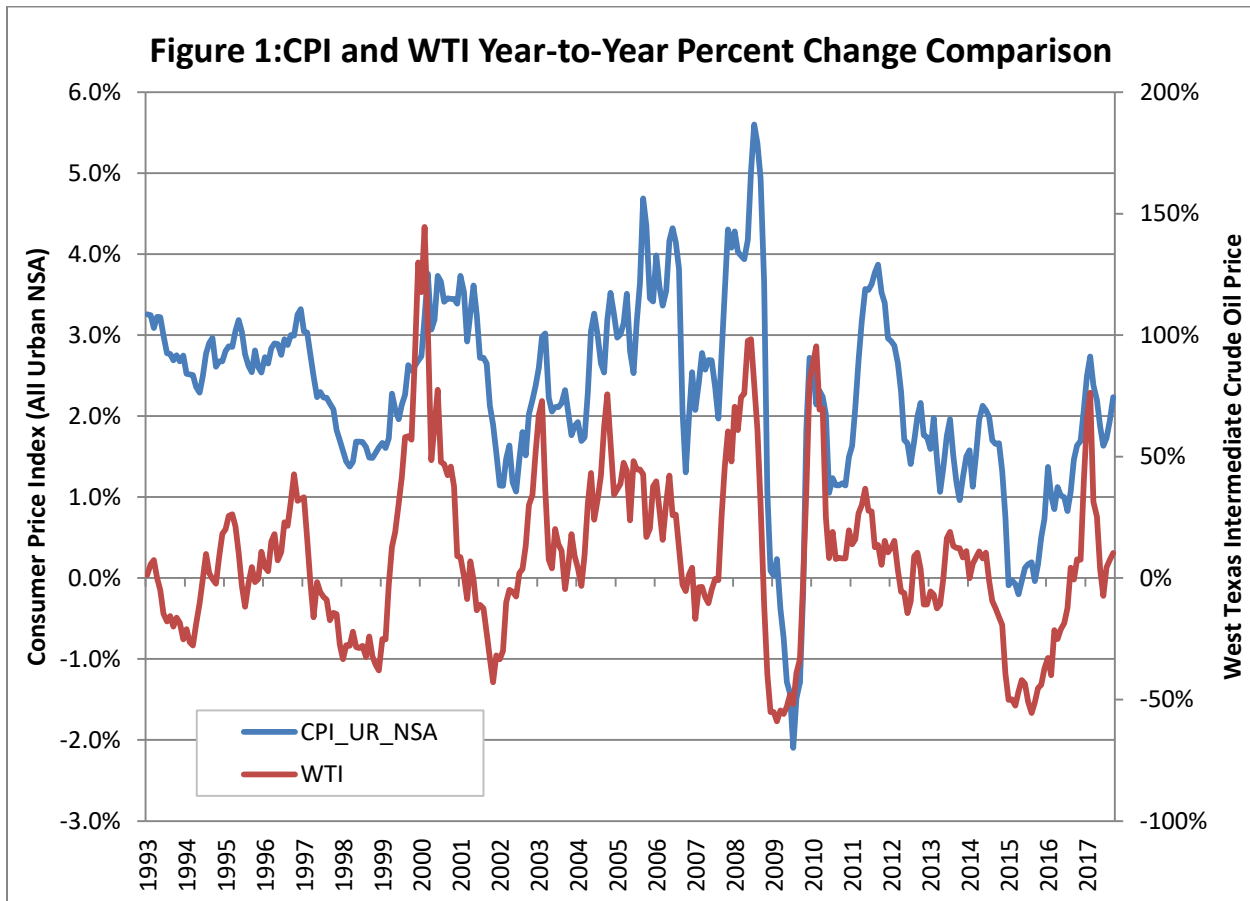


Inflation and the Price of Oil

October 30, 2017

As the Federal Reserve Board tries to move its interest rate target higher one confounding factor has been and continues to be the low rate of inflation. So, why have prices remained so stubbornly low? Or alternatively, are there any specific factors holding prices down? Low energy prices, at least recently, seems to be one possible explanation. But what about prior to mid-2014, when oil prices exceeded \$100 per barrel?

Here we explore the relationship between changes in the consumer price index (CPI) and energy prices. For the CPI we use the all urban non-seasonally adjusted series and for energy we use the price of West Texas Intermediate (WTI) crude oil. Figure 1 shows the year-over-year percent change for each of these series by month from January 1993 through September 2017.



As the graph shows, both data series have gone through seven cycles over these 24 plus years. Although there are differences, both series show similar patterns of rises and falls. The main difference between the two series is the magnitude of their fluctuations. For this reason Figure 1 includes separate scales

for the two series. The left-side scale, which ranges from -3.0% to 6.0%, applies to the consumer price index. The right-side scale, which ranges from -100% to 200%, applies to the price of WTI crude oil. Table 1 presents summary statistics for the year-over-year percent changes of the two series and for the absolute values (Abs) of the year-over-year percent changes. The statistics presented for each are the mean, standard deviation and the coefficient of variation. Also, means for negative and positive percent changes are presented separately for the CPI and WTI series. Other statistics provided for the CPI and WTI price series are the numbers of negative and positive changes, maximum and minimum changes, and the range of change values.

Table 1: Summary Statistics for CPI and WTI Year-over-Year Percent Change Series

Statistic	CPI	Abs CPI	WTI	Abs WTI
Mean	2.26%	2.33%	9.16%	26.76%
Standard Deviation	1.16%	1.03%	34.95%	24.23%
Coefficient of Variation	51.17%	44.09%	381.68%	90.51%
Negative Mean	-0.67%		-20.92%	
Positive Mean	2.41%		31.01%	
Number of Negative Changes	14		125	
Number of Positive Changes	283		172	
Maximum	5.60%		144.55%	
Minimum	-2.10%		-59.02%	
Range	7.70%		203.57%	

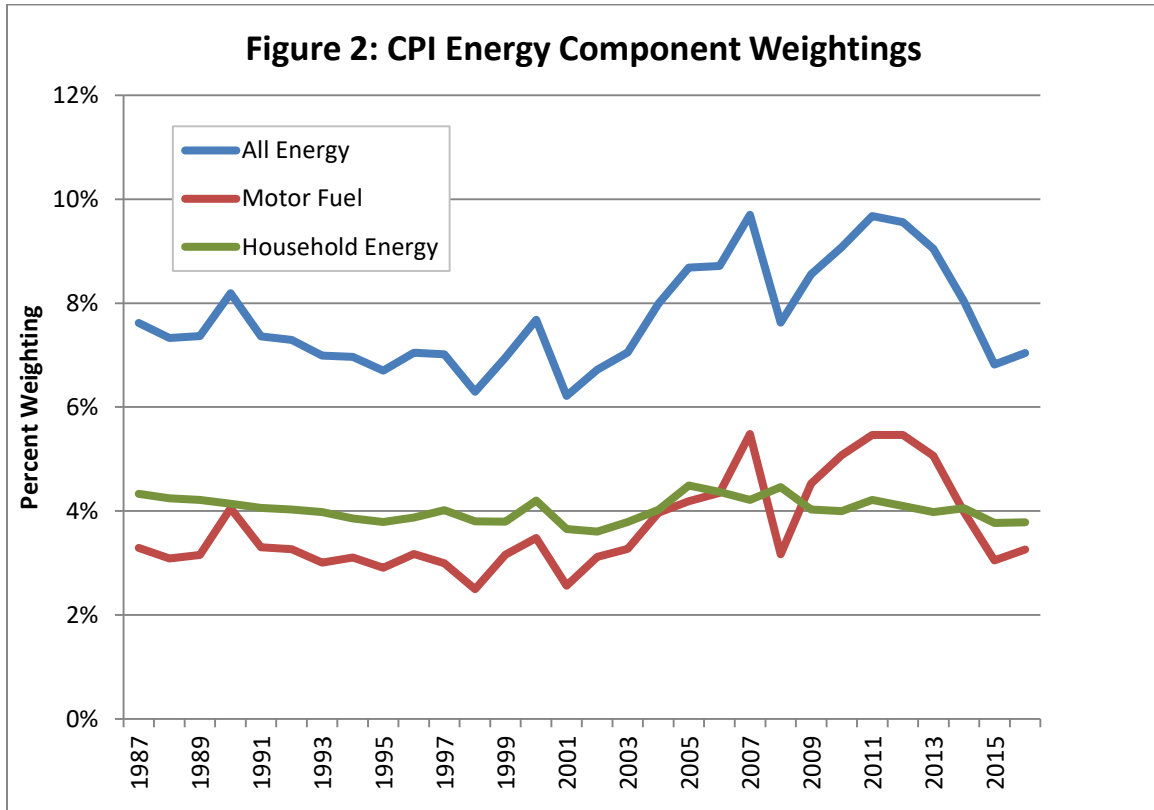
As the mean percentage statistics show, the WTI oil price changes exceeded CPI price changes by over a factor of four. And the difference in variability of the percent change in the WTI price as measured by its standard deviation is over 30 times larger than for the CPI. Even the normalized measure of variation of the year-over-year percent changes – the coefficient of variation – is about seven and a half times greater for the WTI price as for the CPI.

On an absolute value basis, the mean percent change value for the WTI price is almost eleven and a half times as large as for the CPI and the WTI price percent change standard deviation is twenty-three and a half times as large as for the CPI.

Over most of 24 plus years covered by the data the CPI increased. Only during 14 months did the CPI experience year-over-year decreases. On the other hand, the WTI price experienced 125 year-over-year decreases. Also, the year-over-year percent changes for the CPI stayed within the fairly narrow range from -2.10% to 5.60%. For the WTI price year-over-year percent changes ranged from -59.02% to 144.55%.

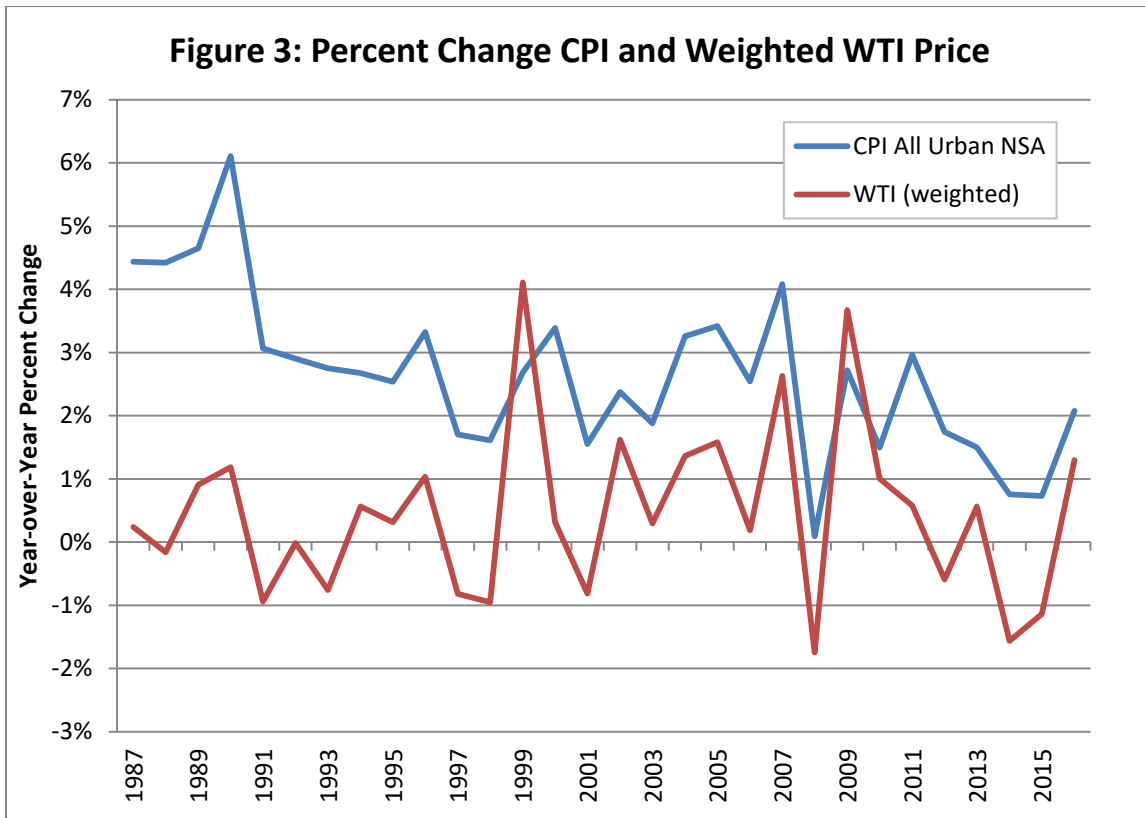
So, what does all this mean? How much influence do changes in the price of oil have on overall price inflation? Energy costs directly affect the overall consumer price index through household energy expenditures and through purchases of motor fuel for transportation. Indirectly energy costs impact almost every good and service consumed, but the extent to which energy costs are embedded in other product costs is beyond the scope of this analysis.

Figure 2 shows annual levels for the weightings for the all energy, household energy, and motor fuel components of the CPI. Over the 30 years presented in the graph the weighting for all energy ranged between 6.22% and 9.70%. The weighting range for household energy has been very stable moving only between 3.60% and 4.49% and moving in a somewhat downward trajectory. The motor fuel weighting shows somewhat greater variation spanning the range from 2.49% to 5.48%.



Applying the motor fuel weightings to the annual percent changes in the WTI price provides an indication of the strong influence the price of oil exerts on changes in consumer prices overall. Figure 3 illustrates this relationship. As this figure shows, if from one year to the next the WTI price decreased 23 out of 29 times (79.3%) so did the CPI. Regressing the first difference of year-over-year percent changes in the CPI on to the first different of the year-over-year percent change in the WTI price shows that changes in the WTI price explains over half (53.9%) the change in the CPI rate of inflation.

Change in the WTI price is not a perfect predictor of changes in the CPI, but generally the two series move in a similar fashion. Often differences in the direction of the movements of the two series reflect greater variability in the WTI price series. Four of the six years during which the changes in the CPI and the WTI price moved in opposite directions the percent change in the CPI decreased while the percent change in the WTI price increased. During one noticeable period, 1998 to 2000, both series increased starting in 1998, but the WTI price change peaked in 1999 while the CPI change did not peak until 2000. Furthermore, the CPI series exhibits a noticeable and statistically significant downward trend. The WTI price series exhibits no trend. It is a random walk.



So, what does all of this mean? Most significantly, those looking for an increase in inflation should keep a close eye on changes in the price of oil. Recently, since the end of August, the WTI price inched up from about \$47 per barrel to about \$52 per barrel, a 10% rise.

However, I wish to offer the following qualification. Although this relationship has held up well over the past several decades, the future may tell a very different story. As electric and autonomous vehicles become more common the demand for oil and oil prices may begin to act in a very different way. The price of energy used for transportation may become more stable, similar to the pattern exhibited by household energy prices. This change is likely several years into the future, but it merits watching. So, more on this later.

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