Is the Phillips Curve Alive and Well After All?
Inflation Expectations and the Missing Disinflation

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THE MISSING DISINFLATION IN THE U.S.

"Prior to the recent deep worldwide recession, macroeconomists of all schools took a negative relation between slack and declining inflation as an axiom. Few seem to have awakened to the recent experience as a contradiction to the axiom."

Bob Hall (2013)

"The surprise [about inflation] is that it's fallen so little, given the depth and duration of the recent downturn. Based on the experience of past severe recessions, I would have expected inflation to fall by twice as much as it has"

John Williams (2010)

THE MISSING DISINFLATION IN THE U.S.

Benchmark: Expectations-Augmented Phillips Curve

$$\pi_t - E_t\pi_{t+1} = c + \kappa x_t + v_t$$

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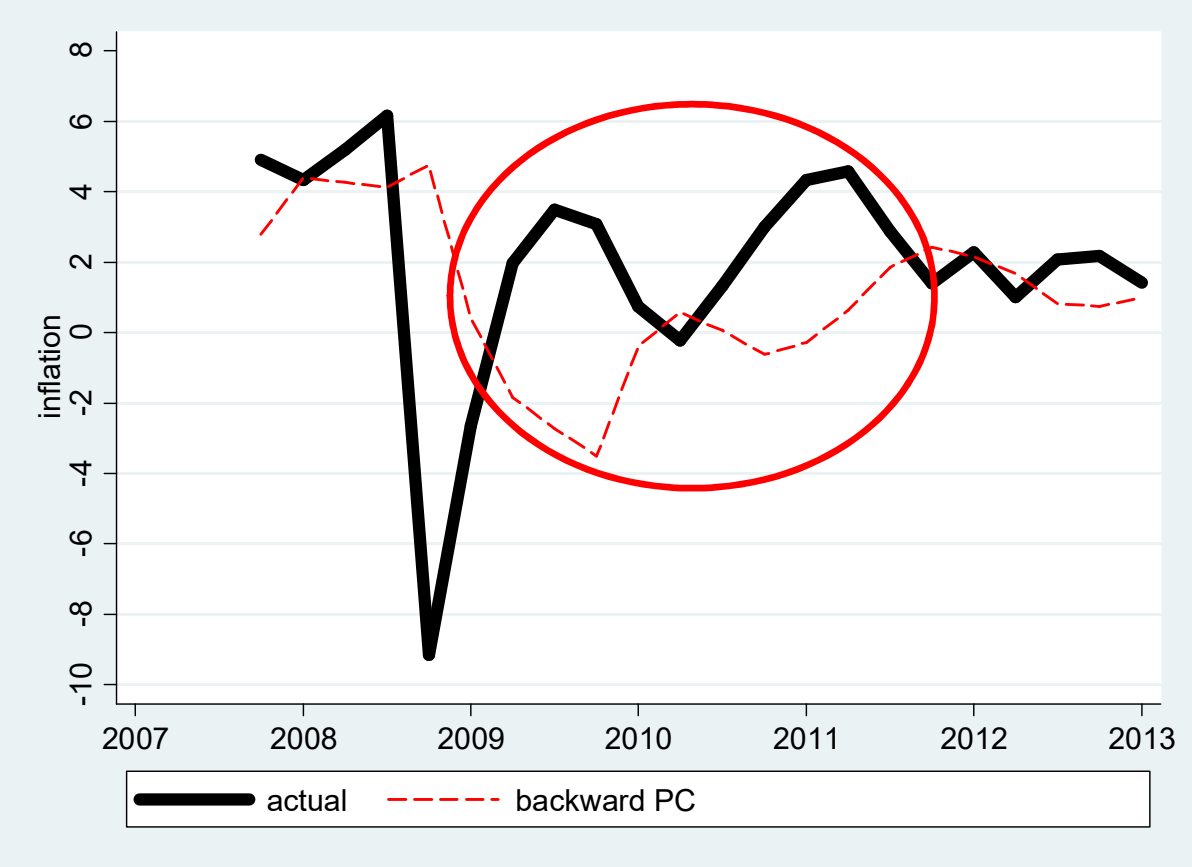

Potential Explanations for The Missing Disinflation

- Core inflation (Ball and Mazumder 2011)
- Oil price shocks shifted Phillips curve
- Anchored expectations (Bernanke 2010, IMF 2013)
- Change in slope of the PC (Ball and Mazumder 2011, IMF 2013)
- Long-term unemployed and wage pressures (Llaudes 2005)
- Downward wage rigidity (Krugman 2012, Daly et al. 2012)
- Rise in natural rate of unemployment (Mulligan)
- Phillips curve is not structural

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  - New empirical estimates of the Phillips curve
  - New survey evidence of firms' inflation expectations
- Inflation expectations of households display extra sensitivity to oil price movements (i.e. are not "anchored").
- Oil price increase since 2009 can account for rise in household inflation expectations and through these the "missing disinflation".

THE MISSING DISINFLATION: INFLATION EXPECTATIONS

$$\pi_t - E_t^{Firms}\pi_{t+1} = c + \kappa x_t + v_t$$

How do price-setting firms form their inflation expectations?

THE MISSING DISINFLATION: FIRMS' INFLATION EXPECTATIONS

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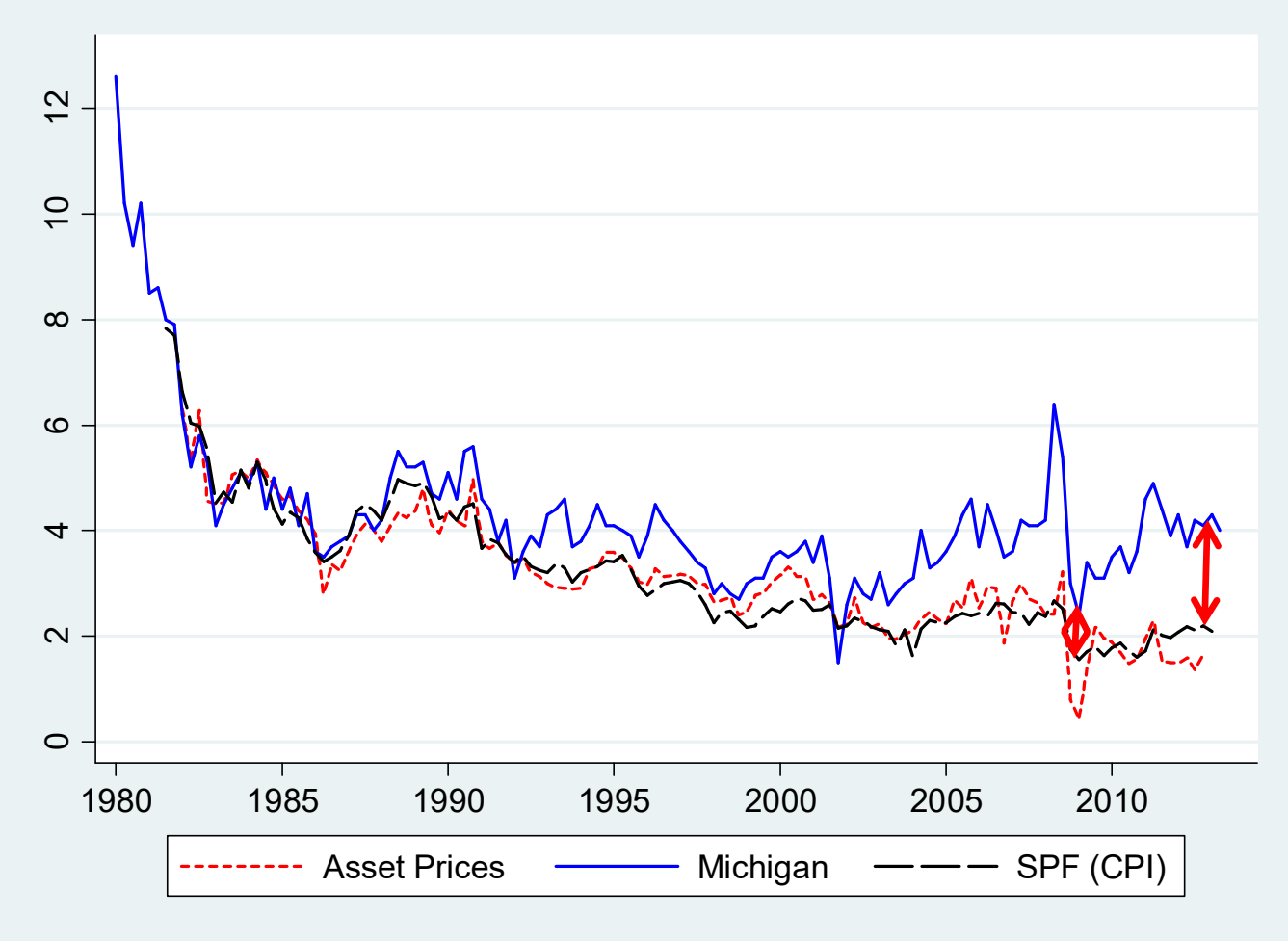
How do price-setting firms form their inflation expectations?

Quantitative Inflation Expectations Data:

- Households: Michigan Survey of Consumers
- Professional Forecasters: SPF, BCEI, Consensus Economics, …
- Financial Market Participants: TIPS spreads
- Federal Reserve: Greenbook forecasts
- Firms: ???

THE MISSING DISINFLATION: FIRMS' INFLATION EXPECTATIONS



THE MISSING DISINFLATION: FIRMS' INFLATION EXPECTATIONS

What if $E_t^{Firms}\pi_{t+1} \approx E_t^{HH}\pi_{t+1}$?

THE MISSING DISINFLATION: FIRMS' INFLATION EXPECTATIONS

What if $E_t^{Firms}\pi_{t+1} \approx E_t^{HH}\pi_{t+1}$?

Stable Phillips curve and no missing disinflation.

DO FIRMS HAVE SIMILAR BELIEFS AS HOUSEHOLDS?

Test #1: Nested PC Regressions $\pi_t = \beta_1 E_t^{MSC} \pi_{t+h} + \beta_2 E_t^{SPF} \pi_{t+h} + \kappa x_t + \varepsilon_t$

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	Pre-Great Recession, 1981Q1-2007Q3
	(1)
$E_t \pi_{t+1,t+4}^{MSC}$	**1.442*** **
	(0.218)
$E_t \pi_{t+1,t+4}^{SPF}$	**0.018**
	(0.200)
UE_t	-0.250**
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$\log\left(\frac{OilP_t}{OilP_{t-1}}\right) \times 400$	
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	Pre-Great Recession, 1981Q1-2007Q3	
	(1)	(2)
$E_t \pi_{t+1,t+4}^{MSC}$	1.442***	**1.089*** **
	(0.218)	(0.210)
$E_t \pi_{t+1,t+4}^{SPF}$	0.018	**0.289***
	(0.200)	(0.171)
UE_t	-0.250**	-0.235**
	(0.106)	(0.096)
$\log\left(\frac{OilP_t}{OilP_{t-1}}\right) \times 400$		0.009***
		(0.003)
Observations	105	105
R^2	0.537	0.612

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	Pre-Great Recession, 1981Q1-2007Q3			
	(1)	(2)	(3)	(4)
$E_t\pi_{t+1,t+4}^{MSC}$	1.442***	1.089***	**1.128*** **	**0.803*** **
	(0.218)	(0.210)	(0.214)	(0.179)
$E_t\pi_{t+1,t+4}^{SPF}$	0.018	0.289*	**-0.128**	**0.197**
	(0.200)	(0.171)	(0.214)	(0.179)
UE_t	-0.250**	-0.235**	-0.077	-0.095
	(0.106)	(0.096)	(0.100)	(0.086)
$\log\left(\frac{OilP_t}{OilP_{t-1}}\right) \times 400$		0.009***		0.010***
		(0.003)		(0.002)
Observations	105	105	105	105
R^2	0.537	0.612	0.262	0.394

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Similar results obtain with UE gap and/or including Great Recession and/or using backward-expectations in place of SPF.

DO FIRMS HAVE SIMILAR BELIEFS AS HOUSEHOLDS?

Test #2: Survey of Firms' Inflation Expectations in New Zealand (CGK 2014)

- Random sample (about 3,000 firms in the initial wave):
  - Broad sectoral coverage
  - Exclude very small firms (less than 6 employees)
- How the survey was conducted:
  - Send questionnaire in advance
  - Phone interview
  - Record interviews and get responses verified by another person
  - Response rate ≈ 20-30 percent
- Multiple waves:
  - Main survey: Late Sept 2013 to Early Dec 2013 (3,150 firms)
  - Wave #2: Mar 2014 to Apr 2014 (716 firms)
  - Wave #3: Jun 2014 to Sep 2014 (1,608 firms)
  - Wave #4: Dec 2014 to Jan 2015 (1,257 firms)

  Questions about expectations, firm and manager characteristics.

DO FIRMS HAVE SIMILAR BELIEFS AS HOUSEHOLDS?

Survey Date	Recent data	Forecasts, percentage points						
		Central Bank	Professional forecasters		Households		Firms	
			Mean	SD	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: 1-year ahead inflation								
2013Q4	1.5	1.3	2.0	0.2				
2014Q1	1.5	1.9	2.0	0.3				
2014Q3	1.6	1.6	1.9	0.2				
2014Q4	1.0	1.1	1.7	0.3				
Panel B: 5-10 year ahead inflation								
2014Q3	2.1	2.1	2.1	n.a.				

At the time of the surveys, inflation in New Zealand was low and projected to remain low by the central bank and all professional forecasters.

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2013Q4	1.5	1.3	2.0	0.2	**3.4**	**2.0**		
2014Q1	1.5	1.9	2.0	0.3	**3.6**	**1.8**		
2014Q3	1.6	1.6	1.9	0.2	**3.5**	**2.2**		
2014Q4	1.0	1.1	1.7	0.3	**3.1**	**1.9**		
Panel B: 5-10 year ahead inflation								
2014Q3	2.1	2.1	2.1	n.a.	**4.1**	**2.8**		

Households in New Zealand, like those in the U.S., were forecasting higher levels of inflation on average, with very high dispersion in forecasts.

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Panel B: 5-10 year ahead inflation								
2014Q3	2.1	2.1	2.1	n.a.	4.1	2.8	**3.4**	**2.4**

Firms in our sample, like the households, were forecasting much higher inflation than professionals on average and, again like the households, with very high dispersion in forecasts.

Do Firms Have Similar Beliefs as Households?

There is no systematic time series of firms' inflation forecasts but

1. If Phillips curve represents firms' pricing decisions and expectations, then household forecasts appear to be the best proxy for time series of firms' inflation forecasts.

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1. If Phillips curve represents firms' pricing decisions and expectations, then household forecasts appear to be the best proxy for time series of firms' inflation forecasts.
2. At one moment in time, the moments of the distribution of firms' inflation forecasts shares same properties as those of contemporaneous household forecasts:
   - High mean/median forecast relative to professionals and central bank
   - Very high levels of dispersion in forecasts

WHY DID HOUSEHOLDS THINK INFLATION WOULD BE HIGH?

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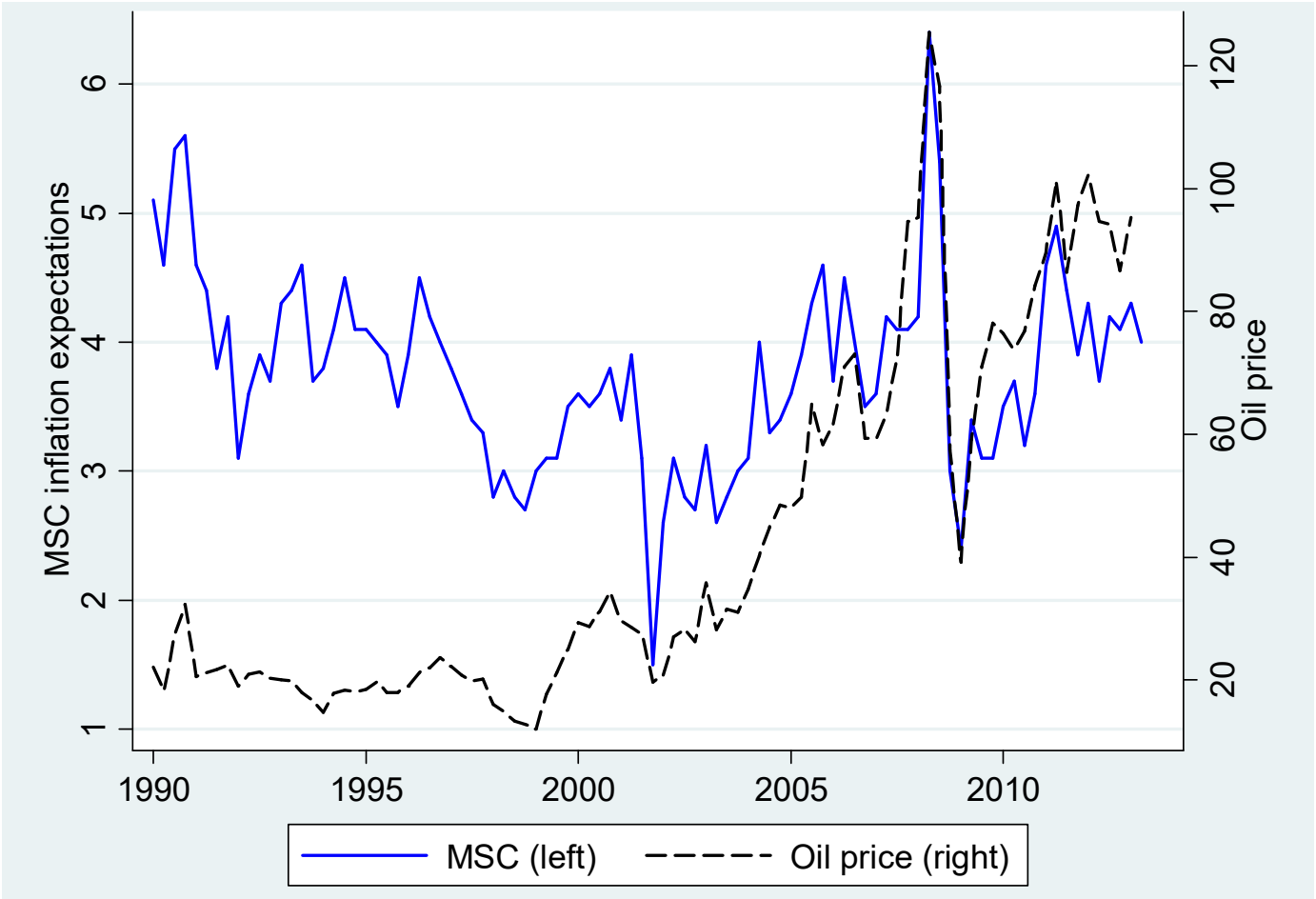

$\rho(E_t^{HH}\pi_{t+12}, Oil_t) = 0.74$ from 2000-2013

What Explains Gaps Between HH and Prof. Forecasts?

WHAT EXPLAINS GAPS BETWEEN HH AND PROF. FORECASTS?

Dependent variable: $E_t^{MSC}\pi_{t+1,t+4} - E_t^{SPF}\pi_{t+1,t+4}$	(1)
Panel A: Levels	
$OilP_t$	**0.026*** **
	(0.002)
R^2	**0.523**

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Panel A: Levels			
$OilP_t$	**0.026*** **	**0.024*** **	
	(0.002)	**(0.005)**	
$PriceAgro_t$		0.002	0.016***
		(0.004)	(0.002)
R^2	**0.523**	**0.524**	0.421

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R^2	0.523	0.524	0.421
Panel B: Growth rates			
$log\left(\frac{OilP_t}{OilP_{t-1}}\right) \times 100$	0.013**	0.011**	
	(0.005)	(0.005)	
$log\left(\frac{PriceAgro_t}{PriceAgro_{t-1}}\right) \times 100$		0.015	0.020
		(0.017)	(0.016)
R^2	**0.048**	**0.060**	**0.024**

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The increase in oil prices since 2009 can fully account for the rise in household inflation expectations since then.

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- Explanation 1: consumers use highly visible gasoline prices as signal of evolution of other prices
  - Households who buy gas more regularly should adjust inflation forecasts more than others.

- Explanation 2: consumers forecast the prices of their own consumption bundles rather than aggregate inflation
  - Households who spend larger share of income on gas should adjust their inflation forecasts more than others.

We use MSC individual data to distinguish between these.

WHY ARE HOUSEHOLDS SENSITIVE TO OIL PRICES?

$$E_t^i \pi_{t,t+12} - E_{t-6}^i \pi_{t-6,t+6} = \alpha + \beta \times \log\left(\frac{OilP_t}{OilP_{t-6}}\right) \times 100 + error_{i,t}$$

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Dependent variable $E_t^i \pi_{t,t+12} - E_{t-6}^i \pi_{t-6,t+6}$	Main effect, β		Interaction, γ		Obs.	R2	Spending on fuel, annual, CEX, 2011	
	coef.	s.e.	Coef.	s.e.			$	Share, %
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Full sample								
All	1.686***	(0.177)			68,355	0.010		

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Panel B: Income quintiles								
HH income quintiles								
1 (bottom)							**1,227**	**5.6**
2							**1,981**	**6.2**
3							**2,694**	**6.4**
4							**3,295**	**5.7**
5 (top)							**4,073**	**4.3**

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1 (bottom)	**0.665*** **	(0.257)			7,883	0.001	**1,227**	5.6
2	**1.488*** **	(0.225)			10,979	0.007	**1,981**	6.2
3	**1.956*** **	(0.282)			12,841	0.013	**2,694**	6.4
4	**1.965*** **	(0.268)			15,918	0.014	**3,295**	5.7
5 (top)	**2.066*** **	(0.202)			16,926	0.018	**4,073**	4.3

Consistent with use of gasoline prices as signals of other prices.

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Interact with $	**0.484*** **	(0.099)	**0.771*** **	(0.248)	64,547	0.010		
Interact with budget share	**2.629*** **	(0.547)	**-0.931***	(0.546)	64,547	0.010		

Consistent with use of gasoline prices as signals of other prices.

ARE MANAGERS SIMILARLY SENSITIVE TO OIL PRICES?

In a smaller fifth wave of the survey (Aug. 2015), we asked managers to assess how important different sources of information were to them in forming their inflation expectations.

- 88% rated their personal shopping experience as "very important" or "extremely important"
- 76% rated gasoline prices as "very important" or "extremely important"
- 20% rated professional forecasts as "very important" or "extremely important"

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- ~~Long-term unemployed and wage pressures (Llaudes 2005)~~
- ~~Downward wage rigidity (Krugman 2012, Daly et al. 2012)~~
- ~~Rise in natural rate of unemployment (Mulligan)~~
- Rise in firms' inflation expectations since 2009 due to oil price movements.

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We can explain the missing disinflation through rising inflation expectations starting in 2009, due to rising oil prices.

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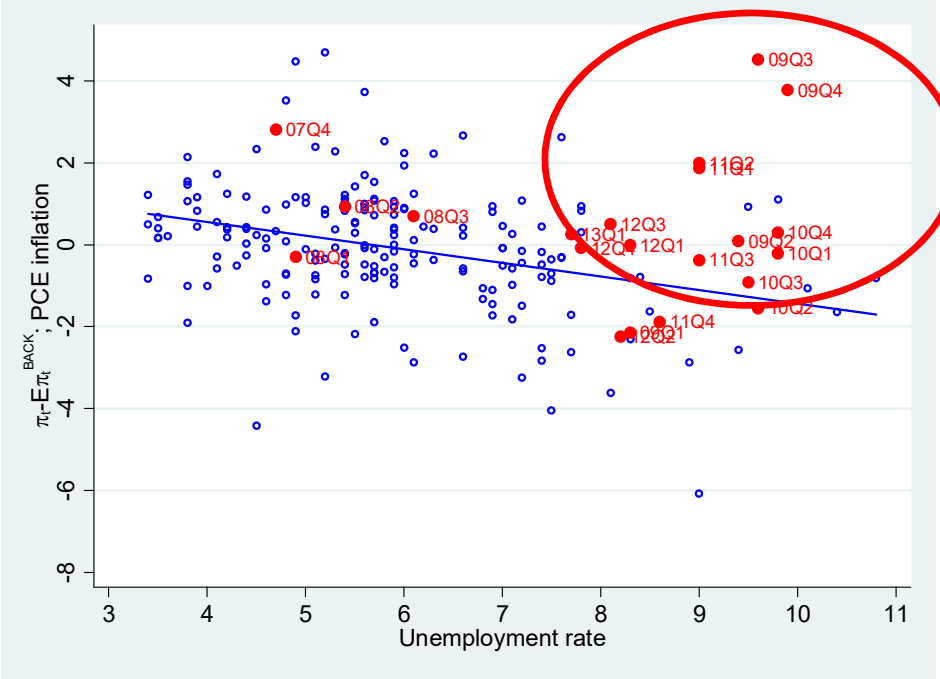
The absence of deflation after the Great Recession may therefore be the positive side-effect of the rise in oil prices (i.e. “good luck”).

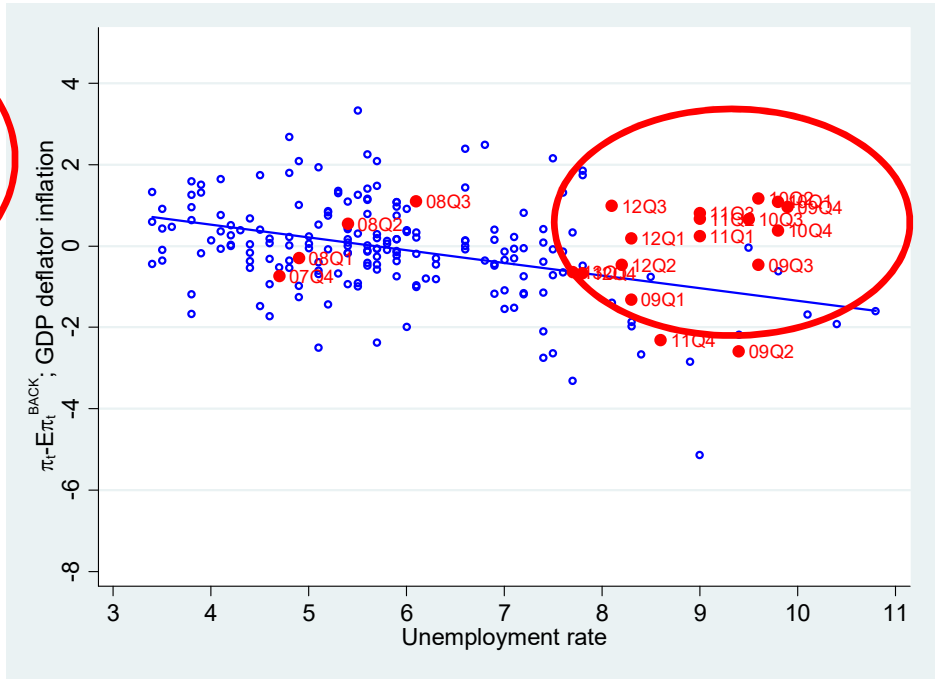
“Unanchored” expectations also played a central role, so this experience is cautionary tale against overemphasizing benefits of “anchoring” expectations.

THE MISSING DISINFLATION: INFLATION MEASURES?

Panel A: PCE Inflation



Panel B: GDP Deflator Inflation

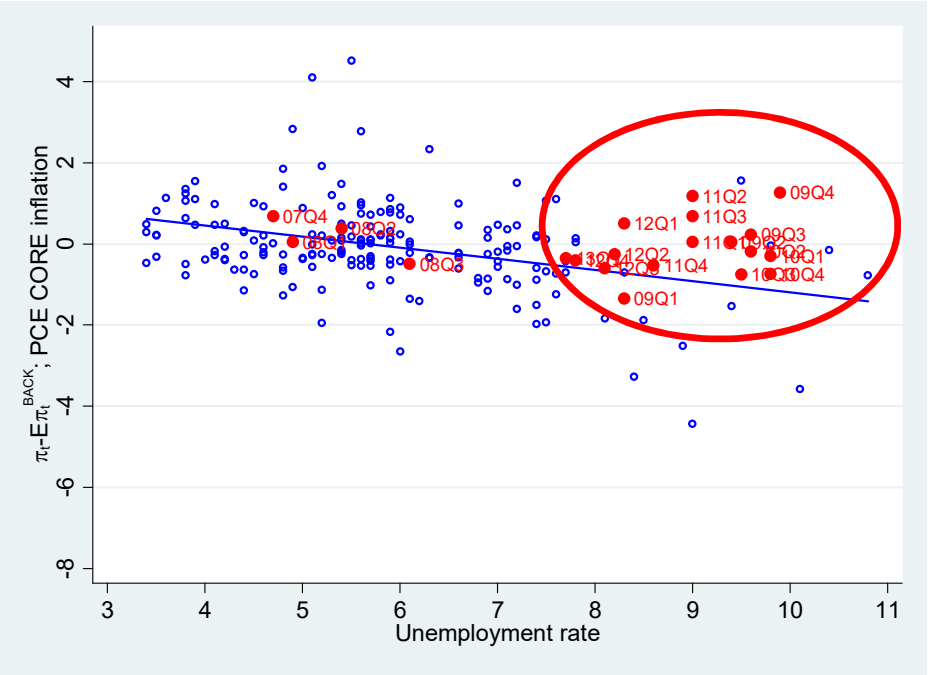


The magnitude and timing of missing disinflation vary with inflation measure, but not the qualitative nature of the episode.

THE MISSING DISINFLATION: CORE INFLATION?

Panel A: Core CPI Inflation

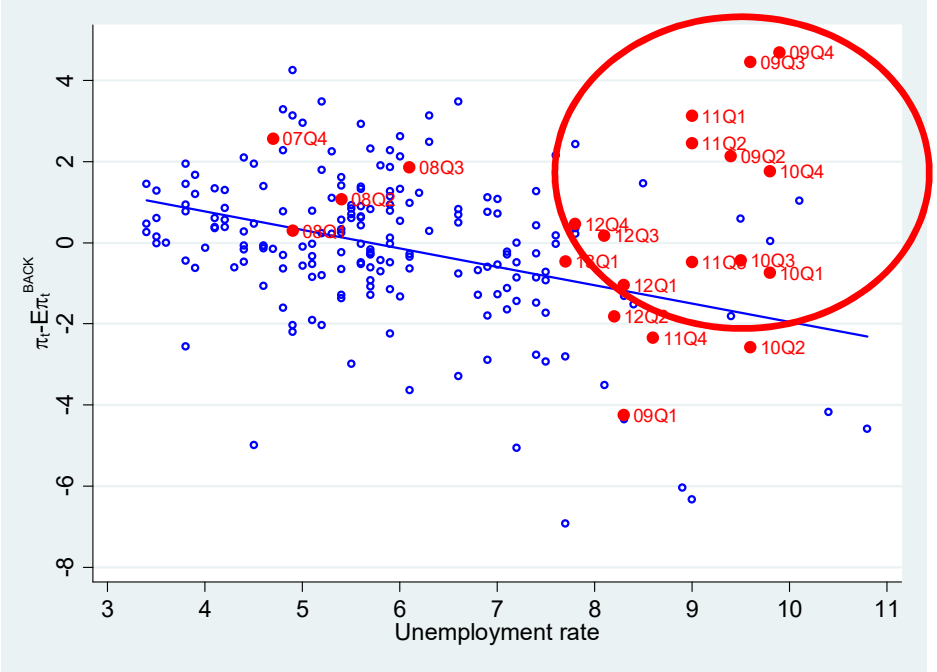
Panel B: Core PCE Inflation



The same qualitative result obtains with core inflation measures.

THE MISSING DISINFLATION: "ANCHORED" EXPECTATIONS?

Panel A: Backward-Looking Expectations

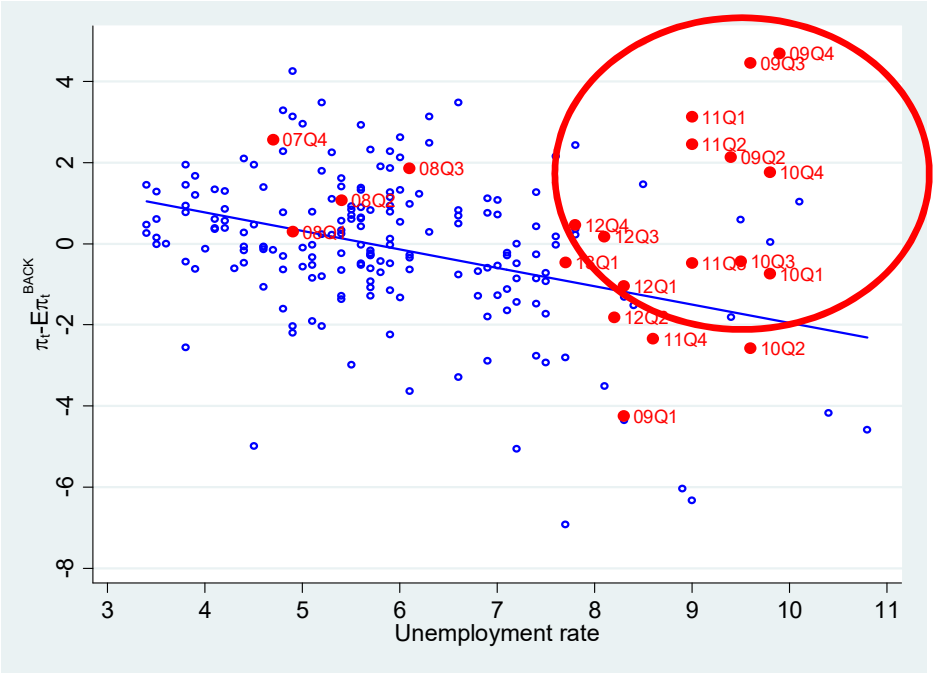


Panel B: SPF Forecasts of Inflation

The same qualitative result obtains using forecasts of professional forecasters, so "*anchoring*" of expectations cannot account for missing disinflation.

THE MISSING DISINFLATION: SUPPLY SHOCKS?

Panel A: Unconditional PC

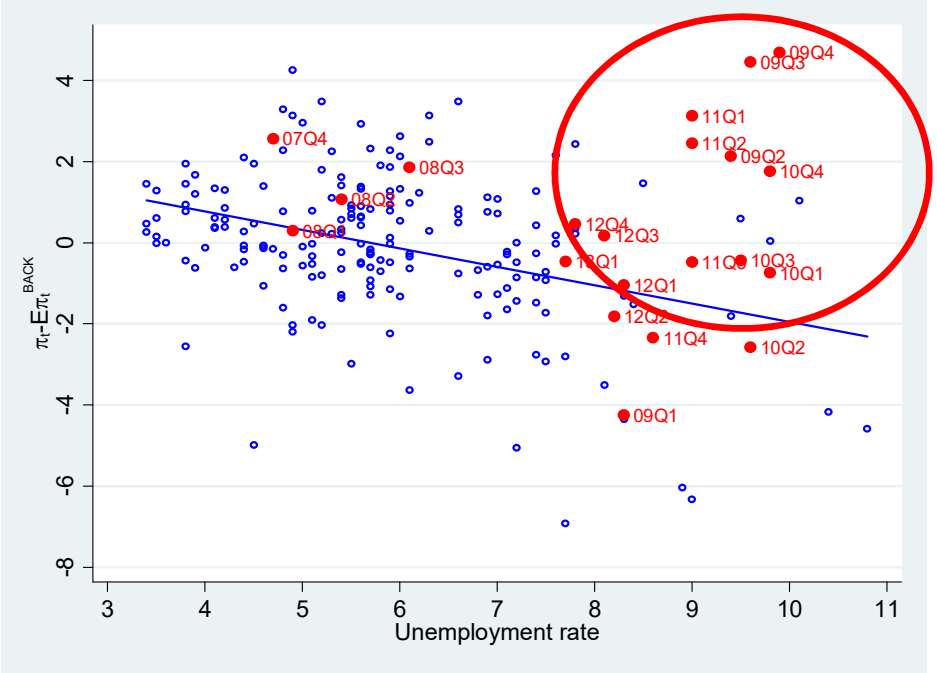


Panel B: Orthogonalized by Oil Price Changes

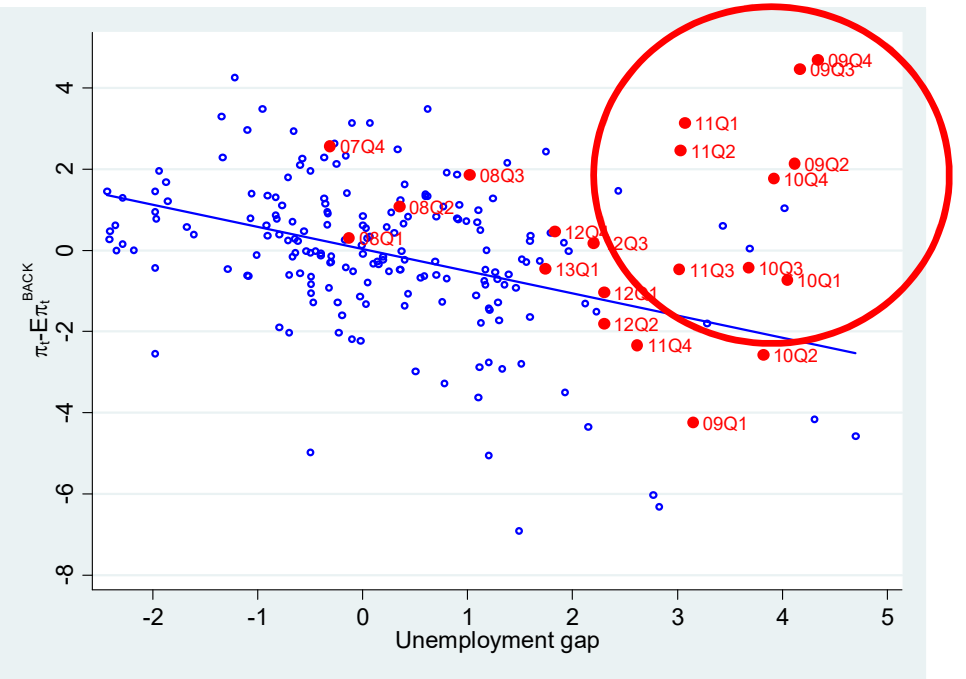
The same qualitative result obtains if we orthogonalize inflation surprises and unemployment to oil price changes.

THE MISSING DISINFLATION: RISE IN THE NATURAL RATE OF UE?

Panel A: Using UE Rate



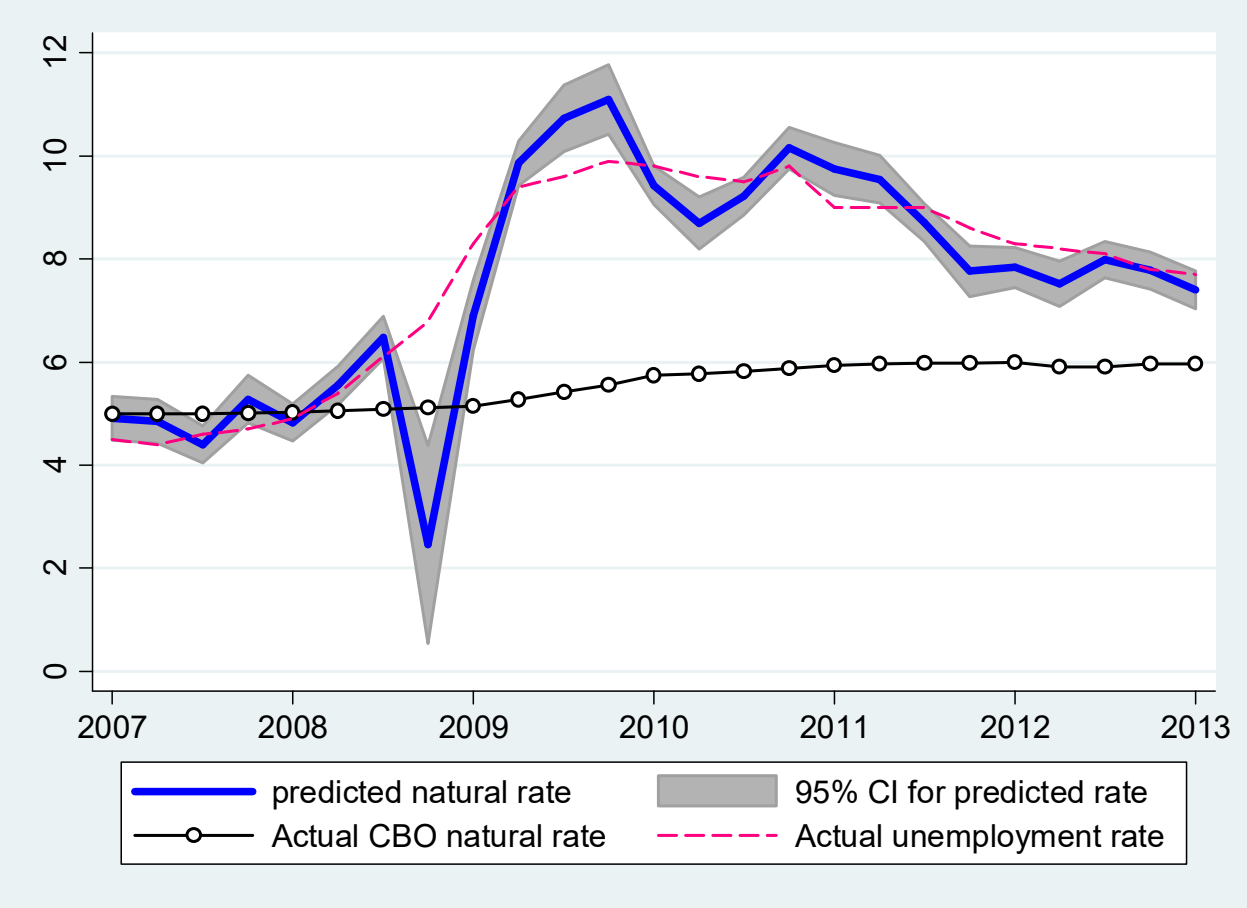
Panel B: Using (CBO) UE Gap



The same qualitative result obtains if we control for time-variation in the CBO's measure of the natural rate of unemployment.

THE MISSING DISINFLATION: RISE IN THE NATURAL RATE OF UE?

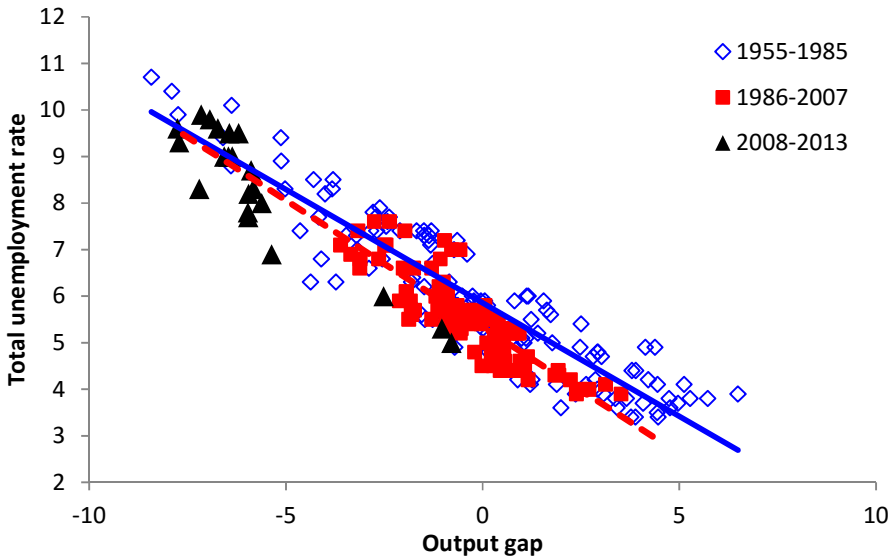
(Lower bound of) Change in Natural Rate of Unemployment Needed to Explain Missing Disinflation



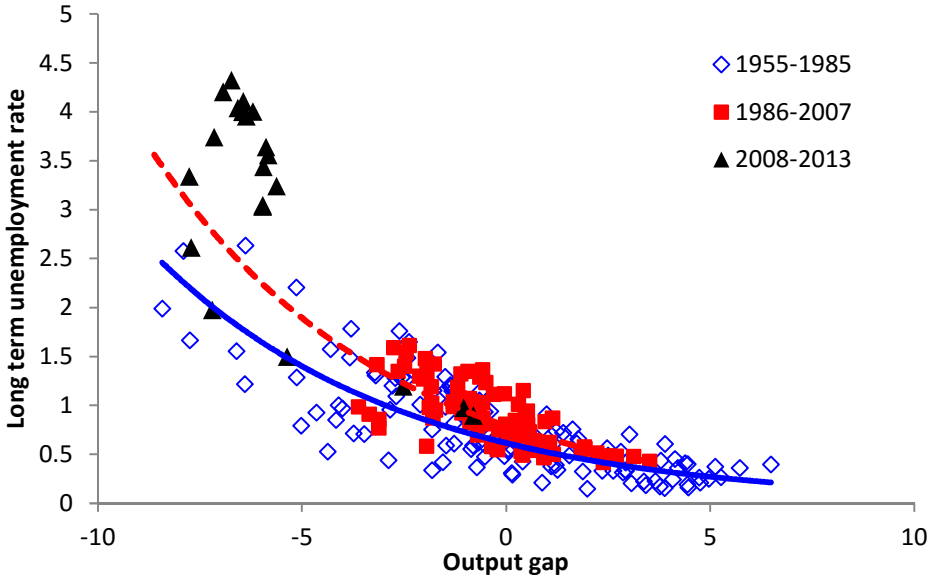
THE MISSING DISINFLATION: LABOR MARKET DIFFERENCES?

Maybe the long-term unemployed have smaller effects on wage pressures than short-term unemployed? (Llaudes 2005)

Panel A: ST UE rate vs. Output Gap



Panel B: LT UE Rate vs. Output Gap

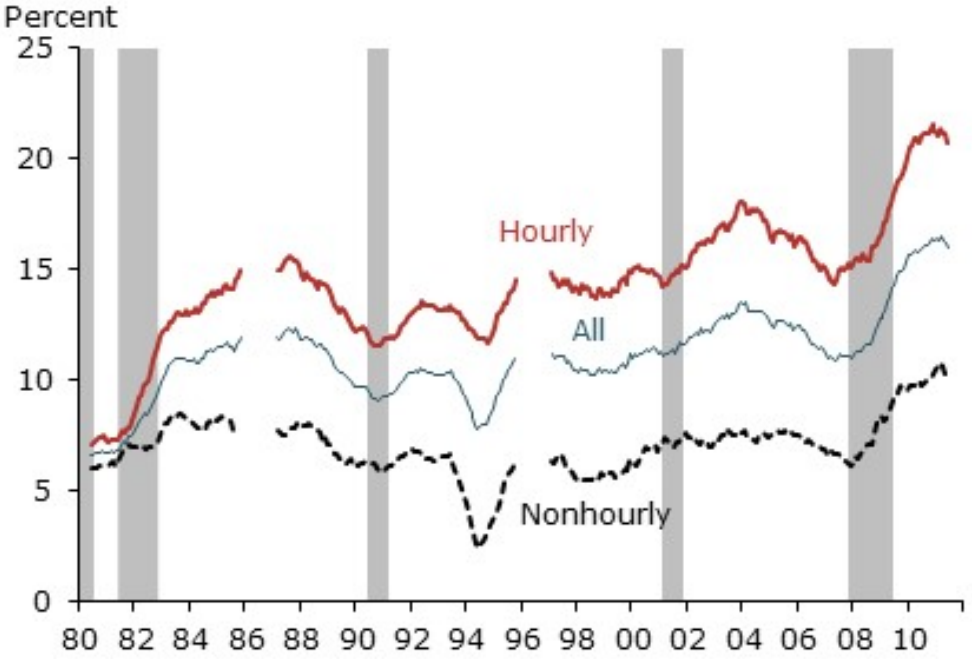


Source: Coibion, Gorodnichenko and Koustas (2013)

THE MISSING DISINFLATION: LABOR MARKET DIFFERENCES?

Or maybe downward wage rigidity is hindering the downward adjustment of wages? (Daly et al. 2012)

Share of workers experiencing "Zero Wage Changes" over 12 months



Source: Daly, Hobijn and Lucking (2012)

THE MISSING DISINFLATION: MISSING *WAGE* DISINFLATION?

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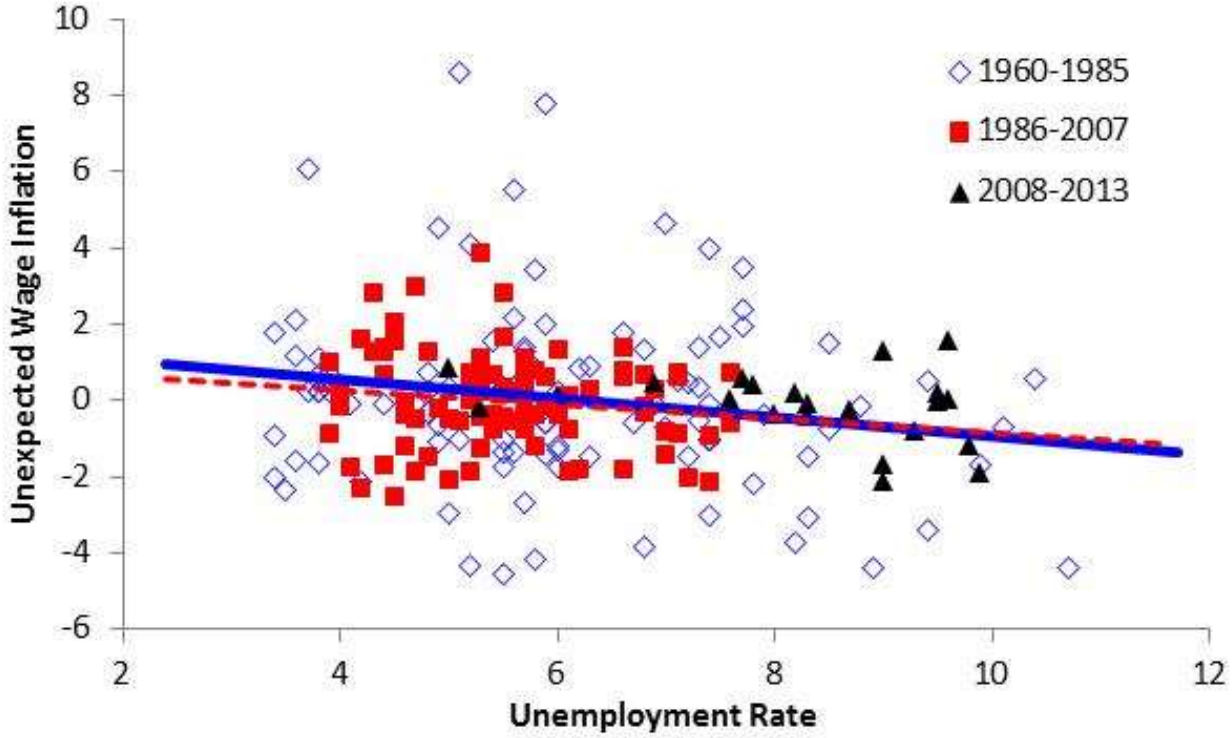
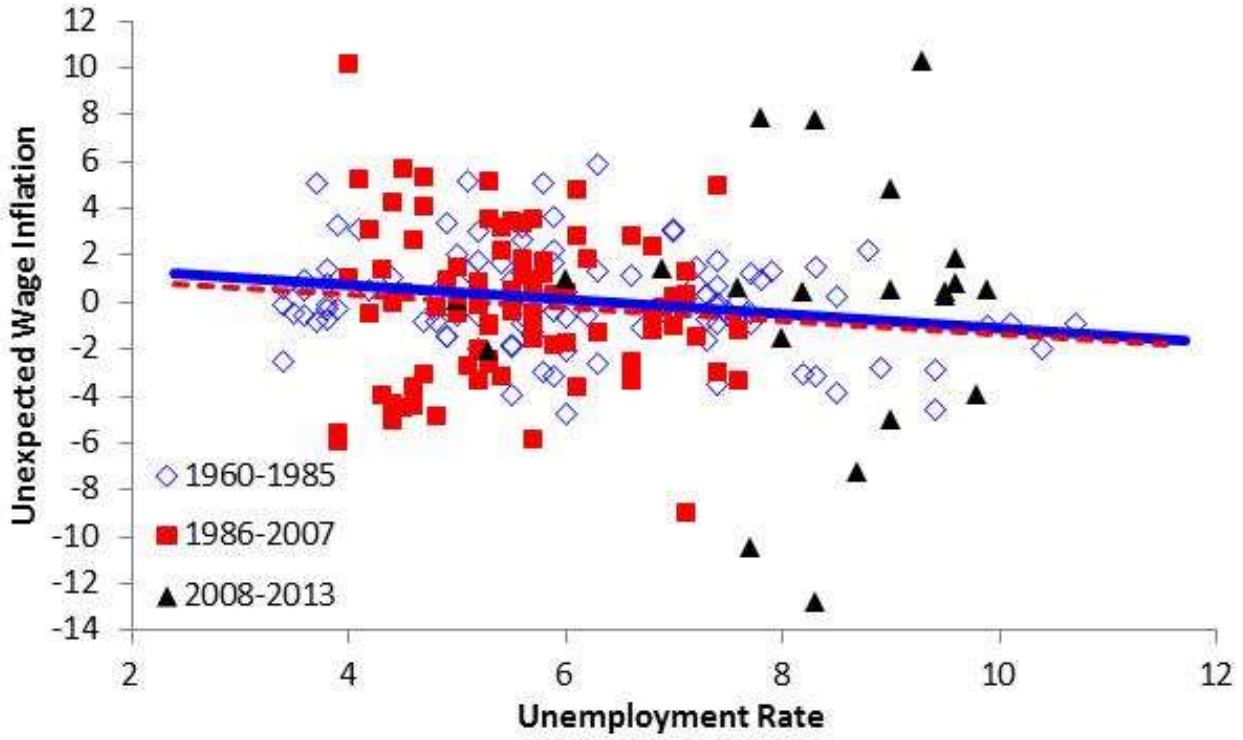
Panel A: Avg. Hourly Earnings, Manufacturing Workers



Stable wage Phillips curve, with no missing wage disinflation.

THE MISSING DISINFLATION: MISSING *WAGE* DISINFLATION?

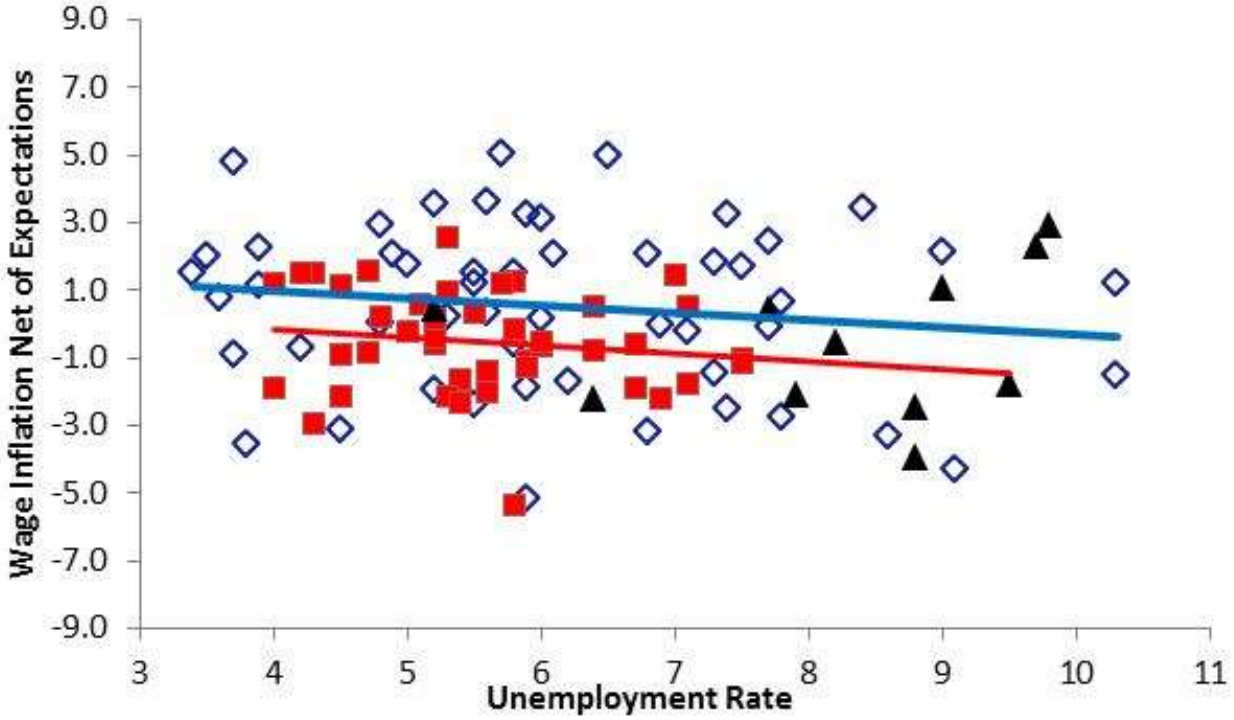
Panel B: Non-Farm Business Sector Compensation per Hour



Stable wage Phillips curve, with no missing wage disinflation.

THE MISSING DISINFLATION: MISSING *WAGE* DISINFLATION?

Panel C: Weekly Manufacturing Earnings
Net of Livingston Professional Forecasts



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THE MISSING DISINFLATION: CHANGING PC SLOPE?

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Panel A: Sample Split in mid-1980s, Backward-Looking PC

No statistically significant change in slope

THE MISSING DISINFLATION: CHANGING PC SLOPE?

Panel A: Sample Split in mid-1980s, Backward-Looking PC

No statistically significant change in slope

Panel B: Sample Split in mid-1980s, Forward-Looking PC

Statistically significant change in slope

Evidence for break in PC is very sensitive to details of specification…

CAN STRUCTURAL FACTORS ACCOUNT FOR CHANGING PC SLOPE?

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- Decline in labor's share of ≈10% (Elsby et al. 2013)
  - ⇒ decline in exponent on labor in production function
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- Increase in profit share of ≈ 50% (6% before 2000 to 9% after 2005)
  - ⇒ increase in elasticity of substitution (20-30%)
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- Decline in trend inflation yields flattening of unconditional PC (Coibion, Gorodnichenko Wieland 2012):
  - ⇒ decrease in slope of less than 10%

THE MISSING DISINFLATION: CHANGING PC SLOPE?

Effects of a smaller slope on Missing Disinflation

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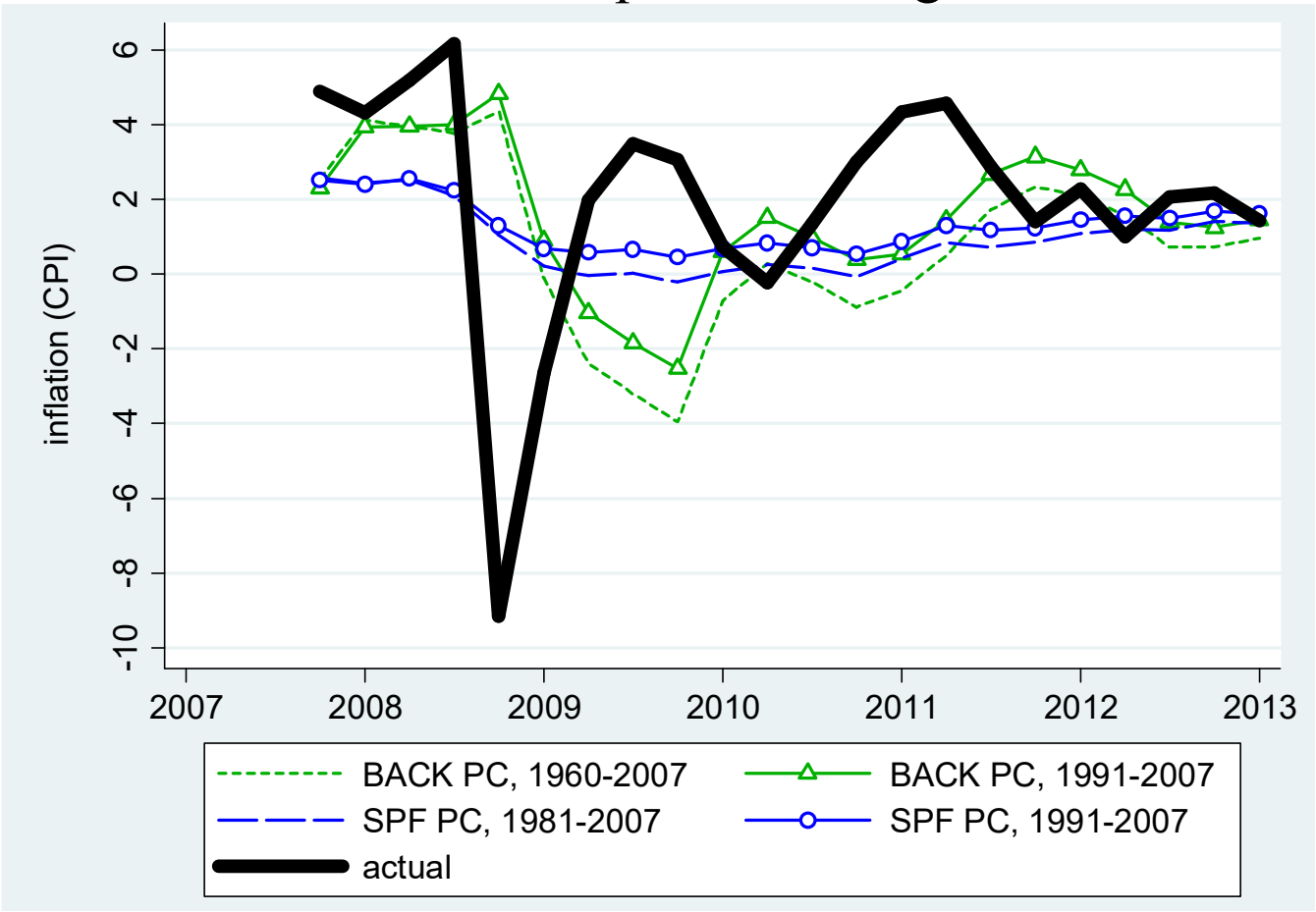

Missing disinflation still exists even with smaller slope of PC

POTENTIAL EXPLANATIONS FOR THE MISSING DISINFLATION

- ~~Core inflation (Ball and Mazumder 2011)~~
- ~~Oil price shocks shifted Phillips curve~~
- ~~Anchored expectations (Bernanke 2010, IMF 2013)~~
- ~~Change in slope of the PC (Ball and Mazumder 2011, IMF 2013)~~
- ~~Long-term unemployed and wage pressures (Llaudes 2005)~~
- ~~Downward wage rigidity (Krugman 2012, Daly et al. 2012)~~
- ~~Rise in natural rate of unemployment (Mulligan)~~
- Phillips curve is not structural?