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Administration

Statistical Methodology of Estimating Petroleum Exports Using Data from U.S. Customs and Border Protection

August 31, 2016



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Introduction

The U.S. Energy Information Administration (EIA) has updated its statistical methodology for estimating crude oil, petroleum products, and biofuels exports in the *Weekly Petroleum Supply Report* (WPSR) by incorporating data collected by U.S. Customs and Border Protection (CBP) through the Automated Commercial Environment (ACE) system. The new WPSR methodology, implemented with the August 31, 2016 release of WPSR, provides a more accurate accounting of U.S. crude oil, petroleum products, and biofuels exports to better inform EIA's weekly estimates of domestic quantity demanded for crude oil, petroleum products, and biofuels.

Exports are an important component for the calculation of EIA weekly estimates of quantity demanded for petroleum products. EIA calculates domestic quantity demanded (measured as product supplied and used as a proxy for consumption) for petroleum products as:

$$\text{Domestic Quantity Demanded} = \text{Production} + \text{Imports} - \text{Stock Change} - \text{Exports}.$$

EIA uses weekly survey data to estimate production, imports, and stocks, but not exports. For exports, EIA previously used forecasts based on an autoregressive integrated moving-average (ARIMA) procedure to model weekly export statistics using U.S. Census Bureau (USCB) data. EIA obtained official USCB export data for crude oil, petroleum products, and biofuels exports on a monthly basis approximately six weeks after the close of the reporting month and published them in the *Petroleum Supply Monthly* (PSM). These data provided the inputs to the weekly export model. However, as the volume and variability of U.S. exports increased, significant discrepancies were observed between modeled weekly estimates and final monthly exports data provided by the USCB. Because they directly affected domestic quantity demanded estimates, EIA recognized the need to improve export estimates.

Beginning in 2013, EIA investigated data sources and methodologies to improve its weekly estimates of crude oil, petroleum products, and biofuels exports. EIA found that administrative data collected by CBP through the ACE System could be used to improve EIA's export estimates. To obtain these data, EIA established a Memorandum of Understanding with CBP in September 2014 through the International Trade Data System (ITDS) process. In August 2016, EIA obtained a letter from Office of Management and Budget (OMB) granting EIA an exception to the provisions of OMB's *Statistical Policy Directive No. 3 on the Compilation, Release, and Evaluation of Principal Federal Economic Indicators*. This exception permits EIA to publish weekly reports on the export volumes of crude oil and six refined petroleum products and biofuel categories in advance of the release of official U.S. trade data from the U.S. Census Bureau.

Trade Data Collection and Dissemination

The WPSR includes export estimates for crude oil, finished motor gasoline, kerosene-type jet fuel, distillate fuel oil, residual fuel oil, propane, and other oils (including asphalt, aviation gasoline, biofuels, butanes, ethane, lubricants, motor gasoline blending components, miscellaneous products, non-biofuel oxygenates, petroleum coke, unfinished oils, and wax).

Companies exporting products from the United States, in general, are required to file export transaction data with CBP. This information is then included in CBP's ACE system. EIA is now receiving this transactional ACE data from CBP and using it in the WPSR. The data from CBP include an export date that makes it possible to group transactions into WPSR weekly reporting periods. The data from CBP are not edited to the same degree as data used by USCB in final trade statistics. Because companies exporting to Canada are not required to report exports to CBP, the CBP data underreport Canadian export volumes. To address this issue, EIA had to develop a methodology to edit the data and to estimate exports to Canada.

USCB has an agreement from Statistics Canada to obtain Canadian imports data from the United States, and they use Canadian import data to estimate U.S. exports for the final trade statistics. EIA does not have early access to Canadian import data.

The CBP data EIA now uses to estimate exports are the same data that the USCB receives for its monthly *International Trade in Goods and Services* report (FT900), a principal economic indicator. The FT900 has a six-week publication lag, while WPSR data are released each Wednesday for the weekly report period ending the previous Friday.

Estimation Methodology

EIA's estimation method consists of two components:

- For those products that have adequate coverage in the CBP data, EIA edits the CBP data and reports the sum of the quantities exported. These products include distillate fuel, finished motor gasoline, kerosene-type jet fuel, and propane.
- For those products with a significant export component to Canada and incomplete coverage in CBP data, EIA uses post-editing techniques to account for exports to Canada. These products include crude oil, other oils, and residual fuel oil.

EIA performs the following steps after receipt of CBP data:

- Remove duplicate records.
- Exclude records with entry dates beyond the reporting period.
- Exclude products that are out of scope of the WPSR.
- Convert to barrels exported quantities reported in other units.
- For each product, calculate the dollar value per barrel from CBP and compare against daily spot prices from Thomson-Reuters to identify extreme values. Use a procedure based on shipping weight to replace these values, if necessary.

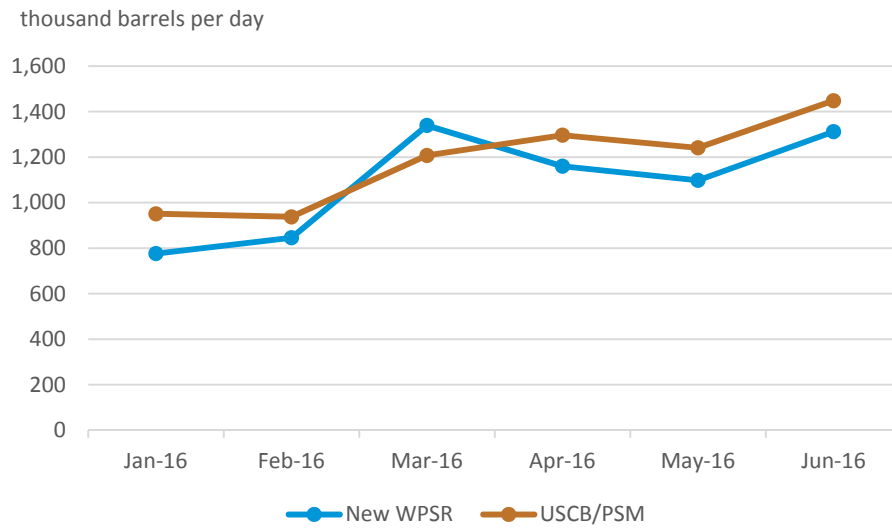
See Appendix A for a more complete list of edit rules that EIA applies to the CBP data.

Estimation methodology and results for specific products

After undergoing edits, the CBP data consistently capture the approximate total export volume of distillate fuel, finished motor gasoline, kerosene-type jet fuel, and propane. Therefore, EIA does not apply any post-editing technique to these products and uses edited CBP data for the weekly export estimates. EIA will continue to monitor weekly export estimates for these products and may use some form of post-editing technique if the weekly estimates diverge from monthly data.

Figures 1-4 show the comparison of the estimates produced by the new WPSR method with the estimates published by the USCB/PSM.

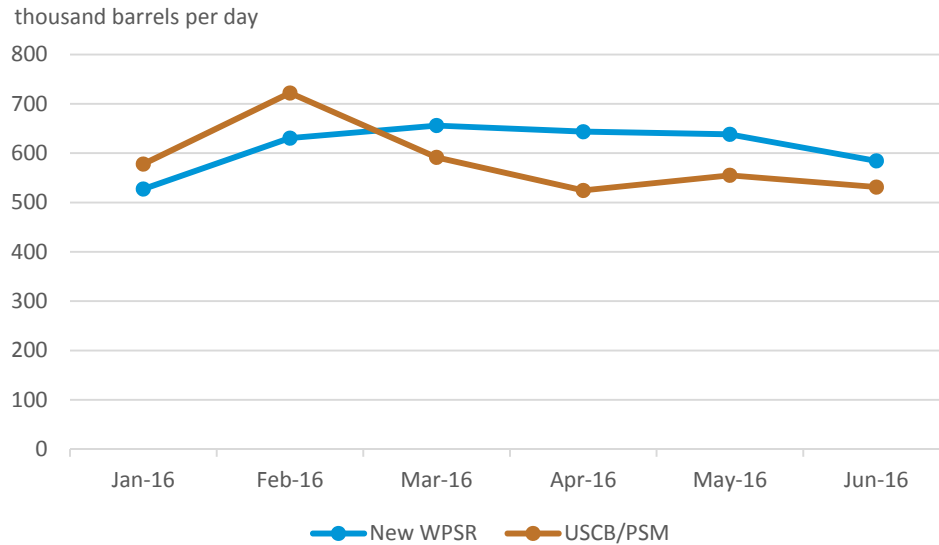
Figure 1. Monthly distillate fuel oil exports for 2016



USCB = U.S. Census Bureau

Source: U.S. Energy Information Administration

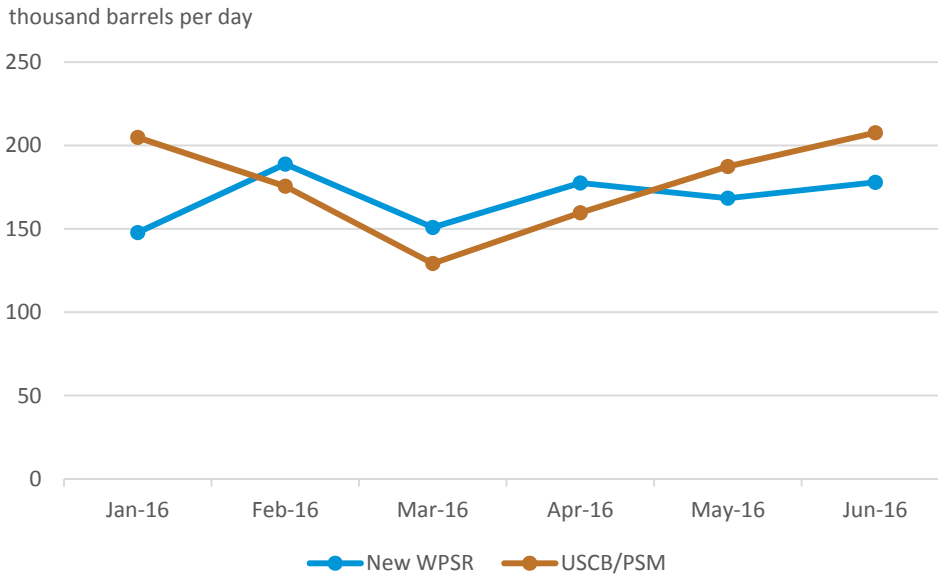
Figure 2. Monthly finished motor gasoline exports for 2016



USCB = U.S. Census Bureau

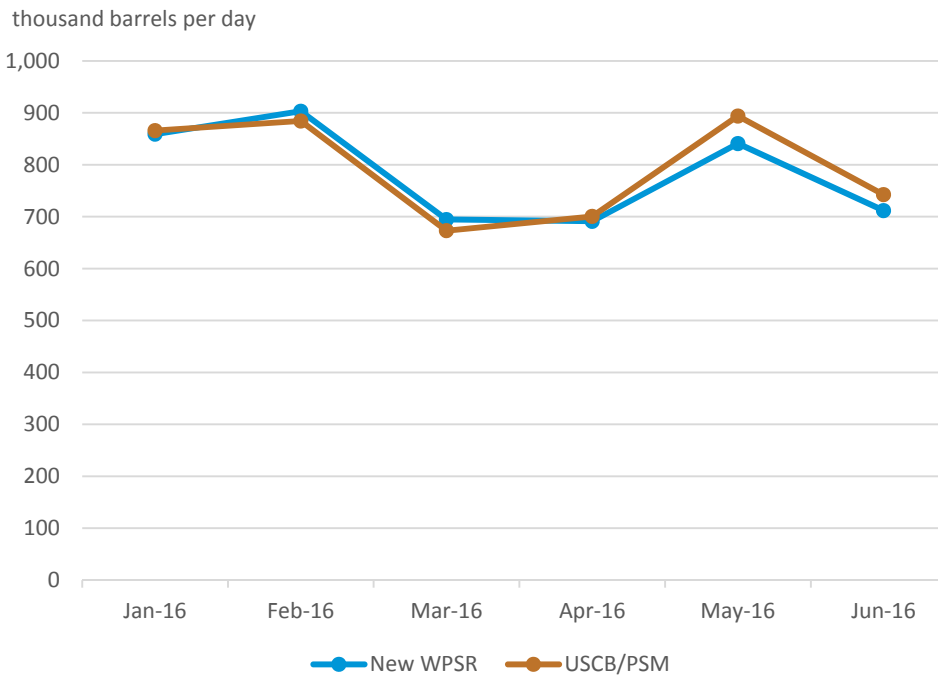
Source: U.S. Energy Information Administration

Figure 3. Monthly Kerosene-Type-Jet Fuel Exports for 2016



USCB = U.S. Census Bureau
 Source: U.S. Energy Information Administration

Figure 4. Monthly propane exports for 2016



USCB = U.S. Census Bureau
 Source: U.S. Energy Information Administration

Exports to Canada account for about 25% of total other oils exports and about 12% of total residual fuel oil exports from 2014 through the first half of 2016. Weekly CBP export data do not provide adequate coverage of exports of other oils and residual fuel oil to Canada. To address this, EIA estimates exports of other oils and residual fuel oil using post-editing regression. The weekly edited CBP data are regressed against the interpolated U.S. Census Bureau data from FT900 series. The regression equation is updated with the release of new monthly export data from USCB each month. The estimation is based on the following formula:

$$Y_t = \beta x_t + \varepsilon_t$$

Where Y_t is the export of other oils or residual fuel oil reported from the U.S. Census Bureau interpolated to a weekly series for WPSR reporting period t ,

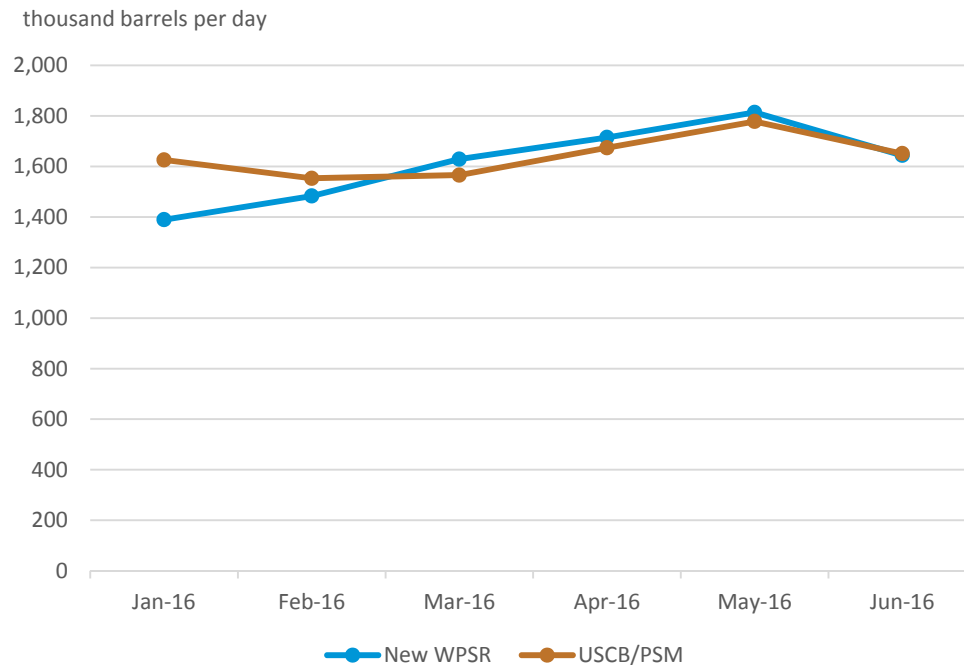
x_t is edited CBP export data for the week t to be used as the regressor

β is the regression coefficient for the regressor x_t over the time period (2015 to present)

ε_t is the error term

Figures 5 and 6 show a comparison of the estimates produced by the new WPSR method with the estimates published by the USCB/PSM.

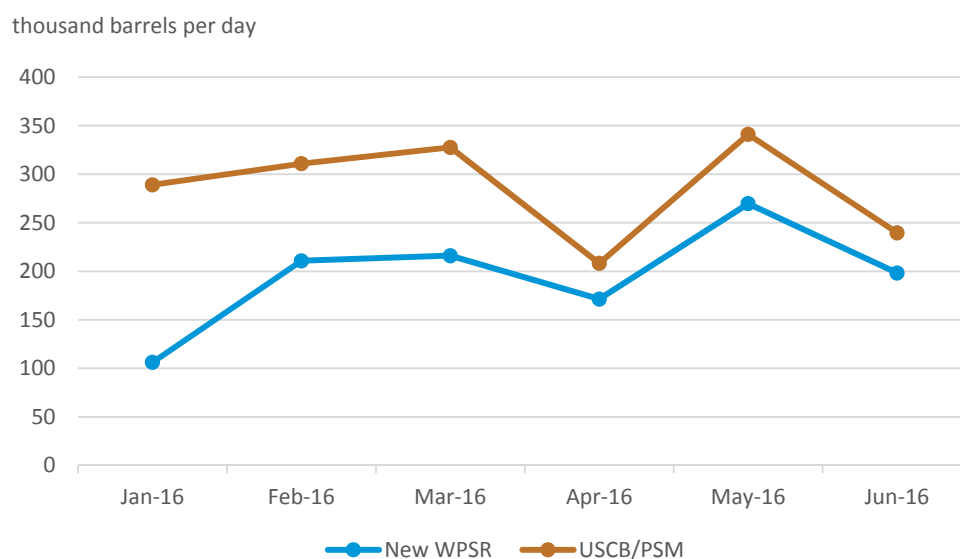
Figure 5. Monthly other oils exports for 2016



USCB = U.S. Census Bureau

Source: U.S. Energy Information Administration

Figure 6. Monthly residual fuel oil exports for 2016



USCB = U.S. Census Bureau

Source: U.S. Energy Information Administration

Arriving at an estimate for weekly exports of crude oil is more challenging compared to other petroleum product categories. Historically, most of the crude oil exports from the United States were made to Canada (above 90% until December 2015). In December 2015, Congress lifted the nation's 40-year-old ban on crude oil exports. The change in U.S. export policy has significantly altered the market for exports of crude oil from the United States, with crude oil exports in 2016 going to several destinations other than Canada. Although some months in 2016 still show more than half of U.S. crude oil exports going to Canada, the proportion of total U.S. crude oil exports going to Canada now varies greatly from month to month depending on crude oil market dynamics. Since crude oil exports to Canada are generally not reported in the CBP data and because of the changing nature of current export activity, EIA needed to identify a model that captured trend, seasonality, and near-term cyclicality of export activity. The Unobserved Components Model (UCM) is a new time series model that decomposes the response variable and past USCB data for crude oil into subcomponents that capture trend, seasonality, and cyclicality. The model then uses CBP data as a regressor for estimating weekly forecasts. All of the model components are re-estimated each time new monthly export data are released from USCB. EIA will continue to monitor how accurately this model performs and adjust the model structure or period of fitting where appropriate. The formula for EIA's estimation is:

$$Y_t = \mu_t + \gamma_t + \psi_t + \sum \phi_i Y_{t-i} + \beta x_t + \varepsilon_t$$

Where Y_t is exports of crude oil as reported from the USCB for WPSR reporting period t ,

μ_t is the trend effect

γ_t is the seasonal effect

ψ_t is the cyclic effect

ϕ_i is the auto-regression coefficient corresponding to Y_{t-i}

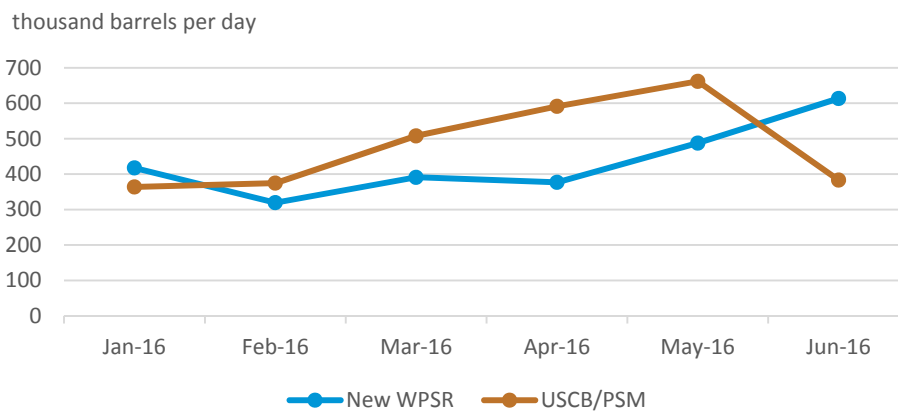
x_t is edited CBP data for week t to be used as the regressor

β is the regression coefficient for the regressor x_t

ε_t is the error term

Figure 7 shows a comparison of estimates of crude oil exports produced by the new WPSR method with the estimates published by the USCB/PSM.

Figure 7. Monthly crude oil exports for 2016

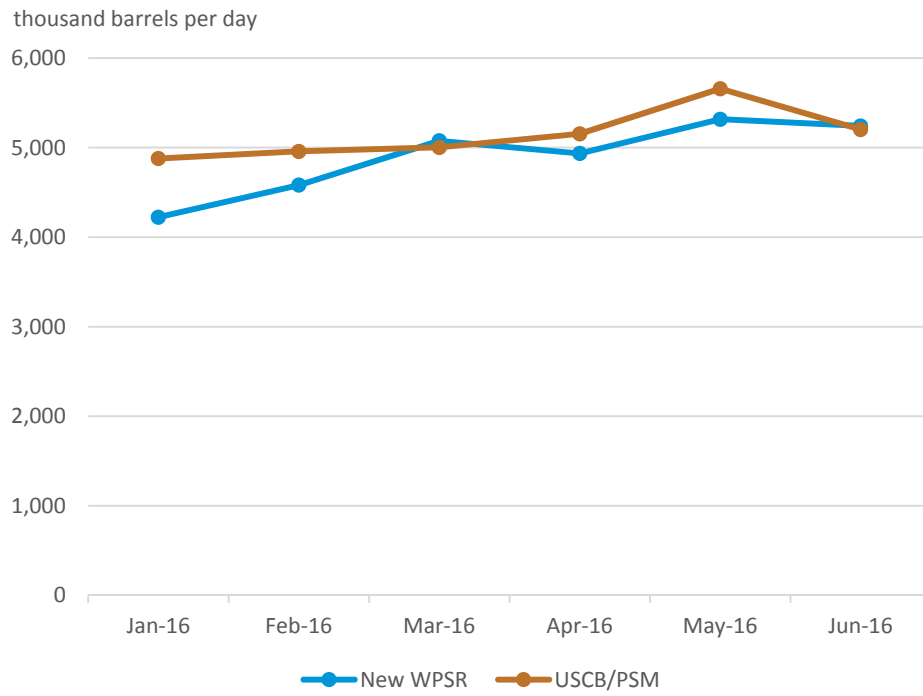


USCB = U.S. Census Bureau

Source: U.S. Energy Information Administration

Figure 8 shows a comparison of total estimates of exports produced by the new WPSR method with the estimates published by the USCB/PSM.

Figure 8. Monthly crude oil, petroleum products, and biofuels exports for 2016



USCB = U.S. Census Bureau

Source: U.S. Energy Information Administration

Summary

By using petroleum export data from CBP and published monthly trade data from the U.S. Census Bureau, EIA is able to estimate and report weekly exports of crude oil, petroleum products, and biofuels in the WPSR with greater accuracy than was possible in the past.

EIA will continue to monitor the performance of the new WPSR method.

Appendix A: Edit Rules

Below are the calculations and edit rules in place to prepare the CBP data for estimates:

1. Identify and remove records that are outside the reporting period.
2. Identify and remove duplicate records.
3. Exclude exports originating from U.S. territories (e.g. Puerto Rico and U.S. Virgin Islands).
4. Map Schedule B/Harmonized Tariff Schedule codes to WPSR products.
5. Keep only products that are within scope of WPSR products.
6. Convert units of quantity (e.g., kg, liters, and tons) into unit barrels with conversion factors.
7. Calculate a dollar value per barrel using spot prices from Thomson-Reuters.
8. Based on value (in dollars) divided by quantity of commodity exported, calculate a unit price (dollars/barrel).
9. Compare the unit price with spot prices to determine outliers based on an acceptable range around spot prices.
10. Flag extreme values. Then use the following procedure:
 - a. Recalculate weight of the commodity exported based on quantity (in barrels) and a conversion factor.
 - b. Compare the recalculated weight against shipping weight based on an acceptable range around shipping weight.
 - c. If the recalculated weight is within an acceptable range around the shipping weight, then use the original reported quantity in barrels.
 - d. If the recalculated weight is not within an acceptable range around the shipping weight, then convert the shipping weight to quantity in barrels using a conversion factor and use this as recalculated quantity.