



Ceridian-UCLA Pulse of Commerce Index®

By UCLA Anderson School of Management

How the Ceridian-UCLA Pulse of Commerce Index® is Constructed

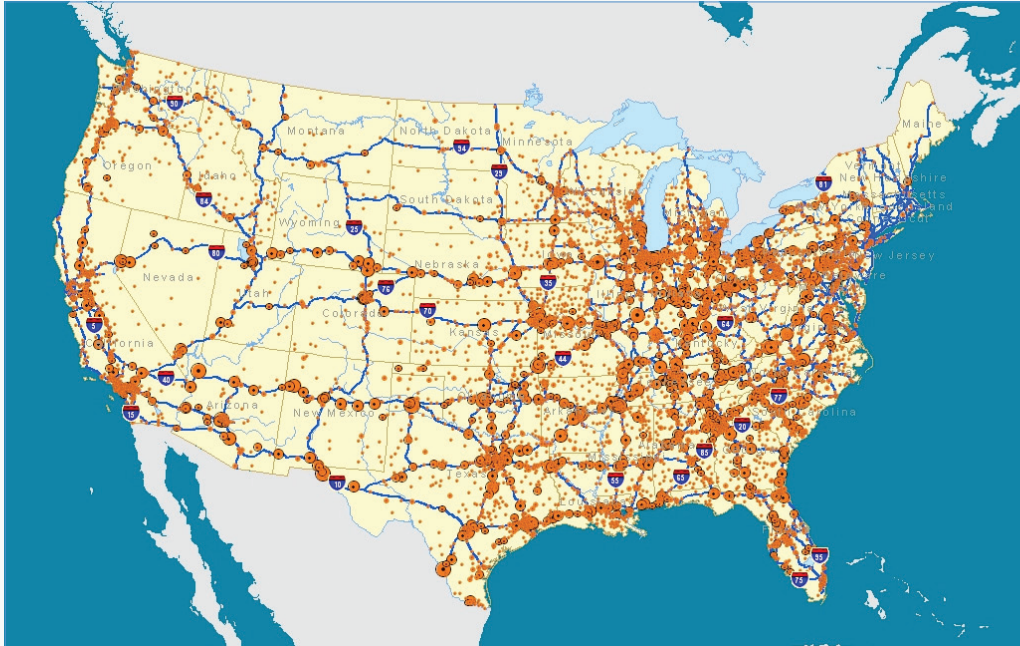


UCLAAnderson
School of Management

I. Overview

At every minute of every day, trucks are rolling across America laden with goods. Measuring the flow of these trucks, just as a doctor measures the flow of blood by checking a patient's pulse as part of their examination of a patient's health, gives us a view into the health of the economy.

Imagine having sensors along the interstate highways indicating when and where these trucks pass by as they move goods at various stages of the production process over the road.



Ceridian Corporation, a global business services company providing electronic and stored value card payment services and human resources solutions, processes payment information for over the road truck fueling through its Comdata subsidiary. These transactions are processed within a fraction of a second, providing Ceridian with real data in real time.

Ceridian Corporation has partnered with UCLA Anderson School of Management and Charles River Associates to provide the Ceridian-UCLA Pulse of Commerce Index® (PCI®) and associated report, which is released on a monthly basis.

The PCI has a wealth of information that is provided in a very timely manner; it is not simply a proxy measure for an existing index of economic activity, but is an independent measure of the health of the economy. However, because of the similarities in the economic activities being measured and the correlations that exist, the PCI closely tracks several indices such as Industrial Production and Retail Sales.

II. Index Construction—Data

1. Data

The PCI is constructed from information on the purchases of diesel fuel for trucks (tractors) which are used to transport goods over the road. Every time a diesel fuel purchase is made with a Ceridian payment card, the information about that transaction is immediately available.¹ Although transactions using cards can be for items besides diesel fuel for tractors, we are only using data on identified “tractor gallons” and not any information on purchases of other items such as oil, brake fluid, propane, fuel for trailers, gasoline (usually for local delivery trucks), and so forth. Thus, we are looking at a consistent measure of what it takes to move these trucks over the road.²

A very important feature of the data used to construct the PCI is that it represents the recording of actual transactions and is not survey data collected *ex post* that is only provided by those who choose to answer, and where participants may have varying incentives regarding the accuracy of the information they are providing. Thus, the PCI is based upon real data available in real time.

2. Data Processing

The data used to construct the PCI includes hundreds of millions of transactions at fueling locations across the continental United States.³ Because the Ceridian data contains information from service center locations in both the US and Canada, the state in which the fueling location was located was used to exclude transaction outside the continental US (e.g., Canada, Alaska, Hawaii, or elsewhere).

Once the transactions in the continental US are identified, they are combined into monthly totals. The raw index is then created with the normalization of dividing the amount of tractor gallons purchased each month by the average monthly amount in 2002.

III. Index Construction—Issues

1. Births and Deaths

One area of potential concern when analyzing changes in a data series is the extent to which the observed changes are due to movement in what is being measured versus changes due to sample selection (e.g., changes in volume purchases due to accounts entering and leaving the sample—also referred to as births and deaths). If we had a complete census of all the diesel fuel purchases for over the road trucking, there would not be a birth/death issue, for there would not be any sample selection concerns. Determining the birth or death of an account can be complicated for a couple of reasons. First, identifying that an account is no longer in the sample does not mean that the account died, for the departing account could have merged with another account and all of the information about its transactions could still be captured in the data.⁴ Also, as the last month of the series is the last observed month for all accounts and since some accounts may

¹ The vast majority of the transactions use a proprietary Comdata card, but there are also a large number of transactions processed and recorded that use a MasterCard®. Ceridian also processes other fuel transactions in addition to those made at service centers with cards (e.g., mobile fueling). The data used in the construction of the PCI includes all electronically available transaction information that identifies purchases of “tractor gallons” from a number of different Comdata products.

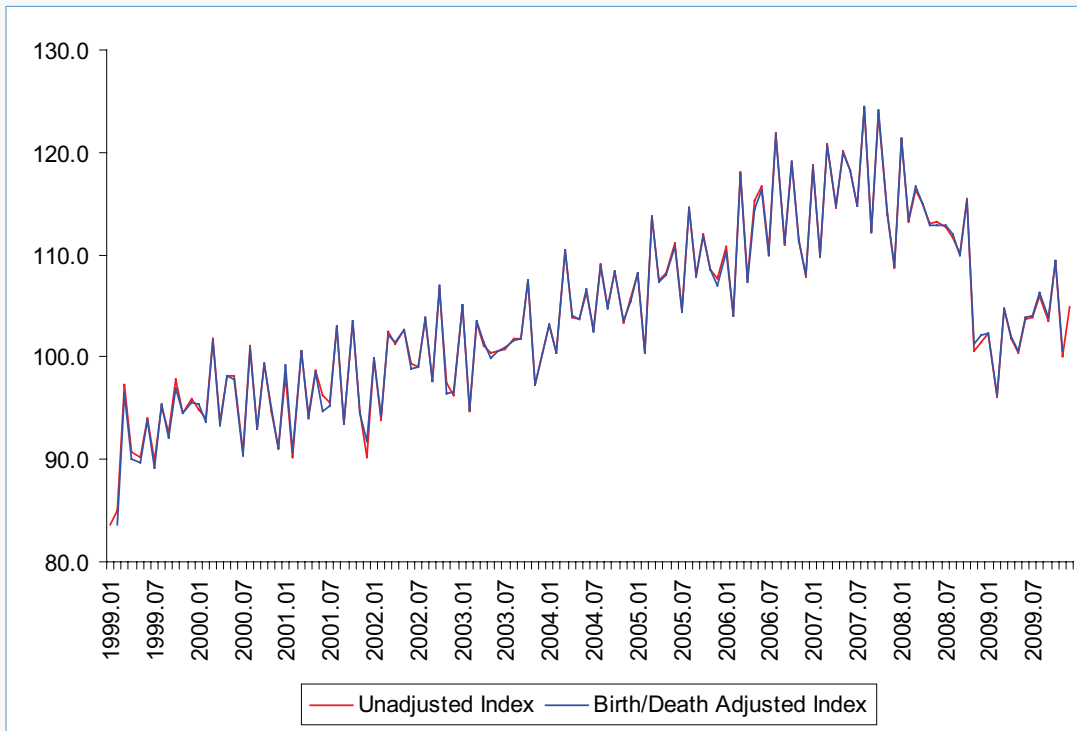
² There are constant incremental changes to the fuel efficiency of these large trucks—some changes, such as the installation of governors or auxiliary power units to decrease idle time, increase fuel efficiency, whereas other changes, such as emission controls and the use of ultra low sulfur fuel, have the opposite and offsetting effect of decreasing fuel efficiency. Over time there may also be differences in load size or composition. Although we do not have a good measure regarding the impact of these changes on overall fuel purchases, if the changes are phased in over time then the impact on the monthly comparisons may not be very noticeable.

³ The 2009 data contained information from more than 7,000 fueling location codes.

⁴ A similar issue of identifying births arises when an existing account acquires a firm not previously processing their transactions through Ceridian. The acquisition would not appear as the birth of a new account in the data, but the recorded gallons would increase by the amount the acquired firm purchased.

not purchase in every month, then there is the potential that deaths for the most recent months of data are overstated. Ultimately, what is of concern is not the number of accounts entering or exiting, but the volume of purchases from accounts entering or exiting.

Since the level of purchases in the month that an account enters or leaves the data is not likely representative of that account's general contribution to the total monthly purchase number of all accounts, to examine the potential impact of an account entering or leaving the data, a net change amount was calculated using the average purchases over the time period when the account was in the sample. Thus, a net birth/death amount for each month was calculated as the total of the average purchases for the accounts entering the sample in that month minus the total of the average purchases for the accounts leaving the sample that month. The net change amount was then subtracted from the raw total to get at an estimated "status quo" level. The resulting



index, together with the original unadjusted index, is shown in the chart below.

Thus, the impact of births and deaths seems to be small and the observed changes in the PCI appear to be driven by changes in the underlying data and not due to sample selection effects.⁵

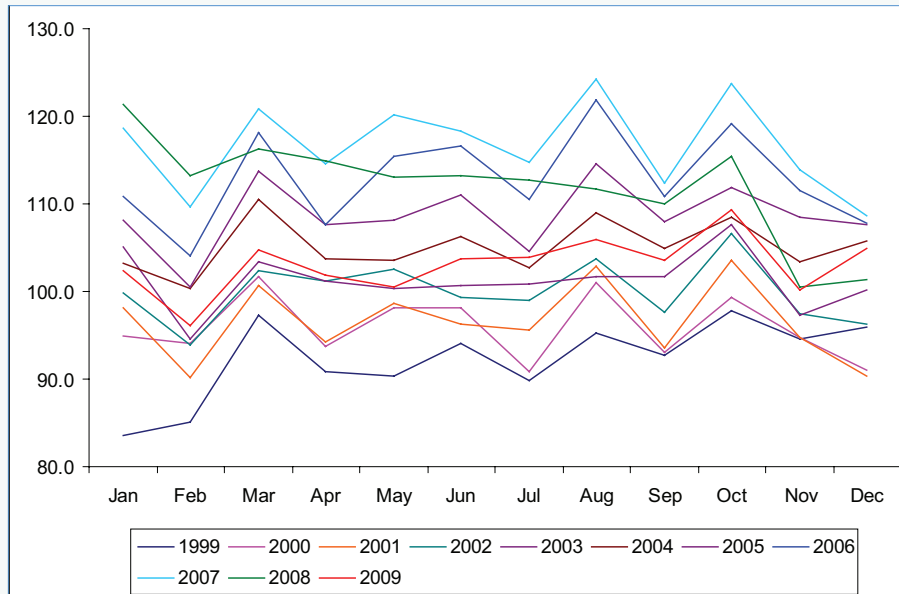
A different way of expressing the potential birth/death concern is that during a time of growth, the growth can come from both within a firm and from the formation of new firms. If the data being used to construct the index were based upon a sample drawn from historically present firms, then there would not be any information on the newly created firms and the index would under report the actual growth amount. However, since newly created firms will need to process their purchases of diesel fuel for their fleet, they are likely to establish a transaction processing solution at inception; if the solution were a Ceridian product, then the transactions of the new firm would immediately be captured in the data.⁶

⁵ Note: on a monthly basis, the net number of accounts is substantially larger and more volatile than the net amount of gallons purchased.

⁶ Note: if the newly established firm were just a single owner/operator, the new firm would not necessarily start with a payment processing solution and would not necessarily be part of the data available to us. We do not know the magnitude of these new individual owner/operator firms during a growth period, but it is not clear that it would be very large relative to the total volume of fuel purchased.

2. Monthly Variability

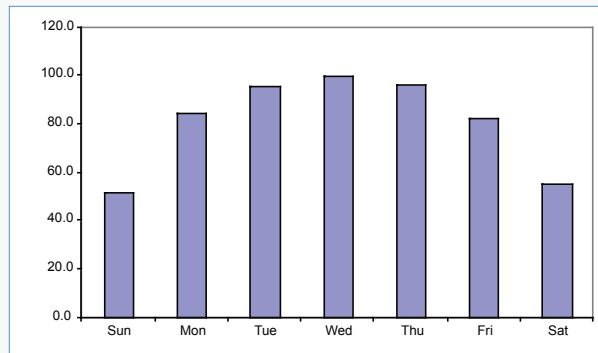
As can be seen from the 11 years of data plotted in the chart below, there exists a large amount of monthly variation in the PCI.



To help decipher monthly changes in the PCI that are different from predictable monthly changes and typical seasonal changes, we need to adjust the index in a way that controls for the expected amount of variation. We make two types of adjustments, one for the number of workdays in a month and one for seasonality.

A. Workday Adjustment

Although trucks are constantly traveling over the road, as the chart below shows, there is substantially less movement on weekend days than on days during the week.



If a given month always had the same number of weekend days and weekdays over time, then traditional seasonal adjustment methods would be able to control for these differences. However, because of year to year changes in the day of the week on which a month begins, the number of weekend days and the number of weekdays for a given month varies year to year. For example, August 2007 began on a Wednesday and so August 2007 had 23 weekdays and 8 weekend days, whereas August 2008 began on a Friday and had 21 weekdays and 10 weekend days.

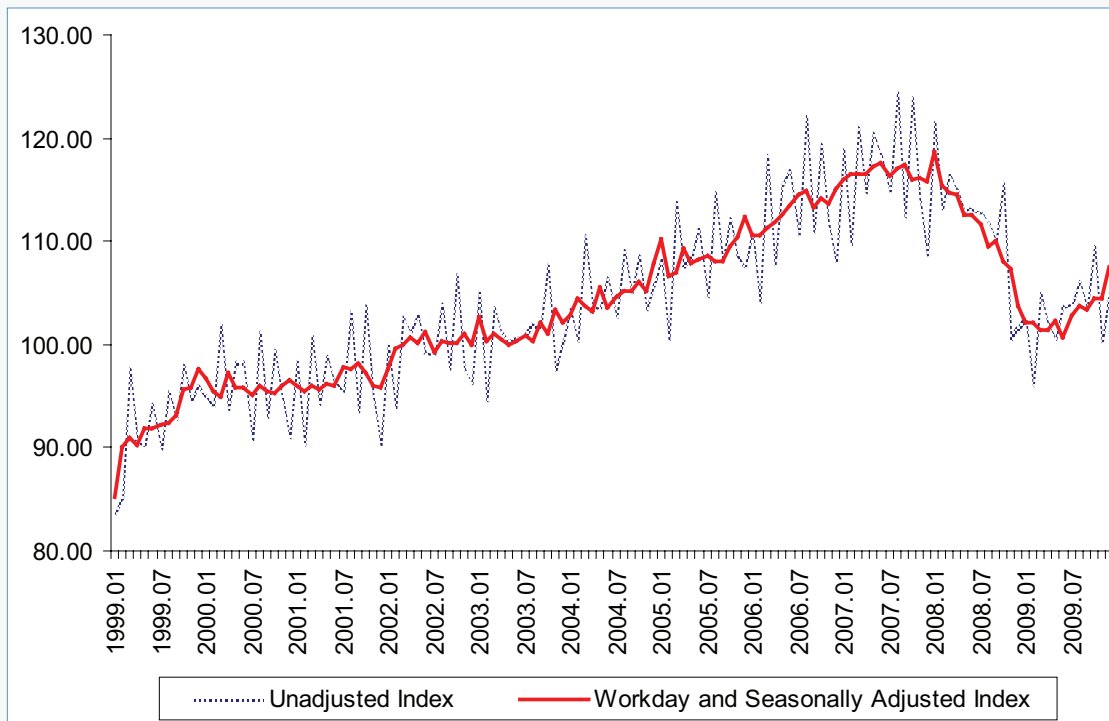
The method we used to adjust for differences in the number of workdays in a month was to divide the total amount of tractor gallons purchased that month by the “effective” number of workdays (where “effective” workdays equals the number of weekdays plus 0.455471 times the number of weekend days in that month.⁷ One way of thinking of the resulting calculation is as the average amount of tractor gallons purchased per “effective” workday during the month.

⁷ The fractional amount of weekend days was estimated through regression analysis using eleven years of monthly data from 1999 to 2009 with the specification of $\log(\text{tractor gallons}) = \log(\text{\#weekdays}) + b(\text{\#weekend days}) + c^*X + e$, where b is the fractional amount to be estimated, c^*X are the coefficient and indicator (or dummy) variables for years and months, and e is the error term. We also examined a specification allowing for separate coefficients for each day of the week, but found this alternative specification to have (i) similar and not statistically significantly different estimated coefficient values and (ii) a singular Hessian matrix.

B. Seasonality

There are a number of ways of making adjustments for seasonality. One method, which is used to adjust many of the government provided indices, is the Census Bureau's X-12-ARIMA adjustment process (X-12).⁸ We chose to use this method of adjustment to be consistent with how those indices are being adjusted.⁹ As X-12 is a "full-sample" method (i.e., both uses and adjusts all available data), to preserve consistency in the historical data (and prevent the possibility of a slight change in the historical seasonally adjusted index values), we only allow for adjustment of the historical numbers annually and therefore use the monthly adjustment factors from the most recent full year of data for the upcoming year.¹⁰ Once an additional full year of data becomes available (in January of each year), we reestimate the entire series, which will adjust all of the historical data and will also provide the seasonal adjustment factors for the coming year.¹¹

The unadjusted index and the workday and seasonally adjusted index are plotted in the chart below, where you can see that the overall shape of the index is the same, but the unadjusted monthly values have much more variability.



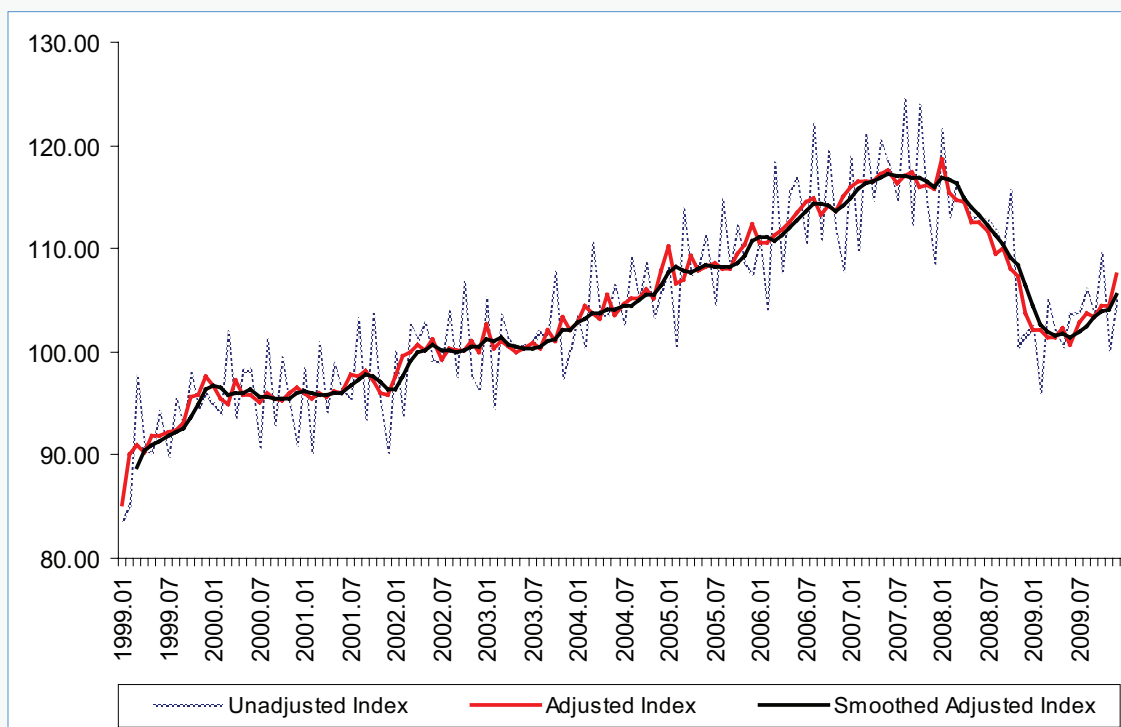
⁸ According to the Census Bureau's website, the X-12-ARIMA "is used for all official seasonal adjustments produced by the U. S. Census Bureau." For information about the Census Bureau's X-12-ARIMA adjustment program (including programs to download and papers dealing with seasonal adjustment) see <http://www.census.gov/srd/www/x12a/>.

⁹ Both the adjusted and unadjusted PCI series are available on the Ceridian-UCLA Pulse of Commerce Index website. (see www.ceridianindex.com).

¹⁰ For example, for the March 2010 seasonal adjustment factor we use the estimated seasonal adjustment factor for March 2009.

¹¹ We examined the seasonal adjustment factors over time and they are quite stable. Thus, we expect that using the adjustment factors from the most recent year of data will be very similar to those that will be estimated when the full year of data becomes available.

Besides seasonal adjustment, we also look at a three-month moving average to smooth the seasonally adjusted index. Smoothing gives a clearer picture of the longer term trends.¹² The chart below shows the effect of the above mentioned adjustments.



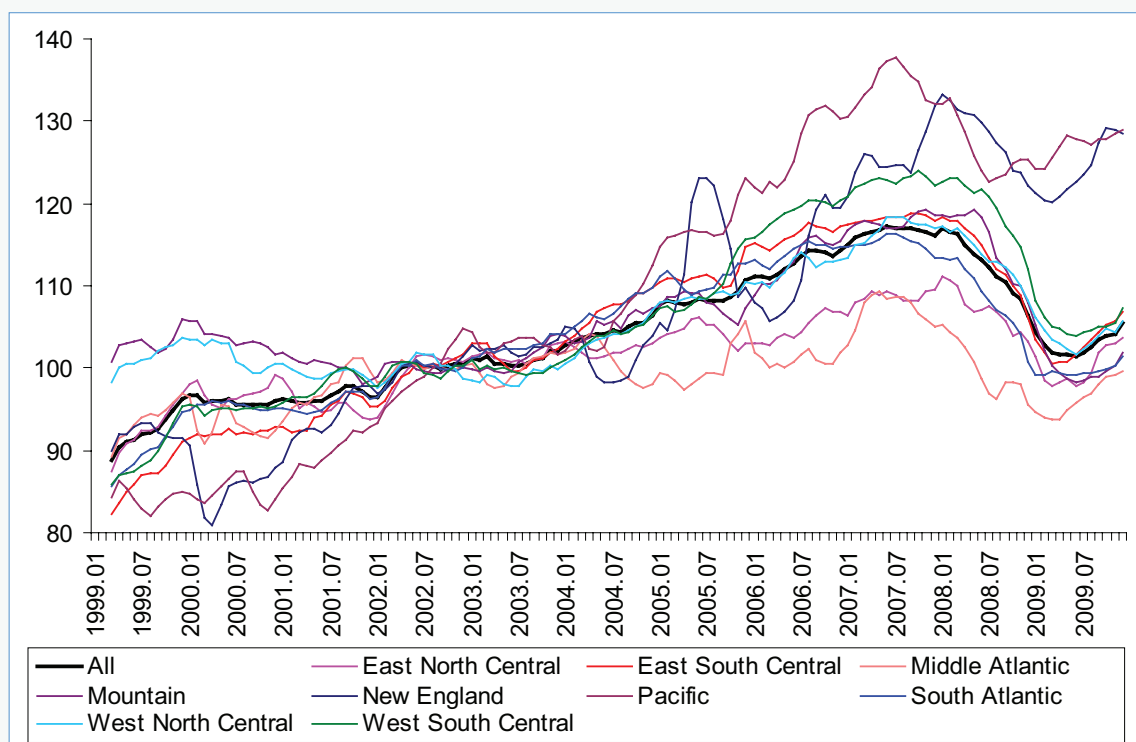
In addition to the PCI at the national level, we also examine and provide the PCI at a regional level—for the nine census divisions.¹³ Each of the nine regional level series have been individually adjusted using both a region specific workday adjustment and a seasonal adjustment using the Census Bureau’s X-12-ARIMA adjustment process to allow for different seasonal patterns in each region, and then each regional series is individually smoothed using a three-month moving average (the same smoothing process that was used with the national level data).¹⁴

¹² Note: the three-month moving average of the seasonally adjusted index closely resembles the X-12 ARIMA estimated trend cycle for this series.

¹³ See the census’ website (www.census.gov) for more information about the nine census divisions.

¹⁴ The fractional weekend adjustment values for the different regions were estimated as: 0.333001 for East North Central, 0.385835 for East South Central, 0.337480 for Middle Atlantic, 0.820852 for Mountain, 0.363669 for New England, 0.526784 for Pacific, 0.339751 for South Atlantic, 0.548946 for West North Central, and 0.557535 for West South Central.

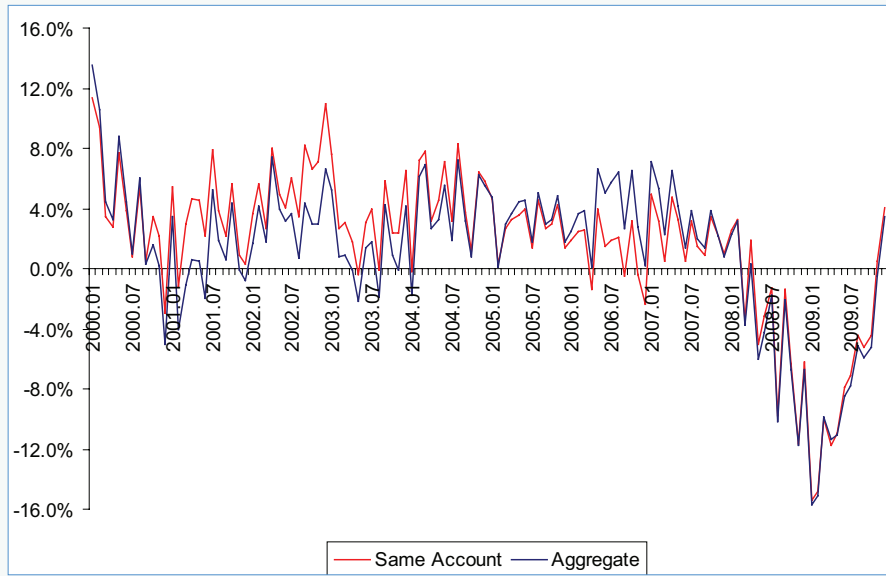
The chart below, plotting the smoothed workday and seasonally adjusted PCI for each of the census regions, shows that there are some large differences in the pulse of commerce for the different regions over time.



Another potential way of controlling for seasonality is to look at year-over-year changes, for if there are seasonal patterns, by definition they would likely be similar at the same time the previous year. We can also look at the impact of both seasonality and births and deaths by examining year-over-year changes for only those accounts that had transactions in both months of comparison.¹⁵ Unfortunately, year-over-year changes for the same account is not a complete solution to the two issues addressed above since, as was discussed above, when accounts combine the possibility exists that one account number is dropped; hence, the “same account” may not be representative of the same entity purchasing gallons. For example, with an acquired account (death of that account number) the volume purchased of the remaining account becomes the sum of the combined accounts. Thus, when looking at year-over-year changes for the same accounts, the dropped account volume will be excluded from the previous year’s amount, but will be included (by virtue of it newly being part of an established account), which will give skewed results.

¹⁵ The aggregate year-over-year change for the same accounts is calculated the same way that the aggregate year-over-year change is calculated, except that for each month of comparison, the volumes used in the calculation are the total of only those accounts that purchased in both the month and the same month a year earlier.

The two ways of measuring year-over-year changes (aggregate of all purchases and only same account purchases) are plotted in the chart below.

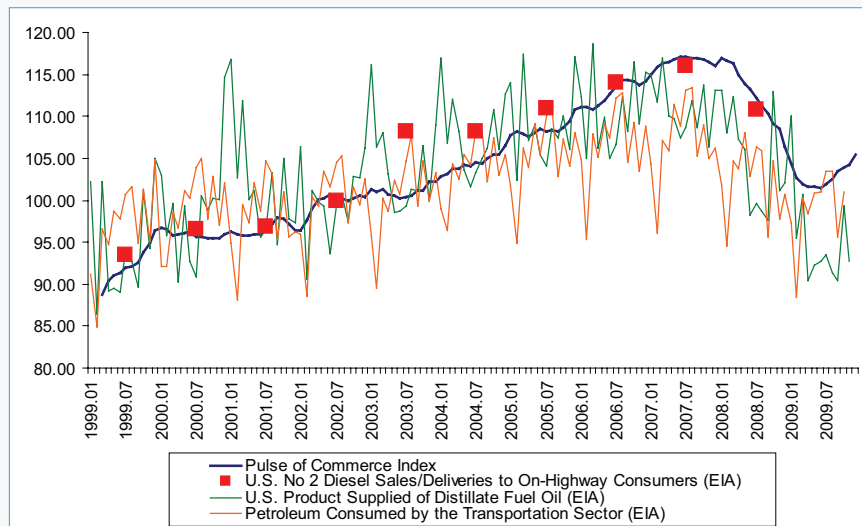


As can be seen in the chart, although there have historically been noticeable differences between these two measures, recently they have been similar.

3. Representativeness

One issue that always arises when using data regards the representativeness of the data. The data used to construct the PCI only contains information on those purchases of diesel fuel for large trucks that is processed by Ceridian through its Comdata subsidiary and does not include any information on purchases where cash was used or purchases that were processed any other way. Although we did not have a single data series that directly compared to the Ceridian data, we examined several different measures relating to diesel fuel consumption that are prepared by the U.S. Energy Information Administration (EIA). The graph below shows the PCI and three different EIA data series.¹⁶ Even though there are differences between the PCI and each of these series, the general trend appears to be somewhat similar; however, since none of the EIA series are directly comparable, they by themselves can neither support nor reject the representativeness of the Ceridian data, but can only give a general sense (which appears to be in line with the Ceridian data).

In addition, the fact that the movement of the PCI was consistently similar to other well established macroeconomic indices was also supportive that the Ceridian data are representative.



¹⁶ U.S. Energy Information Administration (EIA) data is available at their website <http://www.eia.doe.gov/>. All of the data series in the graph were indexed to the average 2002 value for each series.

IV. Index Comparisons

One benchmark as to the potential value of the unique information available from the PCI is to compare the PCI with some well know indices. Two particular indices that *a priori* would seem to be closely aligned with the movement of products around the country are Industrial Production and Retail Sales.

Before examining how the PCI compares with these other indices over time, it is worth noting the difference in the timeliness of the information available from these series. The Ceridian-UCLA Pulse of Commerce Index is released around the 10th of each month, about a week before Industrial Production and a few days before Retail Sales. Not only is the PCI released before the other two, but it is released with more complete information than either Industrial Production or Retail Sales—when the Ceridian-UCLA Pulse of Commerce Index is released, it is 100% complete for the data of the preceding month, where as only 72% of the source data are available for Industrial Production (and the data for a given month may change for up to 5 subsequent months) and Retail Sales only has an estimate for the preceding month and actual data takes an additional month to be released.¹⁷

The chart below displays the smoothed seasonally adjusted Ceridian-UCLA Pulse of Commerce Index, seasonally adjusted Industrial Production, and seasonally adjusted Retail Sales.¹⁸ One thing that is immediately apparent when looking at this graph is that Ceridian-UCLA Pulse of Commerce Index and Industrial Production generally move closely together, with notable exceptions that the Ceridian-UCLA Pulse of Commerce Index tends to lead Industrial Production (e.g., in the most recent recession, the substantial decline in the Ceridian-UCLA Pulse of Commerce Index began before Industrial Production and the Ceridian-UCLA Pulse of Commerce Index turned around and started increased before Industrial Production) and that the Ceridian-UCLA Pulse of Commerce Index and Industrial Production behaved quite differently during the recession in 2001. Comparing the Ceridian-UCLA Pulse of Commerce Index with Retail Sales also indicates that the Ceridian-UCLA Pulse of Commerce Index started its substantial declining before Retail Sales; however, during the 2001 recession, Retail Sales and the Ceridian-UCLA Pulse of Commerce Index tracked each other quite closely. One explanation for the difference in the way the indices moved during the most recent recession in contrast with the recession in 2001 is that in 2001 there was a greater impact on business than consumers (hence, the movement of products for retail sales continues to move forward across the road).



¹⁷ See the Industrial Production Explanatory Notes (which can be found at http://www.federalreserve.gov/Releases/g17/ip_notes.htm) and the Monthly & Annual Retail Trade website (<http://www.census.gov/retail/index.html>).

¹⁸ Both Industrial Production and Retail Sales use the X-12 ARIMA adjustment process for seasonal adjustment.

