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THE DECLINE IN OIL PRICE PASS-THROUGH TO WAGE INFLATION IN 11 EUROPEAN COUNTRIES

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Abstract

A structural break is found on oil price coefficients in wage Phillips curves for 11 European nations that matches the timing found elsewhere. Oil prices fed directly into wage inflation in during the 1960s and 1970s, but had no effect afterwards. The authors develop a model that shows when inflation expectations become unanchored, oil price shocks cause large and persistent increases in wage inflation. These shocks die out when inflation expectations become better anchored.

Keywords: wage inflation, oil price pass-through, anchored expectations, and structural break.
JEL codes: E31, E24, E50

Introduction

Economists have long been interested the degree of oil price pass-through to inflation ever since the 1970s oil price shocks and corresponding stagflation experienced by many world economies. The large run-up in oil prices in the early and mid-2000s brought new concerns of a return to high inflation and high unemployment.

However, the world economies remained resilient to these shocks with unemployment and inflation having a muted response.

Declining oil price pass-through of oil prices to inflation among many economies is well-documented in the literature. Blanchard and Gali (2009) check for the response of price and wage inflation in a six-variable VAR for Canada, France, Germany, Italy, Japan, and the U.K. by separating the data into pre- and post-1984 periods to account for the Great Moderation. They find a much smaller response of wage and price inflation in the post-1984 sample for all countries. The pre-1984 sample periods saw a larger and more persistent response of the inflation measures for most countries.

Hooker (2002) estimates an expectations-augmented Phillips curve for the United States. He finds a structural break in the oil price coefficients in 1981 with oil prices having a large effect on core inflation (inflation less food and energy) prior to 1981, but no effect afterwards.

De Gregorio et al. (2007) use traditional Phillips curves as well as rolling VAR estimates to check for a reduction in oil-price pass-through for 34 developed and developing countries. Most developed countries saw a structural break in the oil price coefficients during the 1970s and 1980s. Estimates reveal a larger pass-through coefficient on oil prices in samples including the pre-break period, with a smaller pass-through coefficient in the post-break periods. The authors' rolling VAR estimates reveal a similar pattern with oil prices having a smaller impact on inflation over time.

Chen (2009) uses Phillips curves estimates with time-varying pass-through coefficient for 19 developed countries. He finds a similar decline oil price pass-through since the 1970s.

Improvements in monetary policy and a better anchoring of inflation expectations can help explain the decline in oil price pass-through. Economists recognize the importance of inflation expectations on the inflation process (Mishkin 2007, Bernanke 2007, Yellen 2015 and 2017).When expectations are well-anchored to the central bank's inflation goals, temporary oil price shocks will quickly die out. If instead the central bank lacks credibility, inflation expectations can become unanchored from the central bank's inflation goals. Oil price shocks can then have a more persistent effect on inflation.

Gurkaynak et al. (2010) look at the effects of economic news on far-ahead interest rates of long-term bonds for the U.K. and Sweden. An economic shock moves short-term interest rates as the economy transitions back to the steady state, but long-term rates respond very little to a shock if inflation expectations are well-anchored. The authors find that long-term rates did react significantly on U.K. long-term bonds prior to the independence of the central bank in 1997, but remained stable to similar shocks

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after the bank achieved independence. Similar results were found with Sweden. In periods after Sweden switched to its inflation targeting regime long-term bond yields showed no response to economic news. They attribute these findings to high levels of central bank credibility and the anchoring of inflation expectations.

Ehrmann et al. (2011) examined bond yields on several European countries to assess the success of the Economic and Monetary Union (EMU) in Europe and the degree in which inflation expectations have become better anchored since then. They expand the countries studied by Gurkaynak et al. (2010) by looking at the behavior of far-ahead forward rates for Germany, France, Italy, and Spain. Their findings show that since the formation of the EMU, the level and the volatility of far-ahead forward rates have become similar across the four countries. In addition, reactions of far-ahead rates to economic news have been minimal across the four countries.

Davis (2012) uses a structural VAR for the U.K., Canada, Norway, Switzerland, and Sweden to compare impulse responses of inflation to oil price shocks in periods before and after each country adopted inflation targeting. He finds a much larger response of inflation to oil price shocks in the periods prior to inflation targeting.

Real wage rigidity can also create larger inflation responses to oil price shocks. Labor market frictions cause real wages to adjust slowly to shocks in the economy. A central bank facing a negative supply shock faces a tradeoff between stabilizing inflation and stabilizing output (Blanchard and Gali, 2007). Blanchard and Gali (2009) argue that reductions in real wage rigidity in part explain the decline in oil price pass-through. They construct a calibrated DSGE new Keynesian model with real wage rigidity for the U.S. They show that for a given monetary policy rule, reductions in real wage rigidity leads to declines in the volatility of inflation.

Blanchard and Riggi (2013) investigate the declines in oil price pass-through to inflation by constructing a DSGE new Keynesian model that allows for real wage rigidity. Their findings highlight the importance of the formation of inflation expectations. When agents base their expectations on the current period's inflation, declines in real wage rigidity explain most of the decline in oil price pass-through. However, when inflation expectations are formed based on lagged inflation, improvements in central bank credibility is the key factor in explaining declines in oil price pass-through.

Gelos and Ustyugova (2017) use Phillips curve estimates for 91 developed and developing countries to analyze factors that explain inflation's response to commodity price shocks. They find in part that countries with more independent central banks as well as inflation targeting nations see smaller inflation responses to oil price shocks. They find little support of countries with greater labor market flexibility having lower commodity price pass-through.

While much of the previous literature focuses on price inflation, research on the effects of oil price shocks on wage inflation is scant. This study analyzes the degree of oil price pass-through to wage inflation by estimating wage inflation Phillips curves for 11 European nations. Structural break tests are used to check the stability of the oil price coefficients. Studying European economies is informative since real wage rigidities are more prevalent there when compared to the United States. If real wage rigidity is important in explaining oil price pass-through, wage inflation should respond positively to oil price shocks over the entire sample period analyzed. If structural breaks are found in the oil price coefficients so that oil price shocks die out in more recent sample periods, improved monetary policy and a better anchoring of inflation expectations can explain this change.

Structural breaks are found in the oil price coefficients for all 11 nations with the timing that matches those found in the previous literature. Oil price shocks feed directly into wage inflation during the 1960s and 1970s, but have a much more muted effect in the 1980s and afterwards. The findings show that improvements in monetary policy and a better anchoring of inflation expectations can help explain the decline in oil price pass-through.

This paper is organized as follow. Section 2 discusses labor market institutions in Europe and evidence of greater real wage rigidity when compared to the United States. Sections 3 develops wage inflation Phillips curve model showing how oil price shocks affect wage inflation differently under different degrees of anchoring of inflation expectations. Section 4 presents the results from the wage Phillips curve estimates. Section 5 concludes.

Section 2: European Labor Market Institutions

Two key differences in wage formations between the United States and European countries are the number of workers covered by collective bargaining agreements and the centralization of the collective bargaining process. A common perception is that countries with higher union memberships tend to have more workers covered under collective bargain. However, while some European countries do have very high union memberships (e.g. Denmark, Finland, and Sweden) others have memberships comparable to the United States (e.g. Germany, France, and Spain). The key difference in institutions between Europe and the U.S. is that in the U.S. bargaining usually occurs at the decentralized firm level and usually through unions. Workers not covered by unions typically do not have a formal wage bargaining mechanism. Contrast this with European labor markets where many workers – union and non-union – have collective bargaining coverage. Many European firms voluntarily extend their wage coverage of bargained labor contracts to non-union workers (Du Caju et al. 2008). In other words, European workers not members of trade unions nevertheless receive contracted wages.

A second difference in institutions is that wages are typically bargained at the national and sectoral level in many European countries. This creates much lower wage dispersion among regions and skill level. Differences in skill level are usually reflected in different wage rates. However, if wages are unable to adjust downward, then low-skilled workers will see higher persistent unemployment rates. A similar finding occurs in regions with low productivity. Wages bargained at a national level will prevent wages from adjusting downward to reflect the low productivity.

Several studies have looked to see empirically what factors lead to greater downward real wage rigidity (DRWR). Dickens et al. (2007) and Holden and Wulfsberg (2007) find a significant effect of union density on DRWR. Babecky et al. (2009) find that high collective bargaining coverage and wage indexing are both positively related to DRWR.

Section 3: Wage Phillips Curve Models

Workers negotiate wages increases through a bargaining framework. Since workers care about real wages, nominal wage inflation π^w, will in part depend on expectations of inflation, π^e, when wages are set. Economic conditions will affect the degree of bargaining power of workers. During economic downturns, output, y, falls below the natural level of output, y^n. Bargaining power declines as the relative number of idle workers increases. This can be described in a wage Phillips curve:

(1) $\pi_t^w = \alpha + \pi_t^e - \beta(y - y^n)_t,$ $\alpha, \beta > 0,$

where $y - y^n$ represents the "output gap" or difference between the actual level of output and the natural level of output.

Workers estimate the current period's output gap based on two lags of the output gap:

2) $(y - y^n)_t = \sum_{i=1}^{2} \eta_i (y - y^n)_{t-i} + \varepsilon_t,$

where ε is a white-noise error term. Substitute this expression into (1) gives:

(3) $\pi_t^w = \alpha + \pi_t^e - \beta \sum_{i=1}^{2} \eta_i (y - y^n)_{t-i} + \varepsilon_t.$

Price inflation, π, is expressed as:

(4) $\pi_t = \pi_t^w + g_t,$

where g is the real growth rate of oil prices.

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The degree in which oil price shocks affect wage inflation depend on the degree in which inflation expectations are anchored to the central bank's medium run inflation target, п*. Suppose inflation expectations evolve as:

(5) $\pi_t^e = \chi\pi^* + (1-\chi)\sum_{i=1}^{4}\gamma_i\pi_{t-i}$, $0 \le \chi \le 1,\ 0 \le \gamma \le 1.$

Inflation expectations depend on a level of inflation desired by the central bank, п*, and four lags of inflation. χ represents the degree of central bank credibility. A fully-credible central bank implies a value of χ equal to 1. Inflation expectations then equal п*.A central bank with low credibility can cause χ to equal 0. Expectations then depend on past inflation.

Oil price shocks will have different effects on wage inflation under different eras of credibility. Substituting (4) and (5) into (3) gives:

(6) $\pi_t^w = \alpha + \chi\pi^* + (1-\chi)\sum_{i=1}^{4}\gamma_i(\pi_{t-i}^w + g_{t-i}) - \beta\sum_{\mathrm{i}=1}^{2}\eta_{\mathrm{i}}\,(y-y^n)_{\mathrm{t-i}} + \varepsilon_{\mathrm{t.}}$

As shown in (6), the degree in which oil price shocks affect wage inflation depends on degree in which expectations are anchored, which is given by χ. Oil price shocks have no effect on wage inflation if expectations are perfectly anchored (χ equals 1 in this case).More specifically, regressions of wage inflation on lagged wage inflation, lagged output gaps, and lagged oil price shocks will see larger coefficient estimates on oil price shocks during periods of low credibility, and smaller coefficient estimates on oil price shocks during periods of high credibility.

Section 4: Wage Inflation Estimates

A wage inflation Phillips given in (7) below is estimated for all 11 countries:

(7)$\pi_t^w = \alpha + \sum_{i=1}^{4}\beta_i\pi_{t-i}^w + \sum_{i=1}^{2}\gamma_i YGAP_{t-i} + \sum_{i=1}^{4}\phi_i OIL_{t-i} + \varepsilon_t.$

Wage inflation is measured at the year-over-year annual rate.This is regressed on four lags of wage inflation, two lags of the output gap, and four lags of the oil price shock. The output gap is measured as the difference between actual GDP and the HP filtered trend GDP. The oil price shock is measured as the growth rate of the PPI crude oil series for the U.S. deflated by the given country's CPI.

The data comes from the Organization for Economic Co-operation and Development (OECD) Main Economic Indicators database. The hourly earnings index is used to measure wages. The data is constructed from a business survey that includes a mix of manufacturing and other private sector industries. The series calculates average

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total earnings paid per worker per hour, including overtime pay and other cash compensation.

Column 1 in Table 1 shows the results of the sum of the oil coefficients for each country over the entire sample period with the heteroskedastic and auto correlated consistent (HAC) standard errors given in parentheses. The sample period for each country is given in column 6. Looking at the entire sample period for each country, the oil coefficients sum to a relatively small value and are each indistinguishable from zero.

The stability of the oil coefficients in (7) is checked with the Andrews structural break test (Andrews, 1993). Andrews recommends searching for breaks across the middle 70 percent of the sample. Column 7 shows the dates over which a break was searched. Column 4 shows the date of the maximum F-statistic for each country with the value of the F-statistic given in column 5. Each country shows a statistically significant break in the oil coefficients. Most of the breaks occur in the late 1970s and early 1980s, except for Sweden which occurs in the fourth quarter of 1990.

Equation (7) is modified to include a dummy variable D associated with the break date $\hat{\tau}$. The dummy variable is then interacted with the oil price term. The dummy variable takes the form:

$$(8) \qquad D = \begin{cases} 0, & t < \hat{\tau} \\ 1, & t \geq \hat{\tau} \end{cases} .$$

The dummy variable takes on the value of 0 in periods before the break date and 1 in the period of the break date and afterwards. Substituting the dummy variable and the dummy-interaction term into (7) gives:

$$(9)\ \pi_t^w = \alpha + \sum_{i=1}^{4} \beta_i \pi_{t-i}^w + \sum_{i=1}^{2} \gamma_i YGAP_{t-i} + \sum_{i=1}^{4} \phi_i OIL_{t-i} + \theta D + \sum_{i=1}^{4} \delta_i D * OIL_{t-i} + \varepsilon_t .$$

Estimates of the sum of the oil coefficients for the pre- and post-break sample periods are given in columns 2 and 3 in Table 1. In the pre-break sample periods, 8 of the 11 countries show a positive and significant effect of oil price shocks on wage inflation. In the post-break sample period only France and Norway show significant effects to oil prices shocks with the magnitude of the coefficients being much smaller.

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Table 1: Wage Inflation: PPI Crude Oil

	Sum Oil Coefficients			Structural Break		Sample Dates	
	Full Sample	Pre-break Period	Post-break Period	Break Date	SupF	Sample Period	Break Dates Checked
Country	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Austria	0.66	4.63***	0.47		4.52***	1962:I-	1969:III-
	(0.35)	(1.54)	(0.36)	1977:IV	(0.010)	2012:IV	2004:III
Belgium	0.16	6.51***	-0.10		13.19***	1962:I-	1969:III-
	(0.27)	(1.56)	(0.28)	1980:II	(0.000)	2012:IV	2004:III
Denmark	-0.30	-2.65	-0.23		6.26***	1973:I-	1976:IV-
	(0.24)	(2.20)	(0.23)	1979:IV	(0.000)	2012:IV	2006:IV
Finland	0.27	4.70***	-0.13		5.96***	1962:II-	1969:III-
	(0.34)	(1.40)	(0.33)	1981:I	(0.000)	2012:IV	2004:III
France	0.40***	3.25***	0.21**		6.64***	1962:II-	1969:III-
	(0.17)	(1.07)	(0.10)	1983:IV	(0.000)	2012:IV	2004:III
Germany	-0.19	1.32	-0.27		4.83***	1962:II-	1969:III-
	(0.21)	(0.85)	(0.21)	1977:IV	(0.01)	2012:III	2004:III
Italy	(0.11)	-1.77	0.06		8.48***	1962:II-	1969:III-
	(0.35)	(2.30)	(0.30)	1977:I	(0.000)	2012:IV	2004:III
Netherlands	0.10	1.87**	-0.00		6.49	1972:I-	1978:I-
	(0.13)	(0.73)	(0.13)	1978:II	(0.000)	2012:IV	2006:IV
Norway	-0.52	7.11***	-1.31***		8.85***	1962:II-	1969:III-
	(0.62)	(2.58)	(0.59)	1980:IV	(0.000)	2012:IV	2004:III
Sweden	0.30	1.75**	-0.14		7.69***	1973:I-	1976:IV-
	(0.38)	(0.73)	(0.29)	1991:I	(0.000)	2012:IV	2006:IV
U.K.	0.29	8.19***	-0.08		18.55***	1965:I-	1972:III-
	(0.35)	(2.67)	(0.20)	1981:II	(0.000)	2012:IV	2006:I

Notes: The results show the sum of the oil price coefficients in a regression of wage inflation on four lags of wage inflation, two lags of the unemployment gap, and four lags of the relative price of oil. HAC standard errors are in parentheses, except for SupF statistics which contains the asymptotic p-values of the Andrews test as constructed by Hansen (1997).

Section 5: Conclusion and Policy Implications

The centralization of the wage bargaining process and the larger number of workers covered in the bargaining process in European countries makes them more susceptible to real wage rigidities. If true and if real wage rigidities are an important source in the dynamics of wage, then the oil price shocks of the 2000s should have a persistent effect on wage inflation. This study finds very little evidence to support this claim. Wage Phillips curve estimates show oil price shocks having a larger and more persistent effect on wage inflation in samples that include the 1970s and a much smaller effect in sample that included the 2000s.

The decline in oil price pass-through is consistent with a better anchoring of inflation expectations. If wage inflation is a key source of price inflation, then these finding has an important implication for central banks as they try to maintain low and stable inflation. When expectations become anchored to a central bank’s inflation goals, oil price shocks have a much more muted effect on wage inflation, which helps stabilize overall inflation.

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