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Do Commodity Price Spikes Cause Long-Term Inflation?

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Abstract:

This public policy brief examines the relationship between trend inflation and commodity price increases and finds that evidence from recent decades supports the notion that commodity price changes do not affect the long-run inflation rate. Evidence from earlier decades suggests that effects on inflation expectations and wages played a key role in whether commodity price movements altered trend inflation. This brief is based on a memo to the president of the Federal Reserve Bank of Boston as background to a meeting of the Federal Open Market Committee.

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Introduction

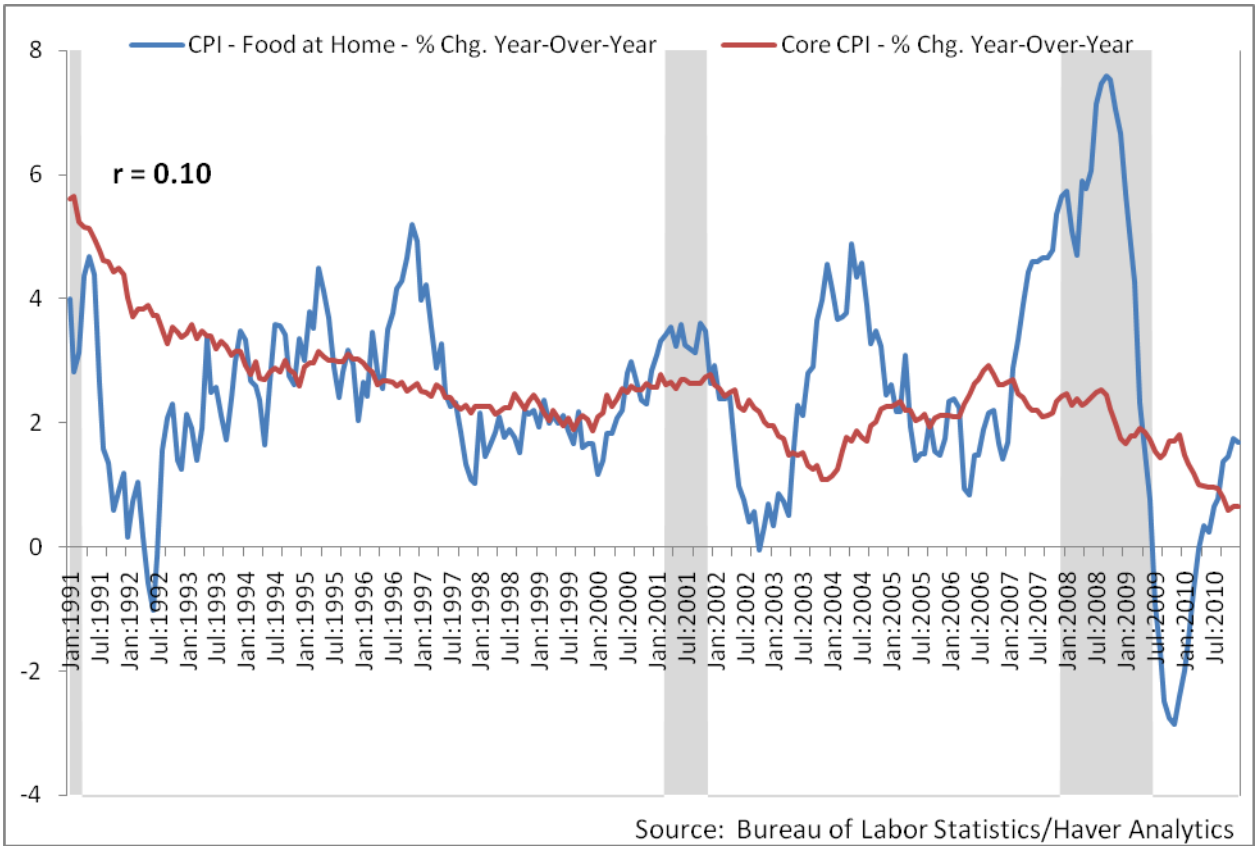
Commodity prices often rebound as a recovery takes hold, and these rebounds usually raise fears of inflation. This recovery is no exception, as oil prices have increased significantly since the end of 2010. In fact, commodity prices in general have been rising since this recovery tentatively began in late 2009. How should central banks respond to rising commodity prices? Certainly increasing relative prices, particularly for goods produced abroad, are painful. Such price increases tend to reduce the real wealth and incomes of domestic consumers. Unfortunately, central banks have little control over relative prices. If, however, these commodity price increases do begin to elevate long-run inflation, central banks should react. Given the possible policy implications of a relationship between oil prices and trend inflation, this brief examines the evidence of such a relationship.

In fact, recent press accounts are filled with warnings that the commodity price increases of the past few quarters will cause a more general and permanent increase in core inflation, the rate of inflation on goods other than food and energy. However, both theory and evidence raise significant doubts about this conclusion. Relative prices are determined by the supplies and demands of the various goods in the economy. These relative prices can change if these demands or supplies change, but once relative prices reach their equilibrium level, they tend to stabilize at their new values. These relative prices do not accelerate forever. Complicating the issue, commodities are often an input to the production of other goods; hence, oil price increases tend to increase the costs of other goods, which should raise their prices as well. In the short run, as all prices adjust to the increase in the level of oil prices, both total and possibly core inflation will increase. Once the price levels adjust, inflation should settle back down to its original rate.[1] To get a permanent increase in inflation from a rise in the price level of commodities, however, requires further assumptions about inflation dynamics. One such assumption is that those relative price changes might get embedded in people's expectations of the inflation of non-energy goods.

[1] Central banks have very little control over relative prices in the long run. As a result, monetary authorities tend to target the longer-term trend in prices in general; they do not attempt to reverse shifts in relative prices.

Chart 1 compares one measure of core inflation with a price that varies significantly through time, the price of food.

Chart 1. Food Price Inflation versus Core Inflation
1991–2010



Significant increases in food prices, such as those that occurred in 1996 and 2006–2008, do not appear to have had much effect on core inflation. In fact, over this sample, 1991 through 2010, the four-quarter change in food price inflation has little relationship with the four-quarter change in core CPI. Chart 1 is consistent with the notion that when relative prices change, there is some adjustment to the aggregate price level, but after that adjustment, the *rate of change* of the aggregate price level settles back down.

Chart 2 expands the sample to include the 1970s and 1980s and examines energy prices instead. Unlike the evidence in Chart 1, over the longer sample the relationship between energy prices and core inflation provides some evidence that changes in commodity prices can affect the trend inflation rate.

Chart 2. Energy Price Inflation versus Core Inflation
1971–2010

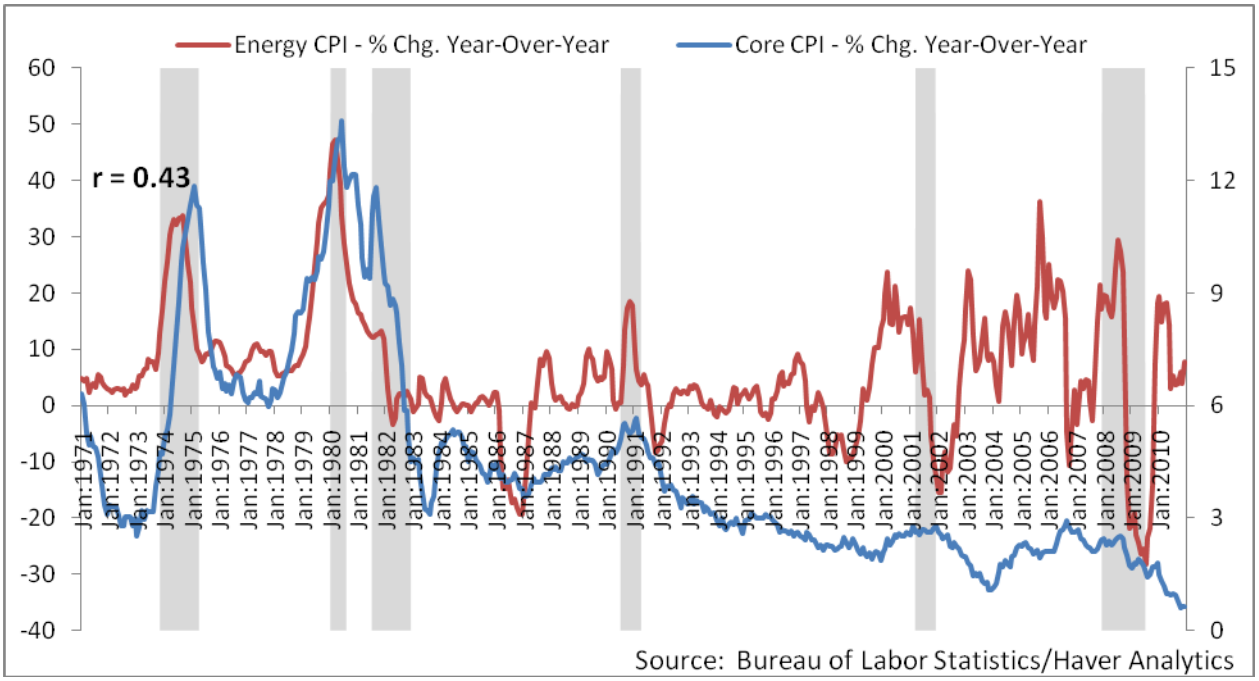


Chart 2 shows that the correlation between core inflation and the oil price inflation is fairly high. However, that tight relationship does not seem to be consistent over the entire sample. The strong association between the two in the 1970s seems to be an anomaly. Since then core inflation and oil price changes are only very loosely related. Why might commodity price increases sometimes pass through into core inflation while at other times not? The explanation is probably that during the 1970s the temporary increase in inflation due to an increase in the relative price of oil became embedded in inflation expectations. The remainder of this public policy brief examines this question more rigorously. Specifically, the brief explores one avenue through which the change in expectations would be visible—wages. And since ocular, or bivariate, analysis is problematic, as core inflation depends on so much more than commodity prices, more comprehensive empirical work is conducted.

Models of Inflation

The exact determinants of inflation remain somewhat of a mystery to everyone, including economists. Economists have historically modeled inflation as a variation of equation 1,

$$\pi_t = \alpha_0 + \alpha_1 * Gap_{t-1} + \alpha_2 * \pi_t^E + \alpha_3 * \pi_{t-1}^{oil} + \varepsilon_t \quad , \qquad (1)$$

where core inflation, π_t, depends on the amount of resource slack, the *Gap*; the expectations about future inflation, π^E; and the relative change in oil prices, π^{oil}.[2] The degree of resource slack is often measure by the unemployment rate. Alternatively, the difference between the current level of GDP and the level of GDP when all resources are fully utilized is often used. The gap is expected to decrease inflation, as excess resources tend to put downward pressure on the prices of those resources, such as wages, which results in lower costs to firms. Inflation expectations also play an important role, as it is assumed that wage and price inflexibilities force firms and workers to set prices and wages over a longer-term horizon. The labor market, for example, is not, in general, a spot market. These inflexibilities force firms and workers to set prices based on their expectations of where prices will go in the future. Finally, commodity price inflation is included as a test of whether changes in these prices affect core inflation.

How to model inflation expectations is far from settled. Proxies such as the recent experiences with inflation, the long-run inflation expectations derived from the responses from surveys of the public or professional forecasters, the expectations derived from bond markets, or the inflation target of the central bank have all been used to measure this variable. A variety of specifications are tested here to ensure that the results on commodity prices are not sensitive to different specifications of inflation expectations. Specifically, this note explores the importance of commodity prices on core inflation, using a mixture of backward-looking and forward-looking measures of inflation expectations.

[2] The literature on this relationship goes back before Phillips himself. A sketch of the progression runs from Keynes, Phillips, Friedman, and Gordon, to the new-Keynesians like Galí and Gertler (1999).

Table 1: Core CPI Phillips Curve - Constrained

	1970–2010			1970–1985			1986–2010		
	Backward	Forward	Hybrid	Backward	Forward	Hybrid	Backward	Forward	Hybrid
Constant	0.758 (0.080)	2.141 (0.000)	0.925 (0.033)	2.524 (0.022)	6.269 (0.000)	2.846 (0.016)	0.281 (0.325)	1.870 (0.000)	0.793 (0.011)
4 Lags of Core CPI	1		0.844	1		0.891	1		0.642
Long-Run Inflation Expectations		1	0.156		1	0.109		1	0.358
3 Lags of Unemploy-ment	-0.140 (0.000)	-0.278 (0.029)	-0.152 (0.000)	-0.389 (0.000)	-0.727 (0.003)	-0.412 (0.000)	-0.057 (0.079)	-0.315 (0.000)	-0.138 (0.011)
Relative Oil Price Growth	0.004 (0.000)	0.008 (0.000)	0.004 (0.000)	0.005 (0.000)	0.007 (0.001)	0.005 (0.000)	0.000 (0.250)	0.001 (0.565)	0.000 (0.273)

Note: Results shown in table are from constrained regressions where for the backward models, the sum of the coefficients on the lags of Core CPI must be 1; for the forward models, the coefficient on Long-Run Inflation Expectations must be 1; and for the hybrid models, the sum of the coefficients on the lags of Core CPI and the coefficient on Long-Run Inflation Expectations must be 1. P-values are given in parentheses for unconstrained coefficients.

Table 1 provides the estimates of the coefficients of oil prices from equation 1. Three different proxies are used to capture inflation expectations. The first three columns present the estimation for the full sample, 1970–2010, using these proxies. The coefficients of greatest concern for this paper are the coefficients on commodity price inflation, in row 5. For the full sample, the results do not depend on how inflation expectations are modeled. If lagged inflation is used to proxy for inflation expectations (column 1), oil prices apparently affect inflation. Estimation of either a completely forward-looking model (column 2) or a hybrid model, with both forward- and backward-looking aspects, also produces significant coefficients on oil prices. Note that the effects are not economically significant. A 20 percent increase in oil prices using the forward-looking model increases core inflation over the next year by only two tenths. It is even lower for the backward looking and hybrid models.

Charts 1 and 2 show an apparent shift in the relationship between core inflation and commodity prices. Because of this potential instability, the models are estimated over two different subsamples—1970–1985, and 1986–2010.[3] The estimated effect of commodity prices on core inflation depends critically on the sample selected. In the early part of the sample, oil prices matter; in the latter part of the sample, they do not. Oil prices are significant in all three

[3] Stability of the coefficients across these two subsamples is strongly rejected.

models during the early part of the sample. And just the opposite is true for the latter sample: oil prices are never significant. Note that the size of the coefficients in the latter part of the sample indicates that even if they were statistically significant, oil prices are not economically important. It would take a huge change in oil prices just to have a discernible effect on the core inflation rate.

As previously mentioned, the results for the latter half of the sample are not surprising. If oil prices increased and stayed at their higher level forever, the effect on inflation should be temporary. Inflation might rise as prices rose to accommodate the increase in oil prices and as oil prices made their way through the system, but eventually inflation would fall back to its previous level, since the increase in relative oil prices would have stopped.[4]

Clearly the economy has reacted to oil price increases in different ways at different times. The early part of the sample shows that, theory aside, oil price increases can have permanent effects on core inflation even when the price of oil settles down. The most common explanation for this phenomenon is that a temporary increase in the level of commodity prices increases the public's expectations of future inflation. If the public believes inflation is going to be higher, equation 1 indicates that core inflation will rise, perhaps because wage demands rise. To put it in the lingo of the 1970s, if expectations move permanently higher, then a wage-price spiral could begin; in this case, what starts as a temporary increase in inflation is made permanent by becoming embedded in wage growth.

The remainder of this brief examines the effect of a commodity price increase on wage inflation.

The Spiral

This section investigates how commodity prices affected wages over the sample and provides evidence that commodity prices may have sparked a wage-price spiral in the 1970s.

[4] In fact, the pattern of coefficient signs suggests this effect. The initial response of core inflation to energy price increases is positive, but after a couple of quarters the response is negative. In total, one cannot reject that the sum of the coefficients on the lagged energy prices is zero in the latter part of the sample.

Since then, however, even significant fluctuations in commodity prices have had little effect on wage inflation.

After the oil crisis in 1974, there was widespread discussion about the "wage-price" spiral. Many observers believed that any temporary increase in inflation due to an increase in oil prices would be embedded into current and future wage demands. In part, current wages reacted to the oil price increase because a significant percentage of workers had wages that were indexed to inflation. With indexation, wages rose automatically with inflation, whether the increase was caused by a price-level change or a change in trend inflation. Furthermore, inflation expectations may have reacted strongly to this temporary acceleration in oil prices. Labor contracts during the 1970s did seem to assume a higher inflation rate, raising costs to firms and prices to consumers.[5] These wage increases helped cause a temporary increase in inflation to become permanent.

Chart 3 shows the wage-price spiral in action. As commodity prices rose in the early and mid 1970s, so did wages. Over the early part of the sample, the raw correlation between the wages and commodity prices was relatively high, about 0.5.

Chart 4 reveals that this relationship has changed substantially since the oil shocks of the 1970s. Since the mid-1980s, large spikes in energy prices seem to have little effect on wages. Again, however, these bivariate correlations can be misleading. As with price inflation, more formal statistical analysis is needed.

[5] What exactly caused this shift in expectations has been hotly debated in the literature. One view is that the Fed did not react aggressively enough to prevent the change in expectations.

Chart 3. The Wage-Price Spiral
1970–1985

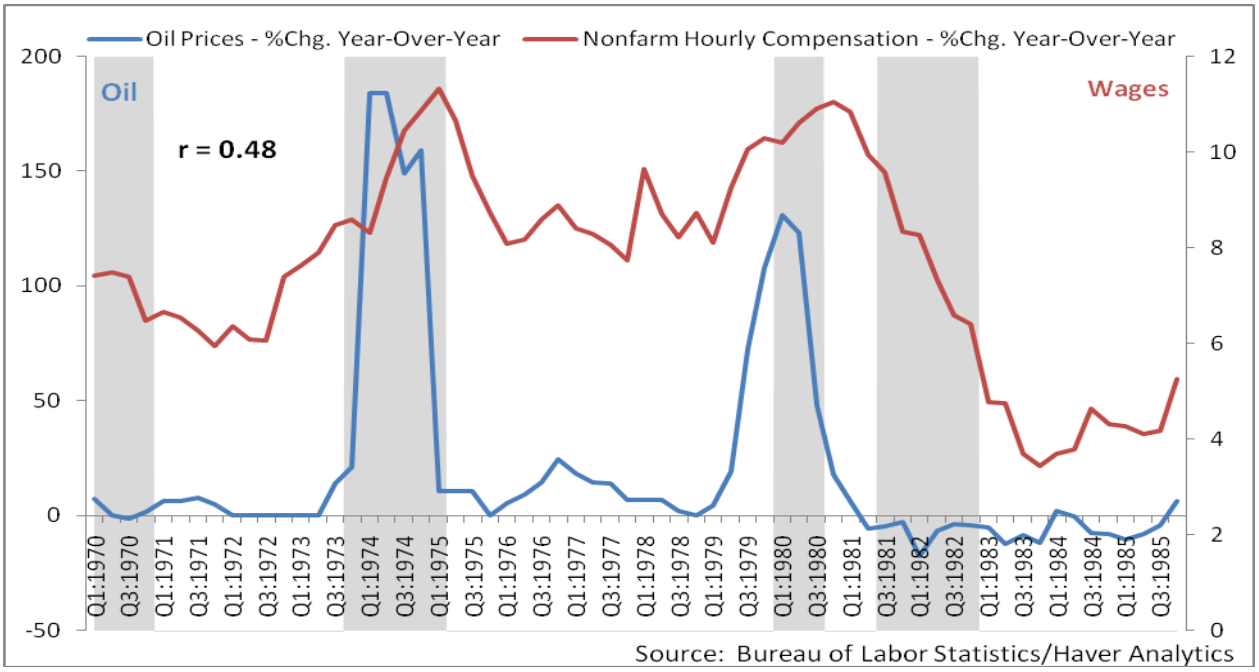
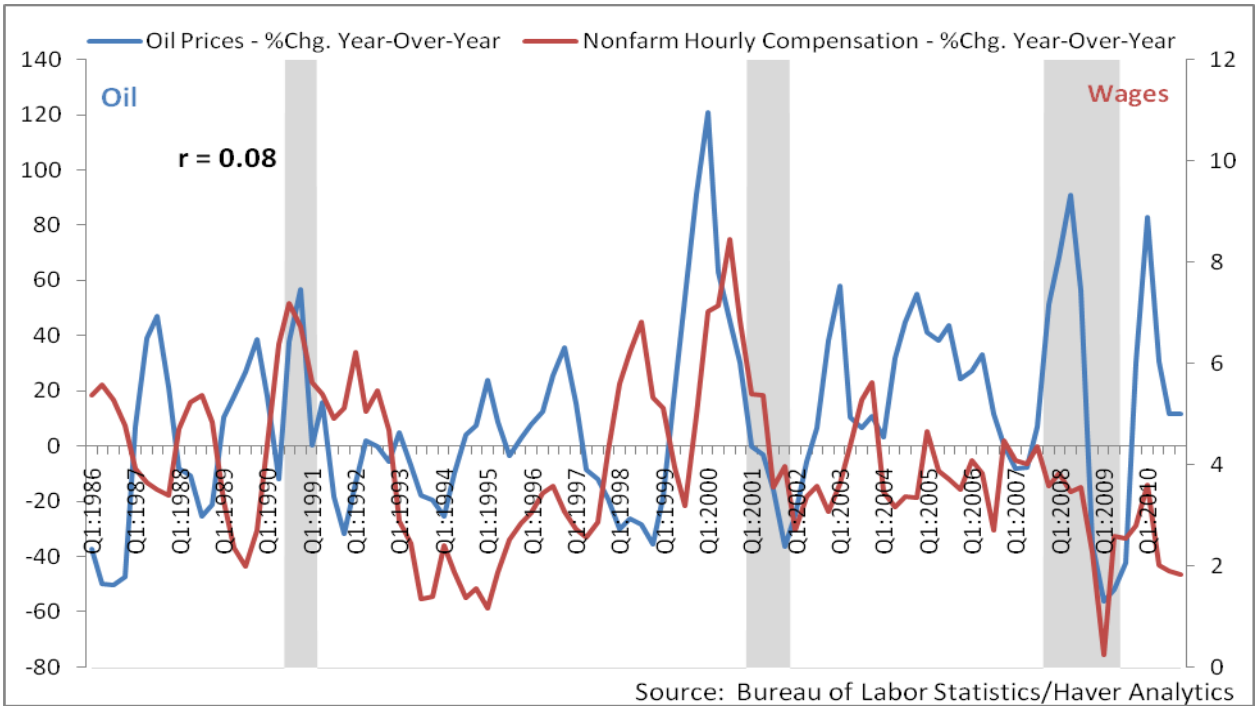


Chart 4. The Nonexistent Wage-Price Spiral
1986–2010



Model of Wages

Specifically, an aggregate wage equation of the form,

$$w_t = \alpha + \beta * UR_{t-i} + \sum_i \vartheta_i * \pi^E_{t-i} + \sum_i \delta_i * \pi^{Com}_{t-i} + \sum_i \gamma_i * \mathrm{Pr}od_{t-i} + \varepsilon_t, \qquad (2)$$

is estimated, where *UR* is the lag of the unemployment rate, π^E is the expectation of inflation, π^{Com} represents inflation in commodity prices, and Prod_{t-i} is the lag of labor productivity growth. The origin of this equation is clear if the inflation of the product prices associated with the wages is used, the commodity price inflation is dropped, and the summation of *the* ϑs and γs are each constrained to equal one. In that case, real wages would be growing at the rate of labor productivity, which is consistent with firms' profit maximization. In the specification estimated in the next table, these two constraints are not, in fact, imposed, since they are resoundingly rejected by the data when consumer price inflation is included on the right-hand side of equation 2. Hence, this is a reduced form regression that should be viewed simply as a "wage inflation prediction equation."

Table 2: Wages Phillips Curve - Unconstrained

	1970–2010			1970–1985			1986–2010		
	Backward	Forward	Hybrid	Backward	Forward	Hybrid	Backward	Forward	Hybrid
Constant	2.250 (0.048)	3.803 (0.001)	2.451 (0.033)	7.038 (0.002)	8.865 (0.000)	6.958 (0.003)	3.771 (0.048)	4.116 (0.015)	3.930 (0.049)
4 Lags of Core CPI	0.935 (0.000)		0.736 (0.004)	0.660 (0.000)		0.639 (0.012)	0.548 (0.103)		0.395 (0.336)
Long-Run Inflation Expectations		1.622 (0.000)	0.433 (0.256)		1.106 (0.006)	0.077 (0.880)		0.612 (0.097)	0.220 (0.766)
3 Lags of Unemploy-ment	-0.437 (0.033)	-0.972 (0.000)	-0.602 (0.019)	-0.671 (0.002)	-1.094 (0.000)	-0.703 (0.007)	-0.481 (0.057)	-0.554 (0.021)	-0.540 (0.085)
Relative Oil Price Growth	0.004 (0.286)	0.005 (0.010)	0.004 (0.312)	0.004 (0.083)	0.004 (0.090)	0.004 (0.089)	0.011 (0.226)	0.011 (0.298)	0.012 (0.219)
8 Lags of Productivity	0.799 (0.054)	0.707 (0.187)	0.841 (0.039)	0.334 (0.017)	0.208 (0.052)	0.360 (0.017)	0.511 (0.155)	0.516 (0.133)	0.516 (0.164)

Note: Results shown in table are from unconstrained regressions. P-values are given in parentheses.

Table 2 presents the estimates of the coefficients from equation 2. The first three columns show that the evidence that commodity prices get embedded into wage inflation over the full sample is slightly weaker than for the price equations. Using two of the three measures of inflation expectations, commodity prices are not statistically significant over the full sample. Of course, the possible instability of these coefficients over time, seen in the inflation equations, might be masking any impact commodity prices might have on wages. Again, the sample is divided into two periods due to significant coefficient instability; the stability of these coefficients across these two periods is strongly rejected.

The next three columns of Table 2 present the coefficients estimated over the early part of the sample, which includes the 1970s oil shocks. The sum of the coefficients for each variable is correctly signed and most are significant. The summation of the coefficients on commodity prices, shown in the first of these columns, is significant at the 10 percent level.[6] No matter what measure of inflation expectations is used, there is some evidence that lags of commodity prices appear to have affected wage inflation in the 1970s.

The final three columns of Table 2 present the estimated coefficients for the latter part of the sample. As with price inflation, the results from the early subsample are reversed. Regardless of what measure of inflation expectations is used, the coefficients on commodity price inflation are never statistically significant. The coefficients remain small, suggesting that even ignoring statistical significance, the effect on wage inflation of a large increase in commodity prices would be very slight. Since 1985, commodity price increases do not seem to have had even a short-run effect on wages.

Robustness

The next two tables explore whether the results are sensitive to the constraints either imposed or not imposed. When estimating the coefficients for price inflation, the coefficients on

[6] The significance of energy prices in the wage equations in the early sample changes marginally based on the measure of energy prices used. Some measures produce more significant results in the early period. No measure is significant in the latter part of the sample. We show this measure of energy prices to provide consistency with the other tables.

whatever measure of price expectations was estimated were constrained to sum to 1. Depending on the sample, this assumption often cannot be rejected. To ensure that imposing the constraint is not affecting the results, Table 3 replicates Table 1 without the constraint imposed. The results for the commodity price coefficients are identical to those in Table 1. Over the full sample the evidence suggests that commodity prices affect inflation, but that effect is coming entirely from the early part of the sample. Since 1986, there is no evidence that commodity price inflation has had much of an effect on core inflation.

Table 3: Core CPI Phillips Curve - Unconstrained

	1970–2010			1970–1985			1986–2010		
	Backward	Forward	Hybrid	Backward	Forward	Hybrid	Backward	Forward	Hybrid
Constant	0.791 (0.069)	2.218 (0.000)	1.129 (0.009)	2.503 (0.034)	4.587 (0.000)	2.832 (0.014)	0.456 (0.148)	1.670 (0.000)	0.754 (0.017)
4 Lags of Core CPI	0.961 (0.000)		0.698 (0.000)	1.005 (0.000)		0.719 (0.000)	0.932 (0.000)		0.622 (0.000)
Long-Run Inflation Expectations		1.724 (0.000)	0.540 (0.001)		2.107 (0.000)	0.783 (0.015)		1.150 (0.000)	0.435 (0.001)
3 Lags of Unemploy-ment	-0.119 (0.000)	-0.712 (0.000)	-0.311 (0.000)	-0.391 (0.000)	-1.298 (0.000)	-0.746 (0.000)	-0.052 (0.080)	-0.354 (0.000)	-0.159 (0.007)
Relative Oil Price Growth	0.004 (0.000)	0.006 (0.000)	0.004 (0.000)	0.005 (0.000)	0.005 (0.003)	0.005 (0.000)	0.000 (0.243)	0.001 (0.484)	0.000 (0.277)

Note: Results shown in table are from unconstrained regressions. P-values are given in parentheses.

The test for the sensitivity of the wage equation is different. Table 2 does not impose the constraints implied by the first-order condition for profit maximization. Table 4 actually imposes these constraints on the wage equation, even though they are strongly rejected by the data. Imposing these constraints marginally increases the significance of commodity prices on wage inflation. However, the improvement is coming from the early part of the sample. The latter part of the sample still provides no support for the idea that commodity prices have become embedded in wage inflation since the mid-1980s.

The remaining issue is whether a long-run effect can filter into wages through an independent effect of commodity prices on core prices. Traditional backward-looking Phillips curves do not find a strong effect of commodity prices on core prices. Using a more reduced

form version of a wage-price Phillips curve produces slightly different results. If the coefficients on lagged prices in the Phillips curve are constrained to sum to 1, so that these shocks can produce some permanence, it cannot be rejected that commodity prices have no effect on wages and core prices. Finally, including lagged wages in the wage Phillips curve has no effect on the results. Over the course of a year, any effects are temporary.

Table 4: Wages Phillips Curve - Constrained

	1970–2010			1970–1985			1986–2010		
	Backward	Forward	Hybrid	Backward	Forward	Hybrid	Backward	Forward	Hybrid
Constant	1.715 (0.075)	2.921 (0.005)	1.827 (0.062)	3.339 (0.019)	6.524 (0.000)	4.148 (0.005)	1.644 (0.270)	2.738 (0.058)	2.363 (0.169)
4 Lags of Core CPI	1		0.898	1		0.725	1		0.516
Long-Run Inflation Expectations		1	0.102		1	0.275		1	0.484
3 Lags of Unemploy-ment	-0.462 (0.013)	-0.563 (0.001)	-0.470 (0.013)	-0.636 (0.002)	-0.893 (0.000)	-0.696 (0.001)	-0.524 (0.024)	-0.684 (0.001)	-0.638 (0.017)
Relative Oil Price Growth	0.004 (0.276)	0.007 (0.026)	0.004 (0.261)	0.004 (0.094)	0.005 (0.037)	0.004 (0.117)	0.011 (0.214)	0.011 (0.272)	0.012 (0.201)
8 Lags of Productivity	1	1	1	1	1	1	1	1	1

Note: Results shown in table are from constrained regressions where for the backward models, the sum of the coefficients on the lags of Core CPI must be 1 and the sum of the coefficients on the lags of productivity must be 1; for the forward models, the coefficient on Long-Run Inflation Expectations must be 1 and the sum of the coefficients on the lags of productivity must be 1; and for the hybrid models, the sum of the coefficients on the lags of Core CPI and the coefficient on Long-Run Inflation Expectations must be 1 and the sum of the coefficients on the lags of productivity must be 1. P-values are given in parentheses for unconstrained coefficients.

Conclusion

Neither theory nor evidence supports the notion that commodity price changes necessarily affect the long-run inflation rate. In the 1970s there appears to have been some effect on wages, but it is not visible in the latter sample. Commodity price inflation will affect total inflation in the short run. It does not appear to affect core inflation, and thus total inflation, in the long run, at least since the 1970s. Going forward, to determine whether the economy is in a situation like the 1970s or one like the post-1985 period, the response of wages to these commodity price increases should be monitored closely.