ZWHDDUS = heating degree-day deviations from normal
ZSAJQUS = number of days in the month
@TREND(2005:12)*D06on = 1 on January 2006, increasing by 1 each month; 0 before January 2006.

B. Petrochemical feedstocks

Petrochemical feedstocks are used in the manufacture of chemicals, synthetic rubber, and a variety of plastics. In some petrochemical production processes, such as ethylene crackers, there are several alternatives to petrochemical feedstocks and it is possible to substitute feedstocks. Consequently, we expect the consumption of petrochemical feedstocks to be a function of both industrial output and relative prices.

Between 1986 and 2006, consumption of petrochemical feedstocks had been on a relatively steady upward trend, except for the recession of 2001 (March 2001 – November 2001). The decline during the recession of 2008 (December 2007 – June 2009) was significantly greater than the previous recession (Figure 3).

Figure 3. Petrochemical feedstock consumption, January 1981 - December 2010

Source: EIA, Petroleum Supply Monthly, Table 3.
Petrochemical feedstock consumption is estimated as a function of the industrial production index, chemicals and products sector (equation 2). A natural gas – crude oil price spread is included to capture substitution between natural gas liquids and refined crude oil products such as naphtha and gas oil as feedstocks in petrochemical processes. The crude oil price is converted to dollars per million Btu by dividing by its approximate heat content.

\[
FETCPUS = a_0 + a_1 \times ZO28IUS + a_2 \times (NGHHUUS – WTIPUUS / 5.8) + \text{monthly dummy variables}
\]

where,

- \(FETCPUS\) = petrochemical feedstock consumption, million barrels per day
- \(ZO28IUS\) = industrial production index, chemicals and products sector
- \(NGHHUUS\) = natural gas spot price at Henry Hub, Louisiana, dollars per million Btu
- \(RACPUUS\) = refiner average acquisition cost of crude oil, dollars per barrel

C. Miscellaneous other petroleum products

The remaining miscellaneous products, less than 15 percent of the total of other petroleum products consumption, are estimated as a sub-aggregate variable, \(MZTCPUS\). The total volume of remaining miscellaneous products has been trending downwards since 2000 (Figure 4), with most of the decline occurring in kerosene and lubricants (Table 2).

Special naphthas represent all finished products within the naphtha boiling range that are used as paint thinners, cleaners, or solvents. The steady decline in demand for special naphthas may reflect increasingly stringent environmental regulations or a greater participation in the market from the petrochemical sector.

Kerosene is used primarily used in space heaters, cooking stoves, and water heaters. The steady decline in kerosene demand likely reflects fuel switching (e.g., to natural gas or bottled propane) and growing demand for kerosene-type jet fuel.
Figure 4. Remaining miscellaneous products consumption, January 1981 - December 2010

<table>
<thead>
<tr>
<th>Product</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation gasoline blend components</td>
<td>0.000</td>
<td>0.001</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Lubricants</td>
<td>0.137</td>
<td>0.142</td>
<td>0.131</td>
<td>0.118</td>
<td>0.130</td>
</tr>
<tr>
<td>Special Naphthas</td>
<td>0.037</td>
<td>0.041</td>
<td>0.044</td>
<td>0.024</td>
<td>0.014</td>
</tr>
<tr>
<td>Kerosene</td>
<td>0.054</td>
<td>0.032</td>
<td>0.014</td>
<td>0.018</td>
<td>0.020</td>
</tr>
<tr>
<td>Finished Aviation Gasoline</td>
<td>0.018</td>
<td>0.017</td>
<td>0.015</td>
<td>0.014</td>
<td>0.015</td>
</tr>
<tr>
<td>Waxes</td>
<td>0.013</td>
<td>0.011</td>
<td>0.009</td>
<td>0.006</td>
<td>0.008</td>
</tr>
<tr>
<td>Miscellaneous Products</td>
<td>0.064</td>
<td>0.063</td>
<td>0.067</td>
<td>0.072</td>
<td>0.075</td>
</tr>
<tr>
<td>Total remaining miscellaneous products</td>
<td>0.323</td>
<td>0.306</td>
<td>0.281</td>
<td>0.252</td>
<td>0.262</td>
</tr>
</tbody>
</table>

Source: U.S. Energy Information Administration, Petroleum Supply Monthly, Table 3.
Total remaining miscellaneous products (MZTCPUS) is regressed against the industrial production index for the manufacturing sector (ZOMNIUS), a time trend variable, and monthly dummy variables (equation 3):

\[
MZTCPUS = a_0 + a_1 * ZOMNIUS + a_2 * @TREND(2000:12) + \text{monthly dummy variables}
\]

where,

- MZTCPUS = miscellaneous other petroleum products consumption, million barrels per day
- ZOMNIUS = Industrial production index, manufacturing sector
- @TREND(2000:12) = 1 on January 2001, increasing by 1 each month.

**D. Petroleum coke**

Petroleum coke is a by-product of the upgrading of the heaviest petroleum fractions (e.g., residual fuel oil) to more valuable lighter products in crude oil refinery coking units. Petroleum coke is produced as either sponge coke, needle coke, or fluid coke, which vary primarily by particle size. About 65% of the coke produced in the United States is used as fuel. The remaining 35% is sponge coke that, when calcined, is sold as premium-grade coke used in the manufacture of aluminum anodes, furnace electrodes and liners, and shaped graphite products. Petroleum coke consumption had steadily increased as U.S. refiners increased their capability of upgrading heavy crude oil and increased their production of petroleum coke as a byproduct (Figure 5). Downturns in consumption occurred during the last two recessions of March 2001 – December 2001 and December 2007 – June 2009.
Figure 5. Petroleum coke consumption, January 1981 - December 2010

Domestic petroleum coke consumption is estimated in equation (4) as a function of industrial production, the ratio of the natural gas price to the coal price to electric utilities, and heating degree-day deviations from normal per day, and monthly dummy variables:

\[
PCTCPUS = a_0 + a_1 \times ZOTOIUS + a_2 \times \frac{NGEUDUS}{CLEUDUS} + a_3 \times \frac{ZWHDDUS}{ZSAJQUS} + \text{monthly dummy variables}
\]  

where,

- \( PCTCPUS \): current month petroleum coke consumption
- \( CLEUDUS \): average cost of coal to electric power sector, dollars per million
- \( NGEUDUS \): average cost of natural gas to electric power sector, dollars per million Btu
- \( ZOTOIUS \): total industrial production index
- \( ZWHDDUS \): heating degree-day deviations from normal
- \( ZSAJQUS \): number of days in the month
- \( @TREND(2005:12)^*D06on = 1 \) on January 2006, increasing by 1 each month; 0 before January 2006.

Source: EIA, Petroleum Supply Monthly, Table 3.
E. Still gas

Still gas (also known as refinery gas) is any form or mixture of gas produced in refineries by cracking, reforming, and other processes. Still gas is produced as a by-product in the upgrading of heavy petroleum fractions to more valuable lighter products and is consumed internally as refinery fuel. Still gas consumption has been relatively stable over the last 2 years (Figure 6).

**Figure 6. Still gas consumption, January 1981 - December 2010**

Since the supply of still gas creates its own demand, still gas consumption (SGTCPUS) is modeled in equation (5) as a function of refinery inputs of crude oil (CORIPUS) and unfinished oils (UORIPUS).

\[
SGTCPUS = a0 + a1 \times CORIPUS + a2 \times UORIPUS + \text{monthly dummy variables}
\]  

Where,

SGTCPUS = still gas consumption, million barrels per day  
CORIPUS = refinery inputs of crude oil, million barrels per day  
UORIPUS = refinery inputs of unfinished oils, million barrels per day
F. Unfinished oils

Unfinished oils include all oils requiring further processing, except those requiring only mechanical blending. Unfinished oils are produced by partial refining of crude oil and include naphthas and lighter oils, kerosene and light gas oils, heavy gas oils, and residuum. Table 3 summarizes the annual average volumes of unfinished oils consumption by type of oil.

Table 3. Unfinished oils consumption (million barrels per day)

<table>
<thead>
<tr>
<th>Product</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naphtha and lighter oils</td>
<td>0.001</td>
<td>0.037</td>
<td>0.005</td>
<td>-0.026</td>
<td>0.031</td>
</tr>
<tr>
<td>Kerosene and light gas oils</td>
<td>0.056</td>
<td>0.034</td>
<td>-0.015</td>
<td>-0.040</td>
<td>-0.034</td>
</tr>
<tr>
<td>Heavy gas oils</td>
<td>-0.091</td>
<td>-0.100</td>
<td>-0.125</td>
<td>-0.102</td>
<td>-0.139</td>
</tr>
<tr>
<td>Residuum</td>
<td>0.068</td>
<td>0.060</td>
<td>0.110</td>
<td>0.130</td>
<td>0.163</td>
</tr>
<tr>
<td>Total unfinished oils</td>
<td>0.033</td>
<td>0.031</td>
<td>-0.025</td>
<td>-0.036</td>
<td>0.020</td>
</tr>
</tbody>
</table>


We normally expect that unfinished oil consumption should equal zero. Over the last 30 years, however, unfinished oils consumption has generally been negative (Figure 7). Unfinished oils that are delivered to end users should be classified as refined products such as petrochemical feedstocks or residual fuel oil. However, unfinished oils can be misclassified by respondents to EIA’s surveys. For example, one refiner may sell residual fuel oil to another refiner for use as a feedstock. If the first refiner classifies the product as residual fuel oil and the second refiner classifies it as unfinished oil residuum then residual fuel oil consumption may be overstated and unfinished oil consumption understated (and possibly negative).
Figure 7. Unfinished oils consumption, January 1981 – December 2010

Unfinished oils consumption is estimated in regression equation (6) as a function of prior month consumption and monthly dummy variables:

\[ UOTCPUS = a_0 + a_1 \times UOTCPUS(-1) \]

+ monthly dummy variables

(6)

where,

- \( UOTCPUS = \) current month consumption
- \( UOTCPUS(-1) = \) prior month consumption unfinished oils

5. Forecast evaluations

In order to evaluate the reliability of the forecasts, we generated out-of-sample forecasts and calculated forecast errors. Each equation was estimated through December 2008. Dynamic forecasts were then generated for the period January 2009 through December 2010 using each regression equation (see Figures 8 – 13). The forecasts are then compared with actual outcomes.

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.

Table 4 reports the differences between the out-of-sample dynamic forecast and actual consumption for each regression equation for the years 2009 and 2010. A forecast for total other petroleum products is calculated as the sum of the 6 individual product forecasts. The out-of-sample forecast of total other petroleum products consumption for 2009 was about 3.4 percent higher than actual consumption, while the forecast for 2010 was about 2.4 percent higher than actual consumption. The primary sources of forecast error in 2009 were petrochemical feedstocks and unfinished oils consumption. The primary source of error in the 2010 forecast was petroleum coke consumption.

Table 4. Actual versus out-of-sample consumption forecasts, annual averages (million barrels per day)

<table>
<thead>
<tr>
<th>Equation</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Forecast</td>
</tr>
<tr>
<td>ARTCPUS</td>
<td>0.360</td>
<td>0.375</td>
</tr>
<tr>
<td>FETCPUS</td>
<td>0.446</td>
<td>0.488</td>
</tr>
<tr>
<td>MZTCPUS</td>
<td>0.252</td>
<td>0.239</td>
</tr>
<tr>
<td>PCTCPUS</td>
<td>0.427</td>
<td>0.431</td>
</tr>
<tr>
<td>SGTCPUS</td>
<td>0.664</td>
<td>0.655</td>
</tr>
<tr>
<td>UOTCPUS</td>
<td>-0.037</td>
<td>-0.004</td>
</tr>
<tr>
<td>Total</td>
<td>2.112</td>
<td>2.184</td>
</tr>
</tbody>
</table>

Source: EIA, Short-Term Energy Outlook model.
The differences between the monthly out-of-sample forecasts and actual values are shown in Figures 8 through 13 for the 6 regression equations.

**Figure 8.** ARTCPUS, Asphalt and road oil consumption out-of-sample forecast versus actual, January 2009 – December 2010

**Figure 9.** FETCPUS, Petrochemical feedstock consumption out-of-sample forecast versus actual, January 2009 – December 2010

Source: EIA, Short-Term Energy Outlook model
Figure 10. MZTCPUS, Remaining miscellaneous products consumption out-of-sample forecast versus actual, January 2009–December 2010

Figure 11. PCTCPUS, Petroleum coke consumption out-of-sample forecast versus actual, January 2009–December 2010
Figure 12. SGTCPUS, Still gas consumption out-of-sample forecast versus actual, January 2009 – December 2010

<table>
<thead>
<tr>
<th>Month</th>
<th>Actual Consumption</th>
<th>Forecast Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-08</td>
<td>0.75</td>
<td>0.70</td>
</tr>
<tr>
<td>Jan-09</td>
<td>0.68</td>
<td>0.65</td>
</tr>
<tr>
<td>Jan-10</td>
<td>0.59</td>
<td>0.55</td>
</tr>
<tr>
<td>Jan-11</td>
<td>0.62</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Source: EIA, Short-Term Energy Outlook model

Figure 13. UOTCPUS, Unfinished oils consumption out-of-sample forecast versus actual, January 2009 – December 2010

<table>
<thead>
<tr>
<th>Month</th>
<th>Actual Consumption</th>
<th>Forecast Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-08</td>
<td>-0.05</td>
<td>-0.04</td>
</tr>
<tr>
<td>Jan-09</td>
<td>0.08</td>
<td>0.10</td>
</tr>
<tr>
<td>Jan-10</td>
<td>-0.12</td>
<td>-0.15</td>
</tr>
<tr>
<td>Jan-11</td>
<td>0.06</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Source: EIA, Short-Term Energy Outlook model

Table reports summary forecast error statistics 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.

The bias proportions are relatively low for each of the 6 forecasted series in Table 5. The highest bias proportion occurred in the petroleum coke forecast, which can be seen in the forecast of 2010 consumption rising above actual in Figure 11. The variance proportions are also relatively low with the exception of asphalt and road oil, which is a result of the very strong seasonality in that consumption (Figure 8).

Table 5. Regional consumption out-of-sample simulation error statistics

<table>
<thead>
<tr>
<th></th>
<th>UOTCPUS</th>
<th>FETCPUS</th>
<th>PCTCPUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root Mean Squared Error</td>
<td>0.077</td>
<td>0.062</td>
<td>0.072</td>
</tr>
<tr>
<td>Mean Absolute Error</td>
<td>0.062</td>
<td>0.047</td>
<td>0.063</td>
</tr>
<tr>
<td>Mean Absolute Percentage Error</td>
<td>320</td>
<td>10.5</td>
<td>16.7</td>
</tr>
<tr>
<td>Theil Inequality Coefficient</td>
<td>0.601</td>
<td>0.066</td>
<td>0.084</td>
</tr>
<tr>
<td>Bias Proportion</td>
<td>0.000</td>
<td>0.096</td>
<td>0.294</td>
</tr>
<tr>
<td>Variance Proportion</td>
<td>0.047</td>
<td>0.083</td>
<td>0.155</td>
</tr>
<tr>
<td>Covariance Proportion</td>
<td>0.953</td>
<td>0.822</td>
<td>0.551</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>ARTCPUS</th>
<th>SGTCPUS</th>
<th>MZTCPUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root Mean Squared Error</td>
<td>0.065</td>
<td>0.018</td>
<td>0.038</td>
</tr>
<tr>
<td>Mean Absolute Error</td>
<td>0.057</td>
<td>0.014</td>
<td>0.031</td>
</tr>
<tr>
<td>Mean Absolute Percentage Error</td>
<td>16.0</td>
<td>2.11</td>
<td>12.2</td>
</tr>
<tr>
<td>Theil Inequality Coefficient</td>
<td>0.082</td>
<td>0.014</td>
<td>0.077</td>
</tr>
<tr>
<td>Bias Proportion</td>
<td>0.165</td>
<td>0.064</td>
<td>0.221</td>
</tr>
<tr>
<td>Variance Proportion</td>
<td>0.516</td>
<td>0.000</td>
<td>0.003</td>
</tr>
<tr>
<td>Covariance Proportion</td>
<td>0.319</td>
<td>0.936</td>
<td>0.775</td>
</tr>
</tbody>
</table>

Notes: Forecast period = January 2008 – December 2009
Appendix A. Variable definitions, units, and sources

Table A1. Variable definitions, units, and sources

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Units</th>
<th>Definition</th>
<th>Sources</th>
<th>History</th>
<th>Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABTCPUS</td>
<td>MMBD</td>
<td>Aviation gasoline blending components product supplied</td>
<td>PSM</td>
<td>--</td>
<td>STEO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(consumption)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APR</td>
<td>Integer</td>
<td>= 1 if April, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>ARTCPUS</td>
<td>MMBD</td>
<td>Asphalt and road oil product supplied (consumption)</td>
<td>PSM</td>
<td>--</td>
<td>STEO</td>
</tr>
<tr>
<td>AUG</td>
<td>Integer</td>
<td>= 1 if August, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>CORIPUS</td>
<td>MMBD</td>
<td>Crude oil refinery inputs</td>
<td>PSM</td>
<td>--</td>
<td>STEO</td>
</tr>
<tr>
<td>Ddy</td>
<td>Integer</td>
<td>= 1 if year (yy), 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Dyymm</td>
<td>Integer</td>
<td>= 1 if month (mm) and year (yy), 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>DyyON</td>
<td>Integer</td>
<td>= 1 if year (yy) or later, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>D2WHUUS</td>
<td>CPG</td>
<td>Distillate fuel oil wholesale price</td>
<td>PMM</td>
<td>STEO</td>
<td></td>
</tr>
<tr>
<td>DEC</td>
<td>Integer</td>
<td>= 1 if December, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>FEB</td>
<td>Integer</td>
<td>= 1 if February, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>FETCPUS</td>
<td>MMBD</td>
<td>Petrochemical feedstocks product supplied (consumption)</td>
<td>PSM</td>
<td>STEO</td>
<td></td>
</tr>
<tr>
<td>GDPQXUS_PCT</td>
<td>Percent</td>
<td>Change in U.S. real GDP from prior year</td>
<td>GI</td>
<td>STEO</td>
<td></td>
</tr>
<tr>
<td>JAN</td>
<td>Integer</td>
<td>= 1 if January, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>JUL</td>
<td>Integer</td>
<td>= 1 if July, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>JUN</td>
<td>Integer</td>
<td>= 1 if June, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>MAR</td>
<td>Integer</td>
<td>= 1 if March, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>MAY</td>
<td>Integer</td>
<td>= 1 if May, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>MZTCPUS</td>
<td>MMBD</td>
<td>Miscellaneous products product supplied (consumption)</td>
<td>PSM</td>
<td>STEO</td>
<td></td>
</tr>
<tr>
<td>NOV</td>
<td>Integer</td>
<td>= 1 if November, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>OCT</td>
<td>Integer</td>
<td>= 1 if October, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>PCTCPUS</td>
<td>MMBD</td>
<td>Petroleum coke product supplied (consumption)</td>
<td>PSM</td>
<td>STEO</td>
<td></td>
</tr>
<tr>
<td>PRPCUUS</td>
<td>CPG</td>
<td>Propane wholesale price</td>
<td>PMM</td>
<td>STEO</td>
<td></td>
</tr>
<tr>
<td>PSTCPUS</td>
<td>MMBD</td>
<td>Total other petroleum products product supplied</td>
<td>PSM</td>
<td>STEO</td>
<td></td>
</tr>
<tr>
<td>RACPUUS</td>
<td>DPB</td>
<td>U.S. refiner average crude oil acquisition cost</td>
<td>PMM</td>
<td>STEO</td>
<td></td>
</tr>
<tr>
<td>SEP</td>
<td>Integer</td>
<td>= 1 if September, 0 otherwise</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>SGTCPSU</td>
<td>MMBD</td>
<td>Still gas product supplied (consumption)</td>
<td>PSM</td>
<td>STEO</td>
<td></td>
</tr>
<tr>
<td>UORIPUS</td>
<td>MMBD</td>
<td>Unfinished oils refinery inputs</td>
<td>PSM</td>
<td>STEO</td>
<td></td>
</tr>
<tr>
<td>WPCPIUS</td>
<td>Index</td>
<td>Wholesale price index</td>
<td>GI</td>
<td>Gi</td>
<td></td>
</tr>
<tr>
<td>ZO28IUS</td>
<td>Index</td>
<td>Industrial production index, chemicals and products sector</td>
<td>GI</td>
<td>Gi</td>
<td></td>
</tr>
<tr>
<td>ZOMNIUS</td>
<td>Index</td>
<td>Industrial production index, manufacturing</td>
<td>GI</td>
<td>Gi</td>
<td></td>
</tr>
<tr>
<td>ZOTOIUS</td>
<td>Index</td>
<td>Industrial production index, all sectors</td>
<td>GI</td>
<td>Gi</td>
<td></td>
</tr>
<tr>
<td>ZSAJQUS</td>
<td>Integer</td>
<td>Number of days in a month</td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>ZWHDDUS</td>
<td>HDD</td>
<td>U.S. Heating degree-days, deviation from normal</td>
<td>NOAA</td>
<td>NOAA</td>
<td></td>
</tr>
</tbody>
</table>

Table A2. Units key

<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPG</td>
<td>Cents per gallon</td>
</tr>
<tr>
<td>DPB</td>
<td>Dollars per barrel</td>
</tr>
<tr>
<td>HDD</td>
<td>Heating degree-days</td>
</tr>
<tr>
<td>Index</td>
<td>Index value</td>
</tr>
<tr>
<td>Integer</td>
<td>Number = 0 or 1</td>
</tr>
<tr>
<td>MMBD</td>
<td>Million barrels per day</td>
</tr>
</tbody>
</table>

Table A3. Sources key

<table>
<thead>
<tr>
<th>Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLS</td>
<td>Bureau of Labor Statistics</td>
</tr>
<tr>
<td>GI</td>
<td>IHS-Global Insight</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Organization</td>
</tr>
<tr>
<td>PMM</td>
<td>EIA Petroleum Marketing Monthly</td>
</tr>
<tr>
<td>PSM</td>
<td>EIA Petroleum Supply Monthly</td>
</tr>
<tr>
<td>STEO</td>
<td>Short-term Energy Outlook Model</td>
</tr>
</tbody>
</table>

U.S. Energy Information Administration—November 2011
Other Petroleum Products Consumption Module - Short-Term Energy Outlook Model Documentation

21
Appendix B. EViews model program file

'----------------------------------------------------------------------------------------------------------------------
'----- Crude Oil and Other Liquids consumption
'----------------------------------------------------------------------------------------------------------------------

:EQ_UOTCPUS
@ADD UOTCPUS_UOTCPUS_A

:EQ_FETCPUS
@ADD FETCPUS_FETCPUS_A

:EQ_PCTCPUS
@ADD PCTCPUS_PCTCPUS_A

:EQ_SGTCPUS
@ADD SGTCPUS_SGTCPUS_A

:EQ_ARTCPUS
@ADD ARTCPUS_ARTCPUS_A

:EQ_MZTCPUS
@ADD MZTCPUS_MZTCPUS_A

'----------------------------------------------------------------------------------------------------------------------
'----- Calculate a sub aggregate
'----------------------------------------------------------------------------------------------------------------------

@IDENTITY PSTCPUS = FETCPUS + SGTCPUS + ARTCPUS + PCTCPUS + MZTCPUS
Appendix C. Regression results

C1. ARTCPUS, Asphalt and road oil consumption, million barrels per day

Dependent Variable: ARTCPUS
Method: Least Squares
Date: 04/25/11  Time: 15:32
Sample: 2001M01 2010M12
Included observations: 120

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.152337</td>
<td>0.026316</td>
<td>5.788778</td>
<td>0.0000</td>
</tr>
<tr>
<td>GDPQXUS_PCT</td>
<td>0.004909</td>
<td>0.001992</td>
<td>2.464088</td>
<td>0.0155</td>
</tr>
<tr>
<td>RACPUUS/WPCPIUS</td>
<td>0.000393</td>
<td>0.000407</td>
<td>0.966523</td>
<td>0.3362</td>
</tr>
<tr>
<td>ZWHDDUS/ZSAJQUS</td>
<td>0.000979</td>
<td>0.002258</td>
<td>0.433616</td>
<td>0.6655</td>
</tr>
<tr>
<td>@TREND(2005:12)*D06ON</td>
<td>-0.001830</td>
<td>0.000367</td>
<td>-4.985107</td>
<td>0.0000</td>
</tr>
<tr>
<td>D0506</td>
<td>0.133596</td>
<td>0.037108</td>
<td>3.600165</td>
<td>0.0005</td>
</tr>
<tr>
<td>D0511</td>
<td>0.110295</td>
<td>0.037219</td>
<td>2.963414</td>
<td>0.0038</td>
</tr>
<tr>
<td>D0612</td>
<td>-0.102407</td>
<td>0.038332</td>
<td>-2.671563</td>
<td>0.0089</td>
</tr>
<tr>
<td>D0701</td>
<td>0.118694</td>
<td>0.037596</td>
<td>3.157082</td>
<td>0.0021</td>
</tr>
<tr>
<td>D0808</td>
<td>-0.105829</td>
<td>0.038279</td>
<td>-2.764695</td>
<td>0.0068</td>
</tr>
<tr>
<td>D0812</td>
<td>0.114201</td>
<td>0.038674</td>
<td>2.952931</td>
<td>0.0040</td>
</tr>
<tr>
<td>D0902</td>
<td>0.110019</td>
<td>0.039080</td>
<td>2.815270</td>
<td>0.0059</td>
</tr>
<tr>
<td>FEB</td>
<td>0.007684</td>
<td>0.017027</td>
<td>0.451258</td>
<td>0.6528</td>
</tr>
<tr>
<td>MAR</td>
<td>0.061893</td>
<td>0.016179</td>
<td>3.825384</td>
<td>0.0002</td>
</tr>
<tr>
<td>APR</td>
<td>0.132010</td>
<td>0.016712</td>
<td>7.898966</td>
<td>0.0000</td>
</tr>
<tr>
<td>MAY</td>
<td>0.182059</td>
<td>0.019425</td>
<td>9.372221</td>
<td>0.0000</td>
</tr>
<tr>
<td>JUN</td>
<td>0.262516</td>
<td>0.024060</td>
<td>10.91102</td>
<td>0.0000</td>
</tr>
<tr>
<td>JUL</td>
<td>0.209397</td>
<td>0.031683</td>
<td>6.606056</td>
<td>0.0000</td>
</tr>
<tr>
<td>AUG</td>
<td>0.261391</td>
<td>0.031820</td>
<td>8.214787</td>
<td>0.0000</td>
</tr>
<tr>
<td>SEP</td>
<td>0.168264</td>
<td>0.033879</td>
<td>4.966597</td>
<td>0.0000</td>
</tr>
<tr>
<td>OCT</td>
<td>0.147267</td>
<td>0.029730</td>
<td>4.953529</td>
<td>0.0000</td>
</tr>
<tr>
<td>NOV</td>
<td>0.033880</td>
<td>0.027209</td>
<td>1.245167</td>
<td>0.2161</td>
</tr>
<tr>
<td>DEC</td>
<td>-0.061620</td>
<td>0.021078</td>
<td>-2.923349</td>
<td>0.0043</td>
</tr>
<tr>
<td>ARTCPUS(-1)</td>
<td>0.443401</td>
<td>0.073629</td>
<td>6.022075</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared                      | 0.965443    | Mean dependent var | 0.476347 |
Adjusted R-squared             | 0.957164    | S.D. dependent var  | 0.169226 |
S.E. of regression             | 0.035025    | Akaike info criterion | -3.688681 |
Sum squared resid              | 0.117765    | Schwarz criterion   | -3.131182 |
Log likelihood                 | 245.3208    | Hannan-Quinn criter. | -3.462778 |
F-statistic                    | 116.6105    | Durbin-Watson stat  | 1.734857  |
Prob(F-statistic)              | 0.000000    |
C2. FETCPUS, Petrochemical feedstock consumption, million barrels per day

Dependent Variable: FETCPUS
Method: Least Squares
Date: 04/25/11   Time: 15:54
Sample: 2001M01 2010M12
Included observations: 120

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.168628</td>
<td>0.086985</td>
<td>-1.938580</td>
<td>0.0553</td>
</tr>
<tr>
<td>ZO28IUS</td>
<td>0.004816</td>
<td>0.001249</td>
<td>3.855404</td>
<td>0.0002</td>
</tr>
<tr>
<td>NGHHUUS-(WTIPUUS/5.8)</td>
<td>0.008465</td>
<td>0.001993</td>
<td>4.247266</td>
<td>0.0000</td>
</tr>
<tr>
<td>D0402</td>
<td>0.205145</td>
<td>0.060223</td>
<td>3.406428</td>
<td>0.0009</td>
</tr>
<tr>
<td>D0509</td>
<td>-0.218534</td>
<td>0.060971</td>
<td>-3.584248</td>
<td>0.0005</td>
</tr>
<tr>
<td>D0601</td>
<td>0.307875</td>
<td>0.060453</td>
<td>5.092841</td>
<td>0.0000</td>
</tr>
<tr>
<td>FEB</td>
<td>-0.030864</td>
<td>0.026922</td>
<td>-1.146426</td>
<td>0.2543</td>
</tr>
<tr>
<td>MAR</td>
<td>0.021568</td>
<td>0.026254</td>
<td>0.821493</td>
<td>0.4133</td>
</tr>
<tr>
<td>APR</td>
<td>0.034659</td>
<td>0.026277</td>
<td>1.318987</td>
<td>0.1901</td>
</tr>
<tr>
<td>MAY</td>
<td>0.038681</td>
<td>0.026367</td>
<td>1.467024</td>
<td>0.1454</td>
</tr>
<tr>
<td>JUN</td>
<td>0.019377</td>
<td>0.026530</td>
<td>0.730390</td>
<td>0.4668</td>
</tr>
<tr>
<td>JUL</td>
<td>0.059745</td>
<td>0.026639</td>
<td>2.242767</td>
<td>0.0271</td>
</tr>
<tr>
<td>AUG</td>
<td>0.033130</td>
<td>0.026951</td>
<td>1.229297</td>
<td>0.2218</td>
</tr>
<tr>
<td>SEP</td>
<td>0.029425</td>
<td>0.027517</td>
<td>1.069312</td>
<td>0.2875</td>
</tr>
<tr>
<td>OCT</td>
<td>0.013322</td>
<td>0.026350</td>
<td>0.505591</td>
<td>0.6142</td>
</tr>
<tr>
<td>NOV</td>
<td>0.040606</td>
<td>0.026325</td>
<td>1.542477</td>
<td>0.1261</td>
</tr>
<tr>
<td>DEC</td>
<td>0.005965</td>
<td>0.026236</td>
<td>0.227354</td>
<td>0.8206</td>
</tr>
<tr>
<td>FETCPUS(-1)</td>
<td>0.582420</td>
<td>0.071204</td>
<td>8.179599</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.787344  Mean dependent var 0.608259
Adjusted R-squared 0.751901  S.D. dependent var 0.114505
S.E. of regression 0.057034  Akaike info criterion -2.752845
Sum squared resid 0.331798  Schwarz criterion -2.334721
Log likelihood 183.1707  Hannan-Quinn criter. -2.583043
F-statistic 22.21453  Durbin-Watson stat 2.025050
Prob(F-statistic) 0.000000
### C3. MZTCPUS, Remaining miscellaneous products consumption, million barrels per day

Dependent Variable: MZTCPUS  
Method: Least Squares  
Date: 04/25/11   Time: 16:04  
Sample: 2001M01 2010M12  
Included observations: 120

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.247032</td>
<td>0.045808</td>
<td>5.392761</td>
<td>0.0000</td>
</tr>
<tr>
<td>ZOMNIUS</td>
<td>0.001627</td>
<td>0.000474</td>
<td>3.429754</td>
<td>0.0009</td>
</tr>
<tr>
<td>@TREND(2000:12)</td>
<td>-0.000846</td>
<td>0.000114</td>
<td>-7.424980</td>
<td>0.0000</td>
</tr>
<tr>
<td>D0111</td>
<td>0.079968</td>
<td>0.028987</td>
<td>2.758718</td>
<td>0.0069</td>
</tr>
<tr>
<td>D0306</td>
<td>-0.064963</td>
<td>0.028336</td>
<td>-2.292584</td>
<td>0.0240</td>
</tr>
<tr>
<td>D0312</td>
<td>0.100367</td>
<td>0.028320</td>
<td>3.544072</td>
<td>0.0006</td>
</tr>
<tr>
<td>D0602</td>
<td>0.109987</td>
<td>0.028404</td>
<td>3.872293</td>
<td>0.0002</td>
</tr>
<tr>
<td>D0801</td>
<td>-0.097805</td>
<td>0.028696</td>
<td>-3.408337</td>
<td>0.0009</td>
</tr>
<tr>
<td>D1001</td>
<td>-0.102467</td>
<td>0.028850</td>
<td>-3.551700</td>
<td>0.0006</td>
</tr>
<tr>
<td>FEB</td>
<td>-0.058170</td>
<td>0.013153</td>
<td>-4.422480</td>
<td>0.0000</td>
</tr>
<tr>
<td>MAR</td>
<td>-0.035352</td>
<td>0.012644</td>
<td>-2.795925</td>
<td>0.0062</td>
</tr>
<tr>
<td>APR</td>
<td>-0.061470</td>
<td>0.012673</td>
<td>-4.850442</td>
<td>0.0000</td>
</tr>
<tr>
<td>MAY</td>
<td>-0.062044</td>
<td>0.012720</td>
<td>-4.877842</td>
<td>0.0000</td>
</tr>
<tr>
<td>JUN</td>
<td>-0.050699</td>
<td>0.013045</td>
<td>-3.886492</td>
<td>0.0002</td>
</tr>
<tr>
<td>JUL</td>
<td>-0.068492</td>
<td>0.012716</td>
<td>-5.386458</td>
<td>0.0000</td>
</tr>
<tr>
<td>AUG</td>
<td>-0.068451</td>
<td>0.012827</td>
<td>-5.336353</td>
<td>0.0000</td>
</tr>
<tr>
<td>SEP</td>
<td>-0.084331</td>
<td>0.012844</td>
<td>-6.565910</td>
<td>0.0000</td>
</tr>
<tr>
<td>OCT</td>
<td>-0.057842</td>
<td>0.013113</td>
<td>-4.410968</td>
<td>0.0000</td>
</tr>
<tr>
<td>NOV</td>
<td>-0.070092</td>
<td>0.013084</td>
<td>-5.356901</td>
<td>0.0000</td>
</tr>
<tr>
<td>DEC</td>
<td>-0.062092</td>
<td>0.013092</td>
<td>-4.742723</td>
<td>0.0000</td>
</tr>
<tr>
<td>MZTCPUS(-1)</td>
<td>0.082080</td>
<td>0.081323</td>
<td>1.009303</td>
<td>0.3153</td>
</tr>
</tbody>
</table>

R-squared: 0.771237  
Mean dependent var: 0.312974

Adjusted R-squared: 0.725023  
S.D. dependent var: 0.050700

S.E. of regression: 0.026586  
Akaike info criterion: -4.259208

Sum squared resid: 0.069977  
Schwarz criterion: -3.771397

Log likelihood: 276.5525  
Hannan-Quinn criter.: -4.061105

F-statistic: 16.68814  
Durbin-Watson stat: 1.980993

Prob(F-statistic): 0.000000
### C4. PCTCPUS, Petroleum coke consumption, million barrels per day

**Dependent Variable:** PCTCPUS  
**Method:** Least Squares  
**Date:** 04/25/11  **Time:** 16:16  
**Sample:** 2000M01 2010M12  
**Included observations:** 132

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.017987</td>
<td>0.105031</td>
<td>-0.171259</td>
<td>0.8643</td>
</tr>
<tr>
<td>ZOTOIUS</td>
<td>0.002160</td>
<td>0.001301</td>
<td>1.660490</td>
<td>0.0996</td>
</tr>
<tr>
<td>ZWHDDUS/ZSAJQUS</td>
<td>-0.006652</td>
<td>0.002785</td>
<td>-2.388574</td>
<td>0.0186</td>
</tr>
<tr>
<td>NGEUDUS/CLEUDUS</td>
<td>0.004750</td>
<td>0.004454</td>
<td>1.066417</td>
<td>0.2885</td>
</tr>
<tr>
<td>D0105</td>
<td>-0.017847</td>
<td>0.052431</td>
<td>-0.340386</td>
<td>0.7342</td>
</tr>
<tr>
<td>D0405</td>
<td>0.157316</td>
<td>0.052416</td>
<td>3.001290</td>
<td>0.0033</td>
</tr>
<tr>
<td>D0509</td>
<td>0.106498</td>
<td>0.052652</td>
<td>2.022677</td>
<td>0.0455</td>
</tr>
<tr>
<td>D0809</td>
<td>-0.134218</td>
<td>0.052012</td>
<td>-2.580519</td>
<td>0.0112</td>
</tr>
<tr>
<td>D0810</td>
<td>0.114726</td>
<td>0.052874</td>
<td>2.169820</td>
<td>0.0322</td>
</tr>
<tr>
<td>FEB</td>
<td>0.006302</td>
<td>0.021697</td>
<td>0.290468</td>
<td>0.7720</td>
</tr>
<tr>
<td>MAR</td>
<td>0.079333</td>
<td>0.022180</td>
<td>3.576831</td>
<td>0.0005</td>
</tr>
<tr>
<td>APR</td>
<td>0.034516</td>
<td>0.021199</td>
<td>1.628150</td>
<td>0.1063</td>
</tr>
<tr>
<td>MAY</td>
<td>0.057932</td>
<td>0.022530</td>
<td>2.571379</td>
<td>0.0115</td>
</tr>
<tr>
<td>JUN</td>
<td>0.062166</td>
<td>0.021129</td>
<td>2.942238</td>
<td>0.0040</td>
</tr>
<tr>
<td>JUL</td>
<td>0.044620</td>
<td>0.021223</td>
<td>2.102383</td>
<td>0.0378</td>
</tr>
<tr>
<td>AUG</td>
<td>0.056087</td>
<td>0.021315</td>
<td>2.631400</td>
<td>0.0097</td>
</tr>
<tr>
<td>SEP</td>
<td>0.061433</td>
<td>0.022355</td>
<td>2.748016</td>
<td>0.0070</td>
</tr>
<tr>
<td>OCT</td>
<td>-0.008484</td>
<td>0.021633</td>
<td>-0.392167</td>
<td>0.6957</td>
</tr>
<tr>
<td>NOV</td>
<td>0.057751</td>
<td>0.021842</td>
<td>2.644097</td>
<td>0.0094</td>
</tr>
<tr>
<td>DEC</td>
<td>0.075660</td>
<td>0.021410</td>
<td>3.533873</td>
<td>0.0006</td>
</tr>
<tr>
<td>PCTCPUS(-1)</td>
<td>0.462512</td>
<td>0.078438</td>
<td>5.896554</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
<th>Description</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-squared</td>
<td>0.569724</td>
<td>Mean dependent var</td>
<td>0.461306</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.492197</td>
<td>S.D. dependent var</td>
<td>0.069148</td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>0.049275</td>
<td>Akaike info criterion</td>
<td>-3.037879</td>
</tr>
<tr>
<td>Sum squared resid</td>
<td>0.269514</td>
<td>Schwarz criterion</td>
<td>-2.579251</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>221.5000</td>
<td>Hannan-Quinn criter.</td>
<td>-2.851513</td>
</tr>
<tr>
<td>F-statistic</td>
<td>7.348702</td>
<td>Durbin-Watson stat</td>
<td>2.223658</td>
</tr>
<tr>
<td>Prob(F-statistic)</td>
<td>0.000000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
C5. SGCTPUS, Still gas consumption, million barrels per day

Dependent Variable: SGCTPUS
Method: Least Squares
Date: 04/25/11   Time: 16:28
Sample: 2001M01 2010M12
Included observations: 120

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.073584</td>
<td>0.043133</td>
<td>-1.706004</td>
<td>0.0911</td>
</tr>
<tr>
<td>CORIPUS</td>
<td>0.036034</td>
<td>0.003173</td>
<td>11.35748</td>
<td>0.0000</td>
</tr>
<tr>
<td>UORIPUS</td>
<td>0.018331</td>
<td>0.008015</td>
<td>2.286924</td>
<td>0.0243</td>
</tr>
<tr>
<td>D01</td>
<td>-0.014207</td>
<td>0.004282</td>
<td>-3.317746</td>
<td>0.0013</td>
</tr>
<tr>
<td>D02</td>
<td>-0.010021</td>
<td>0.004132</td>
<td>-2.425170</td>
<td>0.0171</td>
</tr>
<tr>
<td>D0501</td>
<td>-0.039719</td>
<td>0.013498</td>
<td>-2.942494</td>
<td>0.0040</td>
</tr>
<tr>
<td>D0505</td>
<td>-0.036692</td>
<td>0.013412</td>
<td>-2.735701</td>
<td>0.0074</td>
</tr>
<tr>
<td>D1002</td>
<td>0.035541</td>
<td>0.013586</td>
<td>2.615993</td>
<td>0.0103</td>
</tr>
<tr>
<td>FEB</td>
<td>0.001119</td>
<td>0.005996</td>
<td>0.186668</td>
<td>0.8523</td>
</tr>
<tr>
<td>MAR</td>
<td>0.007723</td>
<td>0.005887</td>
<td>1.311928</td>
<td>0.1925</td>
</tr>
<tr>
<td>APR</td>
<td>0.008192</td>
<td>0.006396</td>
<td>1.280820</td>
<td>0.2032</td>
</tr>
<tr>
<td>MAY</td>
<td>0.012868</td>
<td>0.006850</td>
<td>1.878395</td>
<td>0.0632</td>
</tr>
<tr>
<td>JUN</td>
<td>0.011150</td>
<td>0.006982</td>
<td>1.596897</td>
<td>0.1134</td>
</tr>
<tr>
<td>JUL</td>
<td>0.011703</td>
<td>0.007219</td>
<td>1.621044</td>
<td>0.1082</td>
</tr>
<tr>
<td>AUG</td>
<td>0.013331</td>
<td>0.006886</td>
<td>1.935869</td>
<td>0.0557</td>
</tr>
<tr>
<td>SEP</td>
<td>-0.002405</td>
<td>0.006683</td>
<td>-0.359824</td>
<td>0.7197</td>
</tr>
<tr>
<td>OCT</td>
<td>-0.014232</td>
<td>0.005905</td>
<td>-2.410152</td>
<td>0.0178</td>
</tr>
<tr>
<td>NOV</td>
<td>-0.009011</td>
<td>0.006395</td>
<td>-1.409013</td>
<td>0.1619</td>
</tr>
<tr>
<td>DEC</td>
<td>-0.003766</td>
<td>0.006591</td>
<td>-0.571393</td>
<td>0.5690</td>
</tr>
<tr>
<td>SGCTPUS(-1)</td>
<td>0.300027</td>
<td>0.060004</td>
<td>5.000080</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared                0.903893 Mean dependent var 0.683460
Adjusted R-squared       0.885633 S.D. dependent var 0.037387
S.E. of regression       0.012644 Akaike info criterion -5.752299
Sum squared resid        0.015986 Schwarz criterion -5.287717
Log likelihood           365.1380 Hannan-Quinn criter. -5.563630
F-statistic              49.50044 Durbin-Watson stat 1.605296
Prob(F-statistic)        0.000000
**C6. UOTCPUS, Unfinished oils consumption, million barrels per day**

Dependent Variable: UOTCPUS  
Method: Least Squares  
Date: 04/25/11  Time: 16:34  
Sample: 2001M01 2010M12  
Included observations: 120

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.003540</td>
<td>0.022859</td>
<td>0.154872</td>
<td>0.8772</td>
</tr>
<tr>
<td>D0202</td>
<td>-0.213088</td>
<td>0.072548</td>
<td>-2.937180</td>
<td>0.0041</td>
</tr>
<tr>
<td>D0212</td>
<td>-0.186881</td>
<td>0.072466</td>
<td>-2.578886</td>
<td>0.0114</td>
</tr>
<tr>
<td>D0501</td>
<td>-0.180372</td>
<td>0.072602</td>
<td>-2.484384</td>
<td>0.0146</td>
</tr>
<tr>
<td>D0504</td>
<td>-0.213126</td>
<td>0.072526</td>
<td>-2.938639</td>
<td>0.0041</td>
</tr>
<tr>
<td>D0506</td>
<td>0.254695</td>
<td>0.072745</td>
<td>3.501222</td>
<td>0.0007</td>
</tr>
<tr>
<td>D0606</td>
<td>0.246559</td>
<td>0.072762</td>
<td>3.388570</td>
<td>0.0010</td>
</tr>
<tr>
<td>FEB</td>
<td>0.070876</td>
<td>0.032398</td>
<td>2.187683</td>
<td>0.0310</td>
</tr>
<tr>
<td>MAR</td>
<td>-0.019272</td>
<td>0.031674</td>
<td>-0.608444</td>
<td>0.5443</td>
</tr>
<tr>
<td>APR</td>
<td>0.015769</td>
<td>0.032336</td>
<td>0.487659</td>
<td>0.6268</td>
</tr>
<tr>
<td>MAY</td>
<td>-0.004813</td>
<td>0.031509</td>
<td>-0.152759</td>
<td>0.8789</td>
</tr>
<tr>
<td>JUN</td>
<td>-0.077182</td>
<td>0.033330</td>
<td>-2.315725</td>
<td>0.0226</td>
</tr>
<tr>
<td>JUL</td>
<td>-0.070518</td>
<td>0.031580</td>
<td>-2.233004</td>
<td>0.0278</td>
</tr>
<tr>
<td>AUG</td>
<td>-0.013675</td>
<td>0.032081</td>
<td>-0.426281</td>
<td>0.6708</td>
</tr>
<tr>
<td>SEP</td>
<td>-0.045086</td>
<td>0.031661</td>
<td>-1.423990</td>
<td>0.1575</td>
</tr>
<tr>
<td>OCT</td>
<td>0.011267</td>
<td>0.031822</td>
<td>0.354072</td>
<td>0.7240</td>
</tr>
<tr>
<td>NOV</td>
<td>-0.000162</td>
<td>0.031514</td>
<td>-0.005139</td>
<td>0.9959</td>
</tr>
<tr>
<td>DEC</td>
<td>0.024726</td>
<td>0.032326</td>
<td>0.764880</td>
<td>0.4461</td>
</tr>
<tr>
<td>UOTCPUS(-1)</td>
<td>0.356410</td>
<td>0.075623</td>
<td>4.713005</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.495698  Mean dependent var -0.012963  
Adjusted R-squared 0.405822  S.D. dependent var 0.088958  
S.E. of regression 0.068571  Akaike info criterion -2.377596  
Sum squared resid 0.474901  Schwarz criterion -1.936243  
Log likelihood 161.6558  Hannan-Quinn criter. -2.198361  
F-statistic 5.515371  Durbin-Watson stat 1.764103  
Prob(F-statistic) 0.000000