

Inflation Dynamics
when
Inflation is very low

**Federal Reserve Bank of Boston Annual
Economic Conference
October 14-16, 2010**

Jeff Fuhrer
Giovanni Olivei
Geoffrey Tootell

Inflation's been falling

Table 1

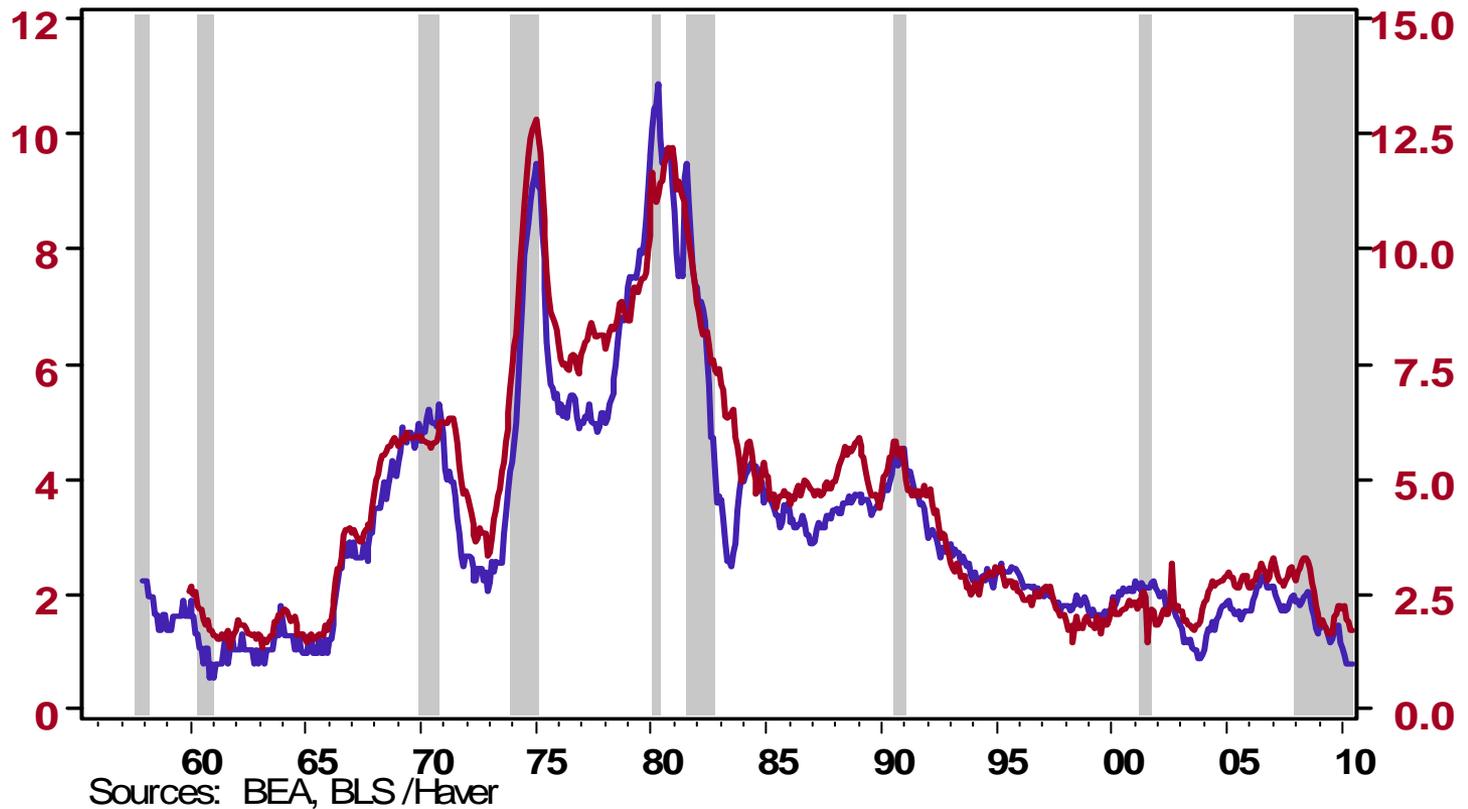
Recent declines in inflation, various measures

Inflation measure	Change since peak (pctg. points)	Current Inflation rate (12-mo. or 4-qtr. chg.)
Core CPI	-1.6	0.95
Headline CPI	-4.3	1.20
Core PCE	-1.3	1.39
Headline PCE	-3.1	1.47
GDP deflator	-2.4	0.85
Cleveland Fed trimmed mean	-3.2	0.50
Cleveland Fed weighted median	-5.9	0.90
ECI private compensation	-1.1	1.82

Which is pretty common following recessions

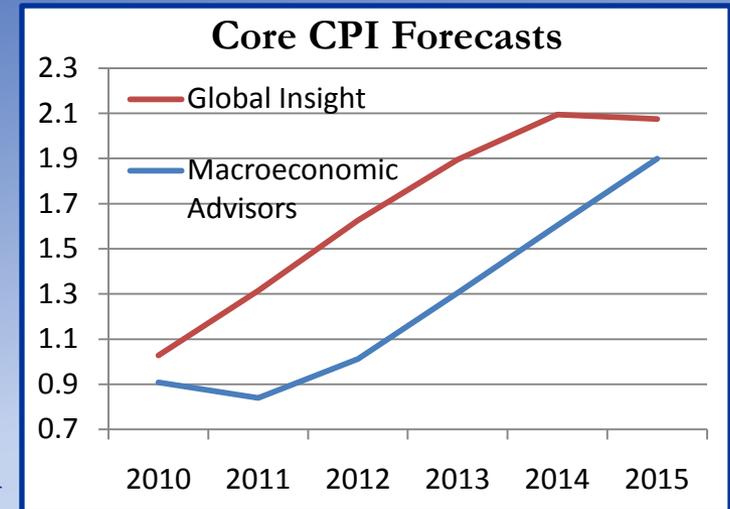
PCE less Food & Energy: Chain Price Index
% Change - Year to Year SA, 2005=100

CPI-U: All Items Less Food and Energy
% Change - Year to Year SA, 1982-84=100



What's at stake/Why this paper on inflation?

- Many forecasters see inflation rising over the next few years to 2%
 - This despite their forecast of lingering unemployment
- Such a forecast usually depends on help from a strong “anchor” in long-run expected inflation
 - We want to examine how strong that anchor is
- The paper examines the risk that inflation could continue to decline
- Obviously matters for policy decisions
 - The lower is inflation, the more stimulus is required, other things equal



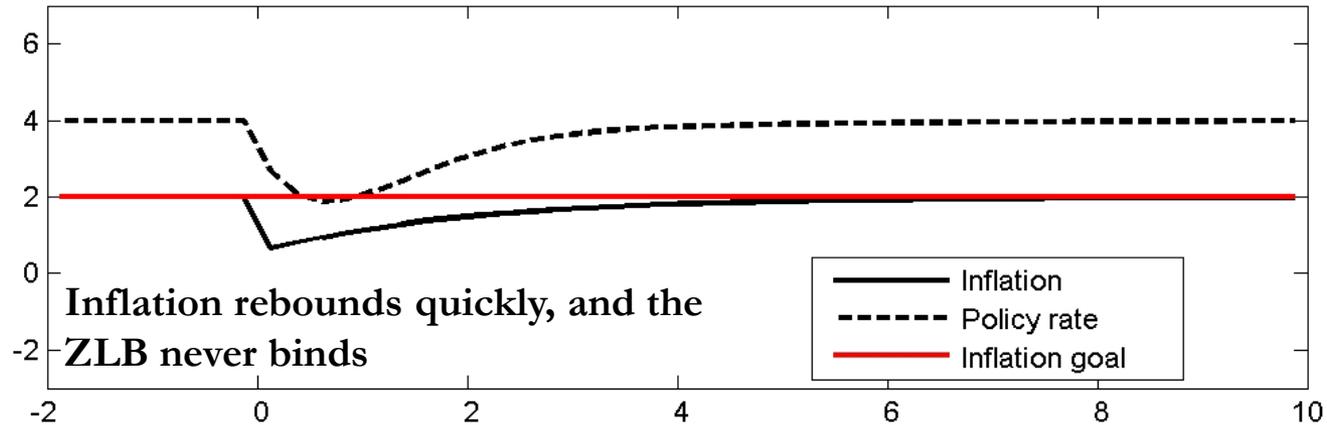
What should we expect going forward?

- Old-style Phillips curve models:
 - Inflation *declines* as long as output gap persists
- New-style Phillips curve models:
 - Depends
 - If forward-looking (FL), inflation *rises* as expected output gap/marginal cost improves
 - If hybrid, inflation behaves more like old-style Phillips curve
 - NOTE: In simulations to follow, all have perfectly-anchored expectations

Inflation following a large recession, FL model

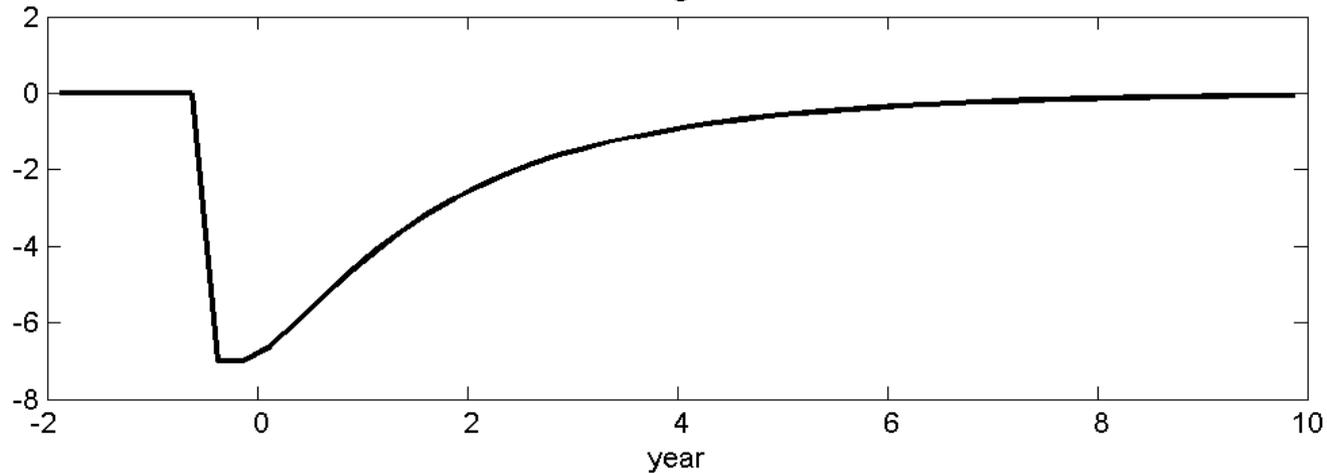
An optimistic scenario

Constant inflation target, $\rho_1=0$, $b_1=0.85$



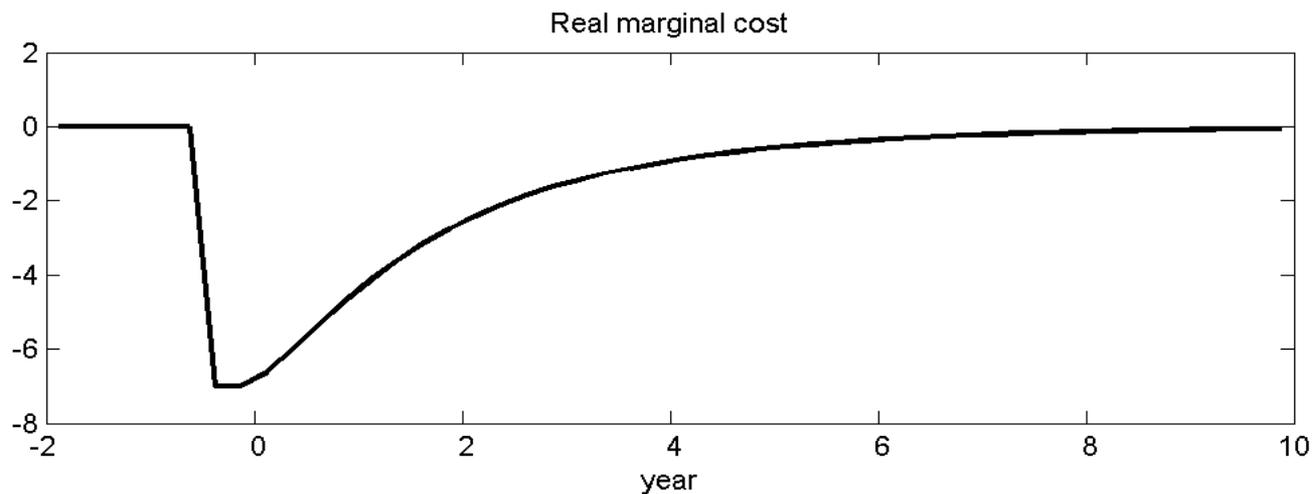
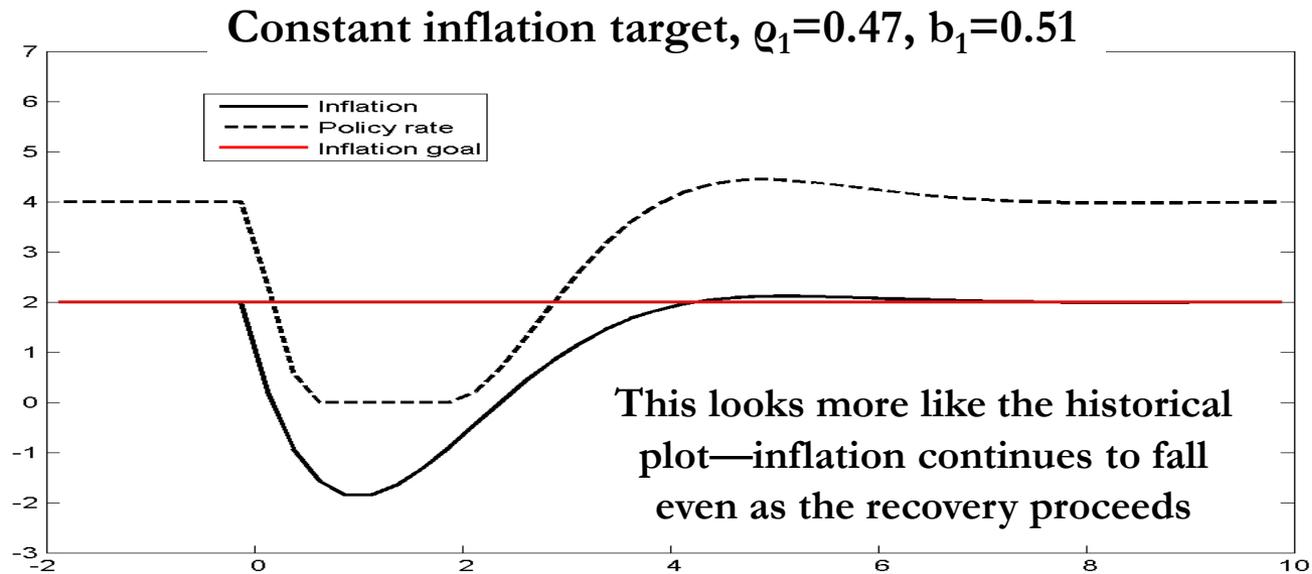
Inflation rebounds quickly, and the ZLB never binds

Real marginal cost

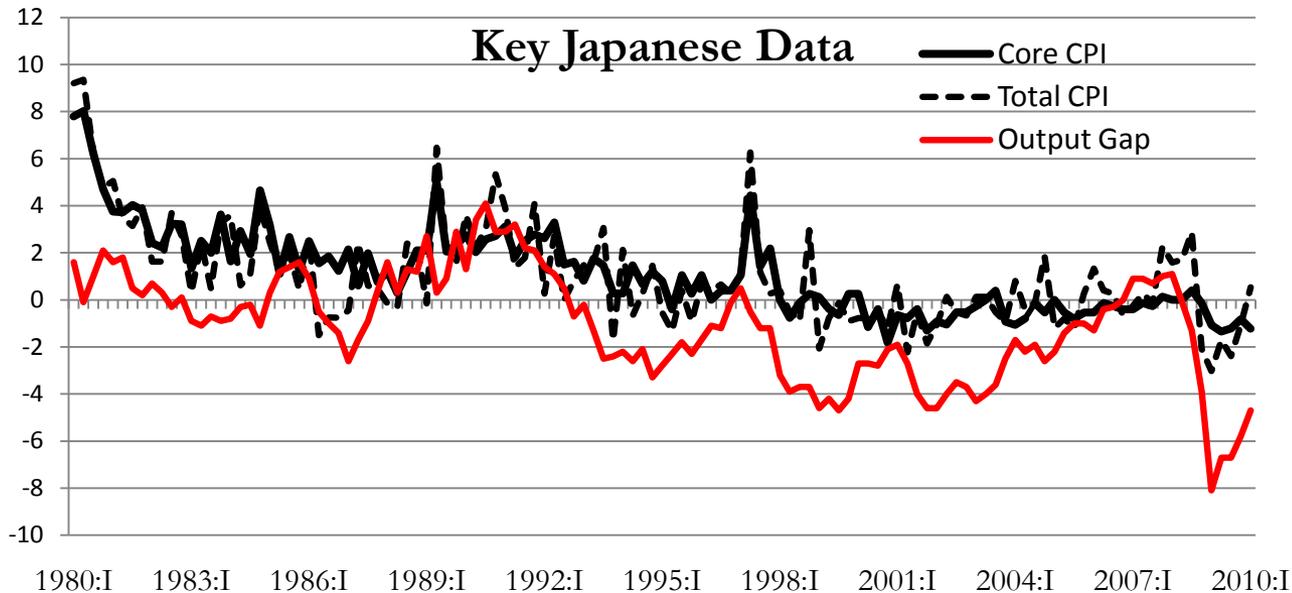


Inflation following a large recession, hybrid model

A less optimistic scenario—more historically consistent?

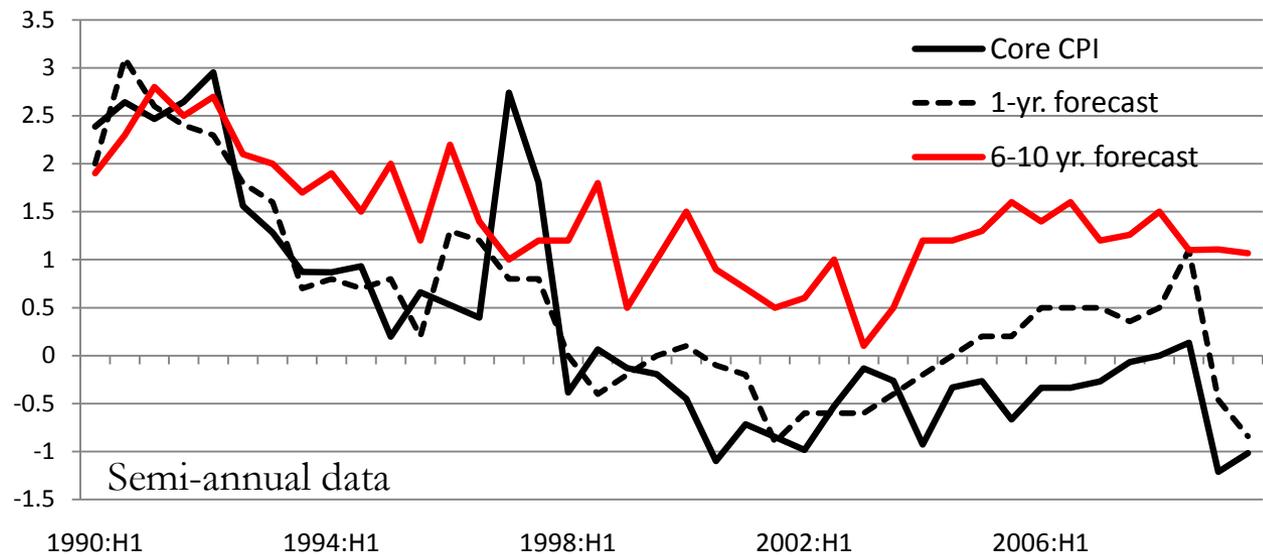


What can we learn from Japan



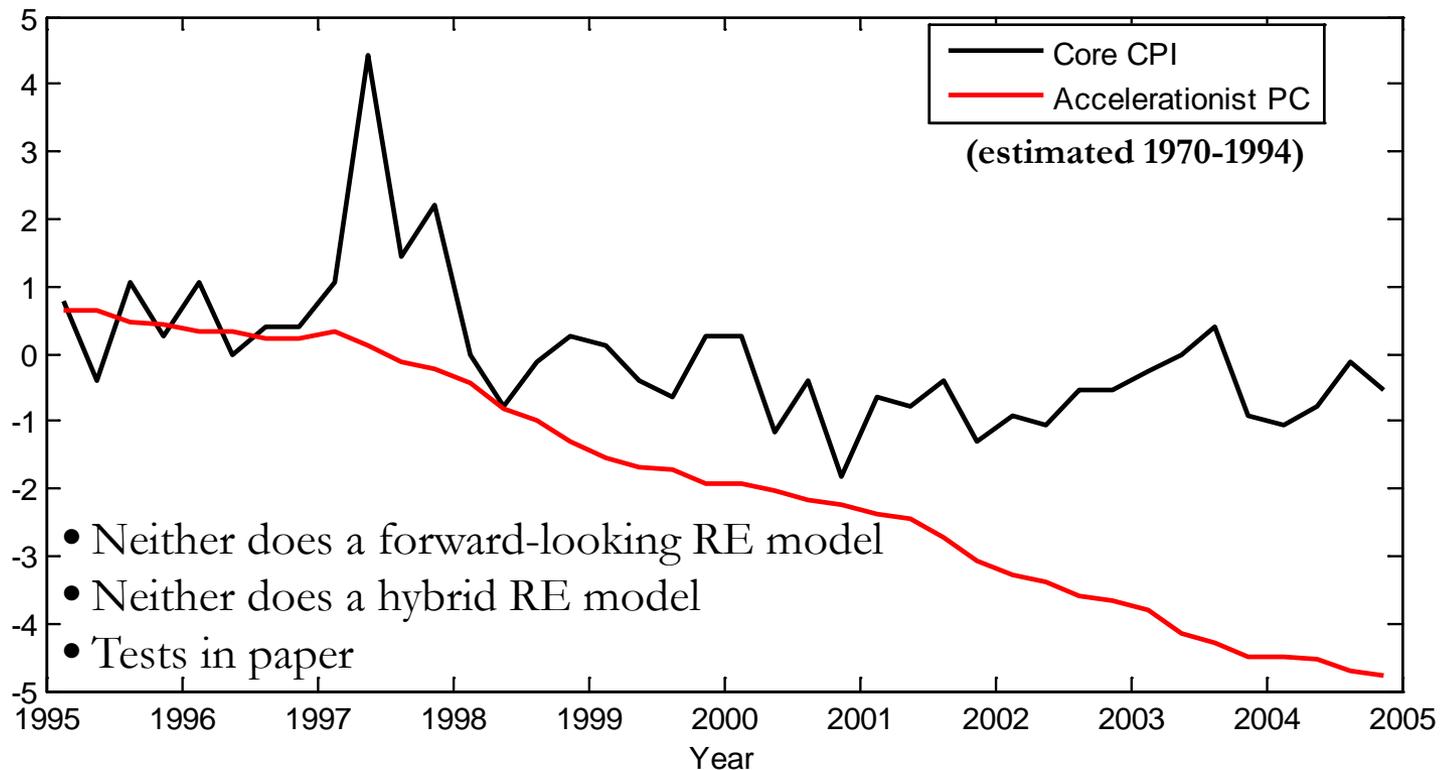
Key observations:

1. Inflation < 0
2. LR expectations anchored at 0.5-1.5%
3. No “downward spiral”
4. 1-yr. expectation tracks inflation well



How to think about Japanese inflation?

The traditional accelerationist Phillips curve does not fit



The slope of the accelerationist Phillips curve has shifted from 0.4 to 0.0

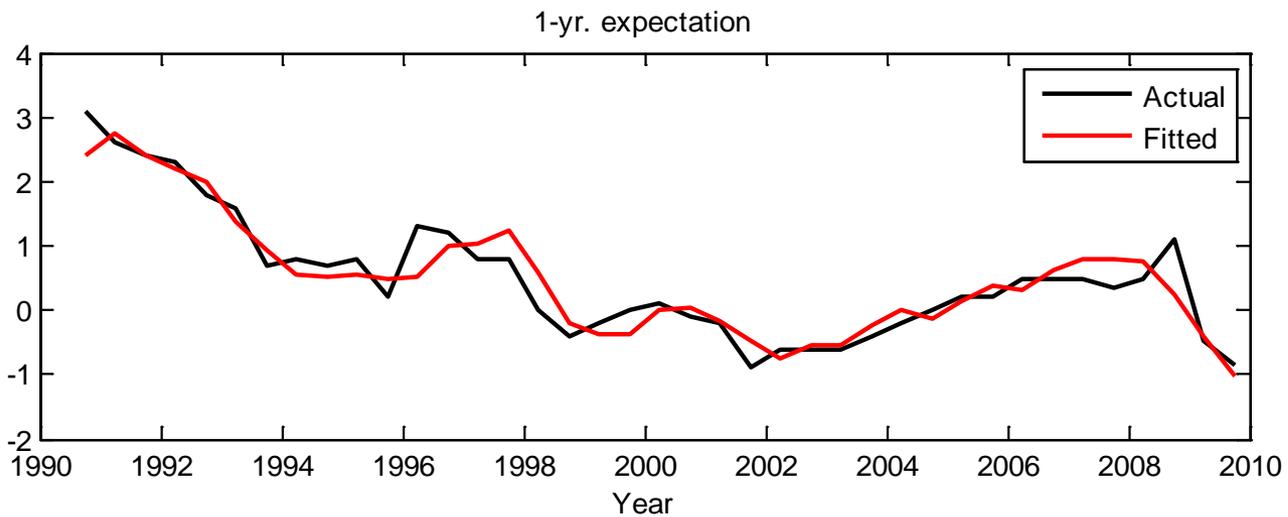
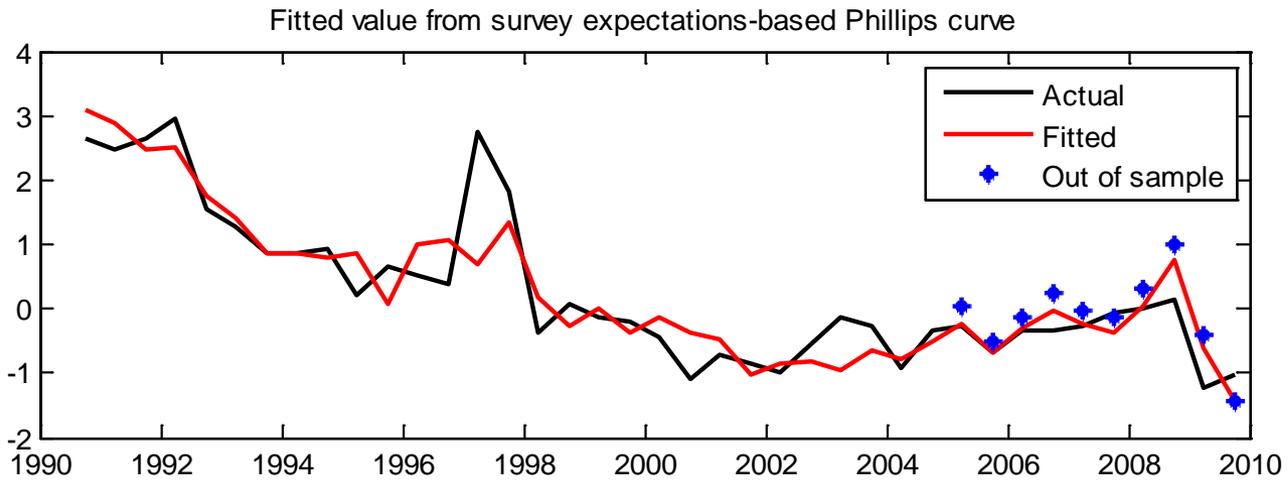
	Coefficient, 70-09	<i>p</i> -value	Shift, 1990-present	<i>p</i> -value
Output gap	0.39	0.00	-0.38	0.00

A survey expectations model of inflation

MODEL	
Variable	Depends on
Inflation	One-year expectation, lagged inflation, marginal cost
One-year expectation	Lagged inflation, output gap, lagged expectation

Estimates of Japanese Phillips curve with survey expectations		
Coefficient	Estimate	<i>p</i>-value
Core Inflation equation		
1-yr. expectation	0.79	0.00
Lagged inflation	0.21	0.037
Marginal cost	0.16	0.005
R ² : 0.79; <i>p</i> -value for unit sum restriction: 0.31		
One-year expectation equation		
Lagged 1-yr. expectation	0.34	0.01
Lagged inflation	0.23	0.01
Output gap	0.18	0.00

How does it do?



Summary of Japanese inflation results

- Not consistent with a backward-looking accelerationist Phillips curve
- Not consistent with a forward-looking NKPC
- Not consistent with the RE hybrid version of the NKPC
- Still, expectations are key—one-year-ahead survey expectations provide a clue
 - These evolve according to the dynamics described above
 - Bears difference implications from either old-style or new-style Phillips curves.

Is the US like Japan?

A parallel specification for the US

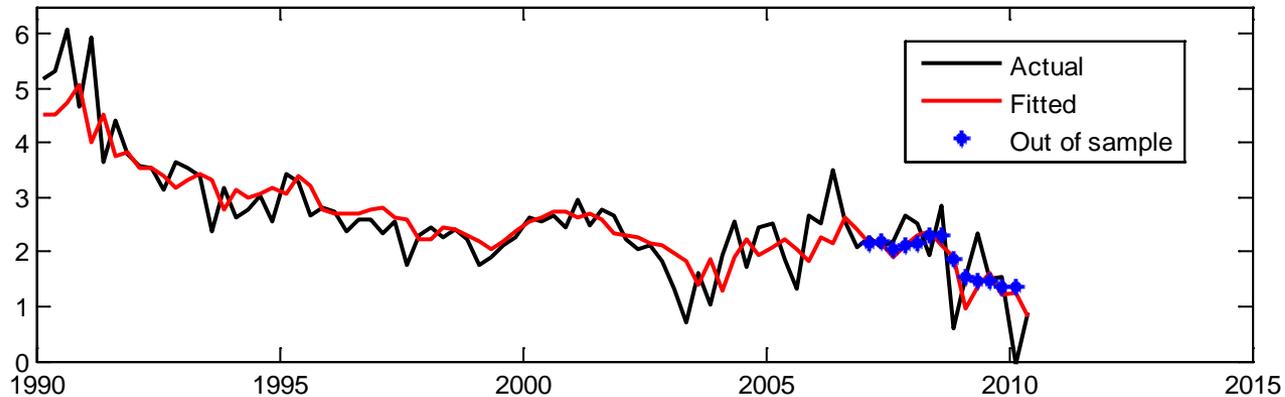
MODEL	
Variable	Depends on
Inflation	One-year expectation, lagged inflation, marginal cost
One-year expectation	Lagged inflation, output gap

Estimate of inflation equations for US, paralleling Japanese specifications		
Coefficient	Estimate	<i>p</i>-value
Core inflation equation		
1-yr. expec.	0.70	0.00
Lagged infl.	0.30	0.010
Marginal cost	0.052	0.067
Intercept	-0.22	0.022
One-year expectation equation		
Sum of lagged infl.	0.66	0.00 (joint)
Sum of lagged output	0.037	0.00 (joint)
Intercept	0.95	0.00

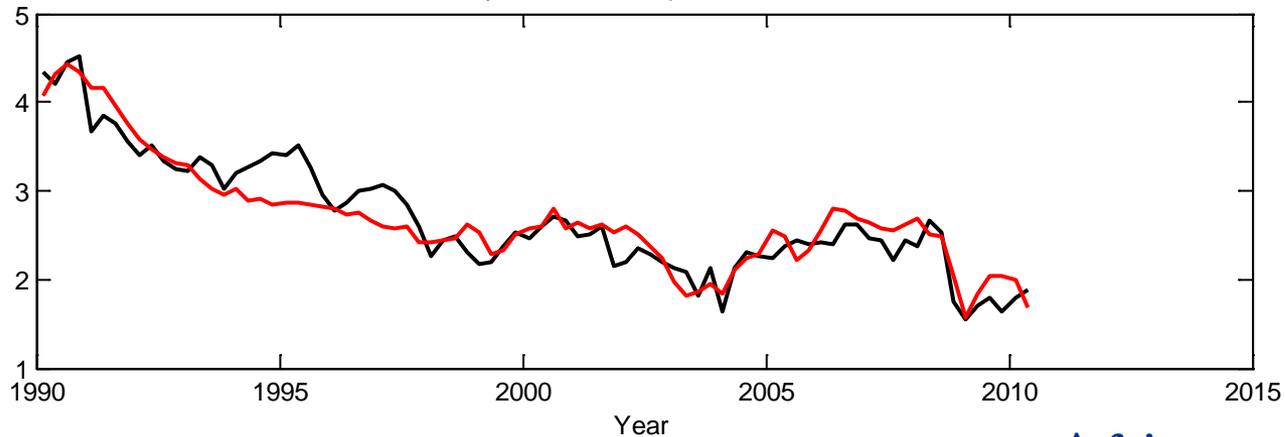
How much of US history does it explain?

A Japanese model for US data?

Core CPI and fitted value



One-year inflation expectations, SPF



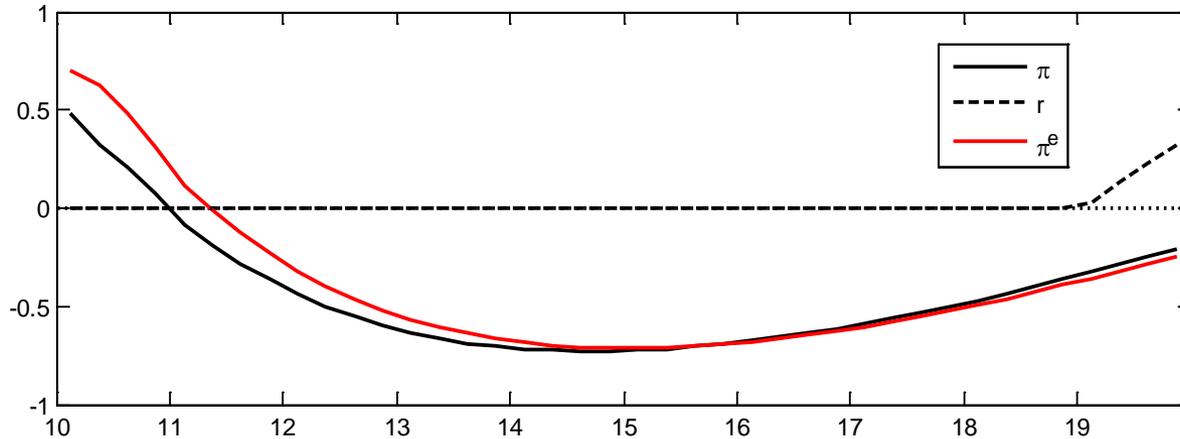
A fair amount!

Implications for inflation in the medium-run

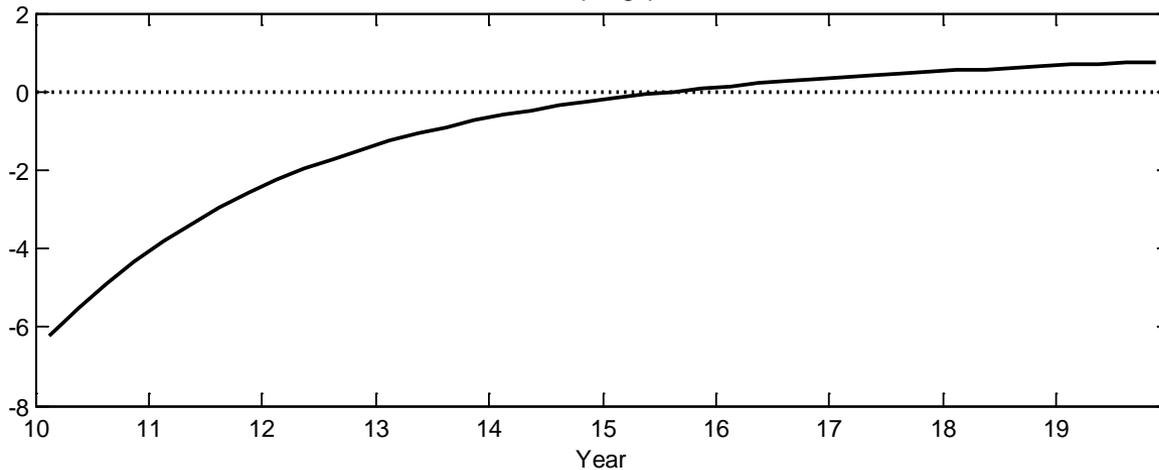
- Imbed this inflation specification in a DSGE model with
 - Explicit policy rule, ZLB imposed
 - Optimizing I—S relation
 - Data-based estimates of parameters
- Simulate model starting with current conditions
 - One percent inflation and expected (short-run) inflation
 - Large output gap
 - Funds rate bound at zero

Implications: Japan-like

Simulation of model with 2010 initial conditions



Output gap



Key conclusions:

1. Policy rate pinned at ZLB for a decade
2. Inflation falls below zero
3. Moderate deflation for a decade

Summary

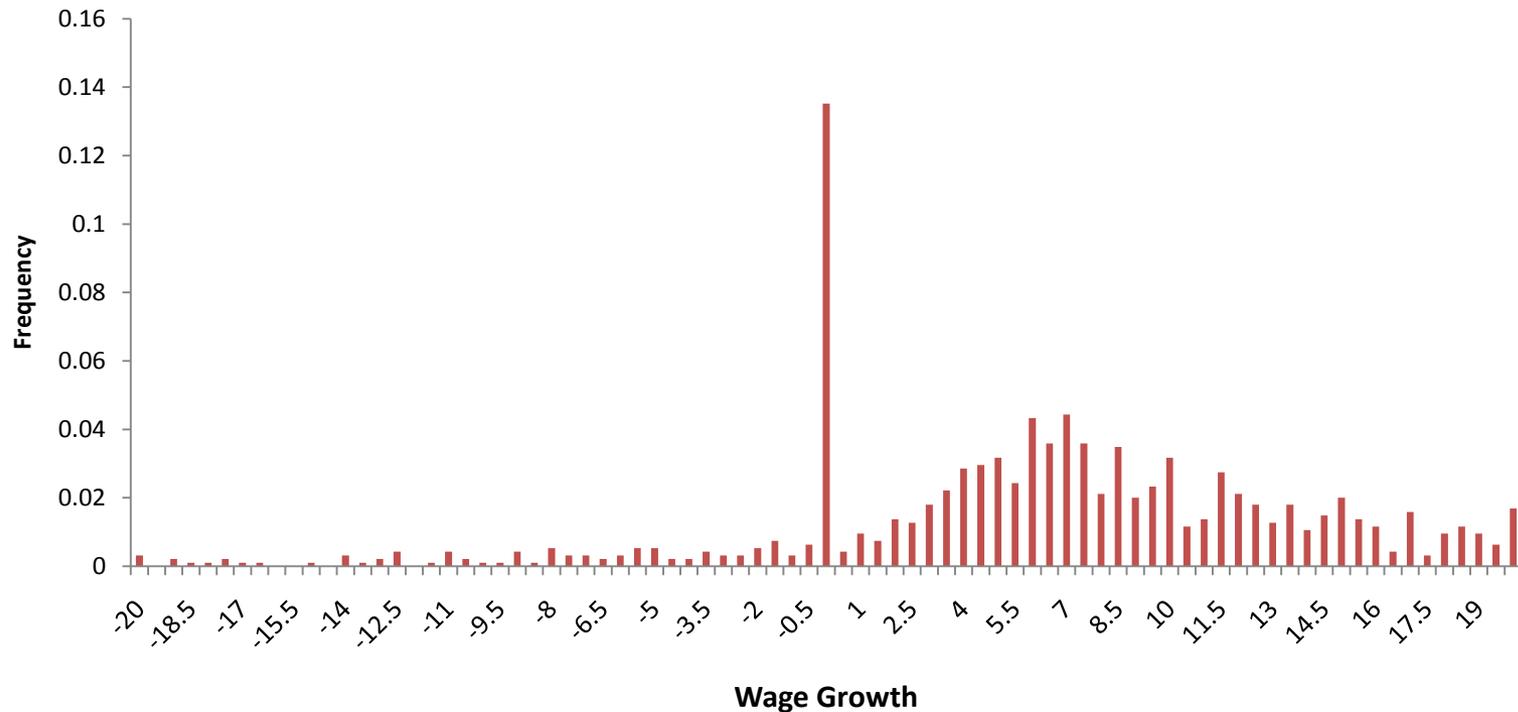
- Japan may serve as a cautionary tale for the US
 - Long-run expectations, even if “well-anchored,” do not necessarily impede the downward motion of inflation
 - They may help avoid a pronounced downward spiral
 - Expectations matter—but not RE
 - One-year survey expectations, which adjust sluggishly to output and inflation, appear to be important
 - Implies a slow adjustment of inflation to improving conditions—could be a long period of undesirably low inflation
- Caveat—some of this is “reduced form”
 - More work is needed to validate/verify

Why might the inflation process have changed? Brushing up against downward wage rigidity

- But why might inflation behave differently now?
- This section focuses on the potential effects of downward wage rigidity on the inflation process
 - If wage changes are stuck at zero, the firms' costs will tend to plateau, no matter the size of the output gap.
- The key distinction here is an emphasis on the wage bill, rather than on individual wages
 - We tentatively conclude that wage rigidity has less of an effect on the inflation process than one might think

Evidence of downward nominal wage rigidity: The individual

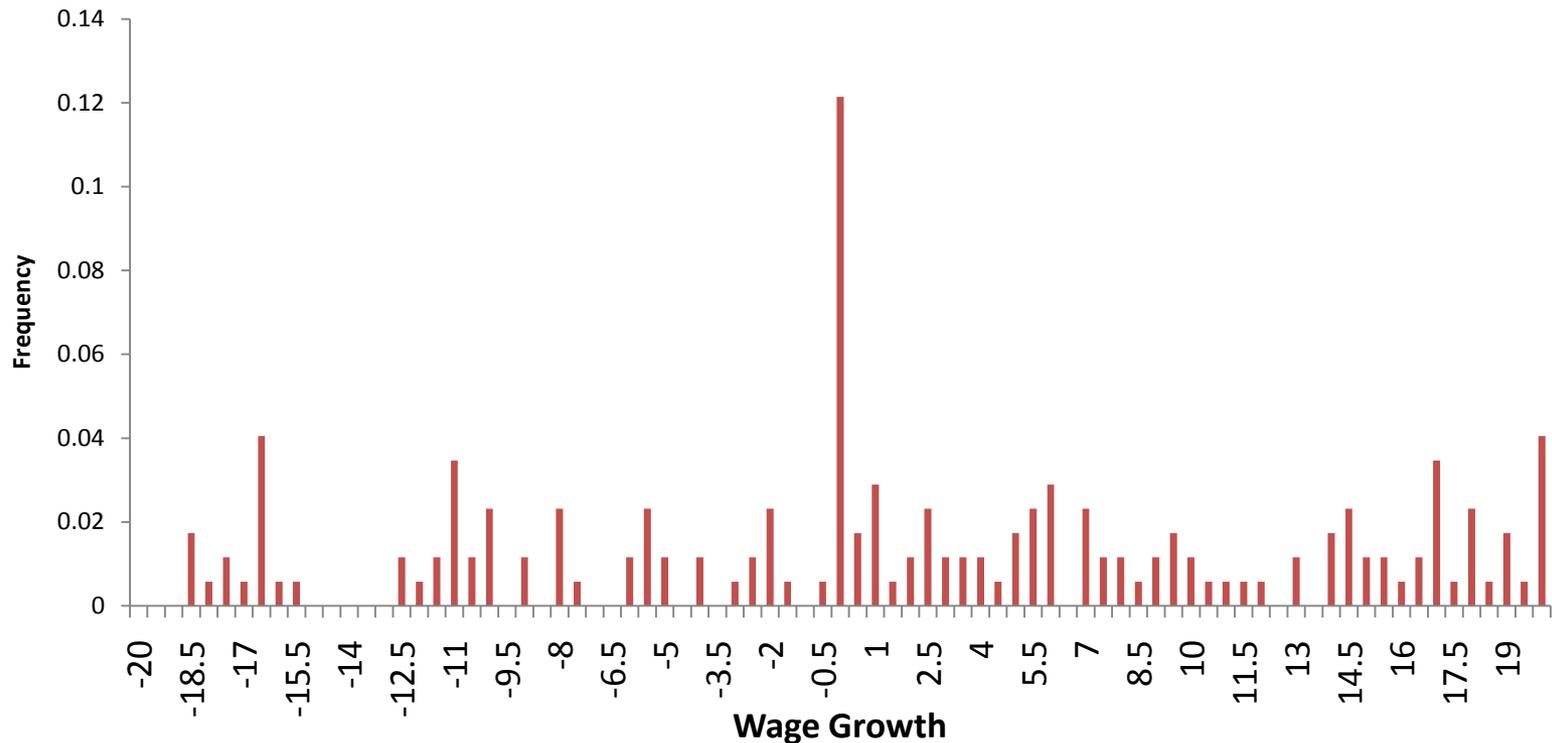
Wage Growth for Job Stayers PSID 2005-2007



Both the spike at zero and the skewed tails strongly suggest downward rigidity

The previous chart examines job-stayers; Job-changers are different

Wage Growth for Job Shifters PSID 2005-2007

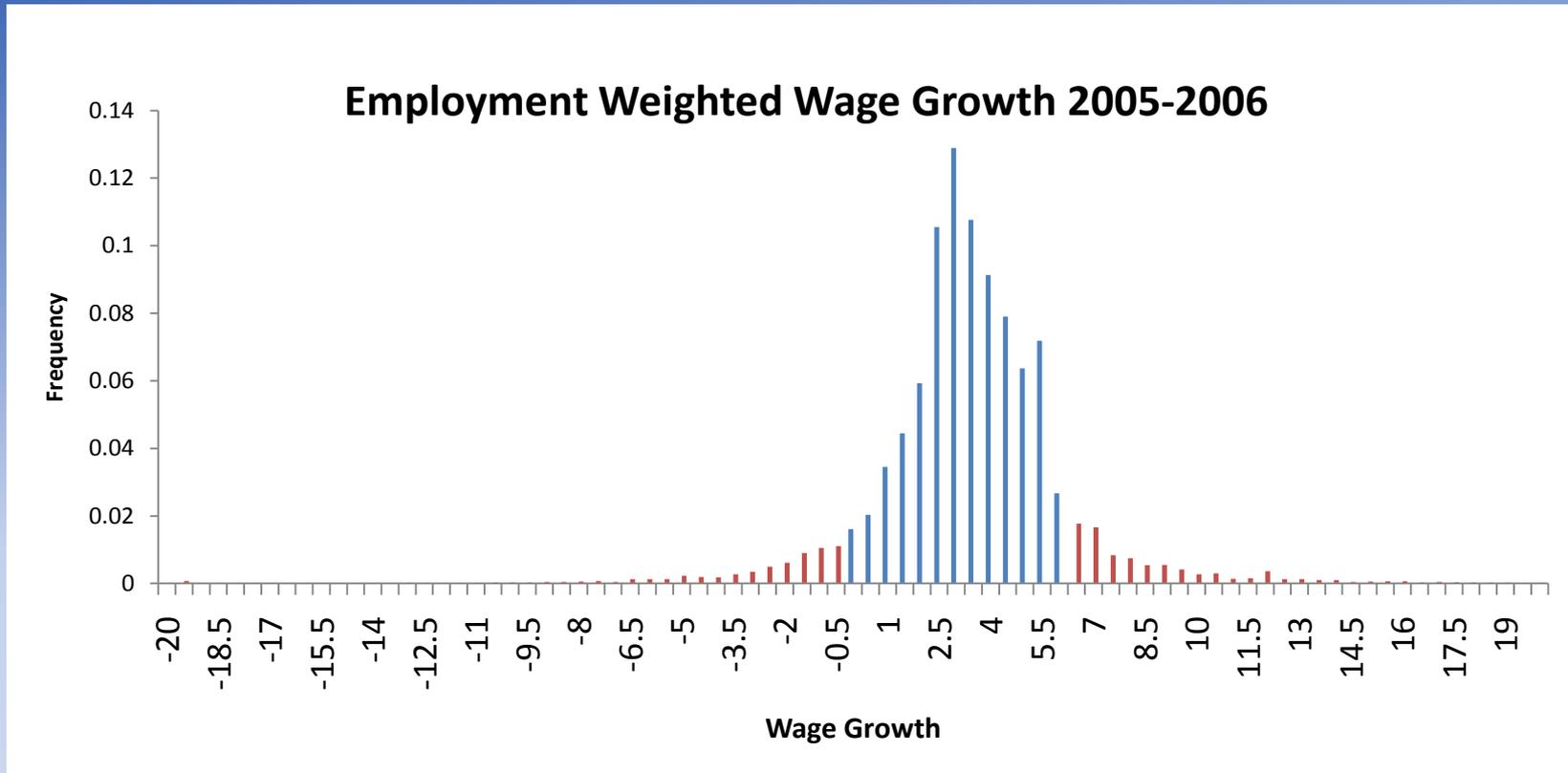


Still a spike at zero, which is not all minimum wage workers, but distribution much more uniform. Wage declines are frequent.

Focusing on the wage bill

- Since job-changers' wages are much more flexible, firms could adjust the wage bill in response to downturns, despite individual wage rigidity for stayers
- Hence, we examine establishment data on wages/wage bill
 - The standard biases that arise with individual wages are much less of a problem – establishments have the payroll records.
 - More closely related to costs and prices
- Specifically, look at OES data from the BLS
 - Collects all workers from exhaustive sample of establishments.
 - Only collects wage data; “only” makes public the wages for 800 occupations in each of the 300 industries.

Distribution of wage changes, weighted by employment



This distribution does not show a spike at zero, and the tails, though not large, are fairly symmetric.

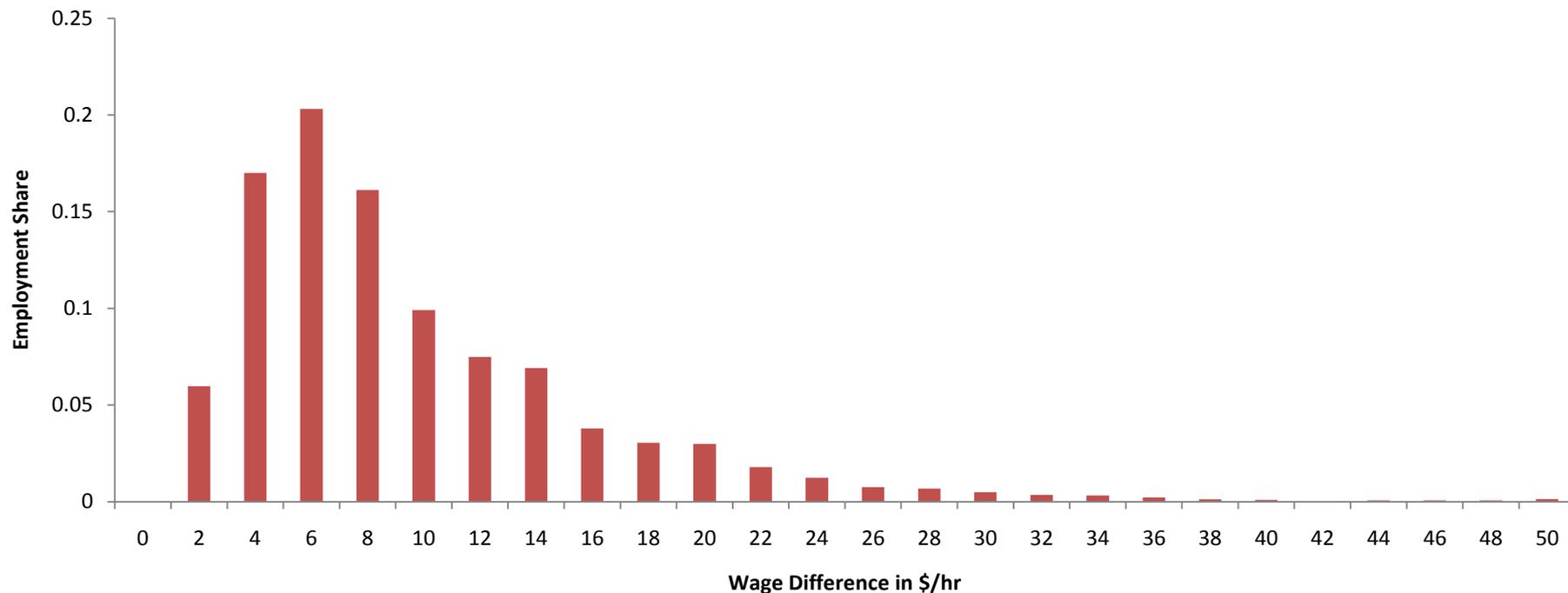
The establishment data suggests more flexibility: Why the difference?

- The data from establishments only looks at the wages of a job
 - The BLS provides the average wage for workers in an industry/occupation
 - Shifts in the composition of workers within that cell may change the average wage, even though no individual job-stayer's wage has changed.
- The OES data includes the job changers and new entrants in its sample
- **This is just what we want for the purposes of this paper**
 - The change in the wage bill determines the behavior of prices.
 - It doesn't matter if labor costs fall because wages decline or firms replace high cost workers with low cost ones.
- In the future we will try to determine the importance of the compositional changes to the flexibility of costs.
 - Now look at suggestive evidence

How much scope do firms have to use compositional shifts to affect the wage bill?

1. Wages vary considerably within cells

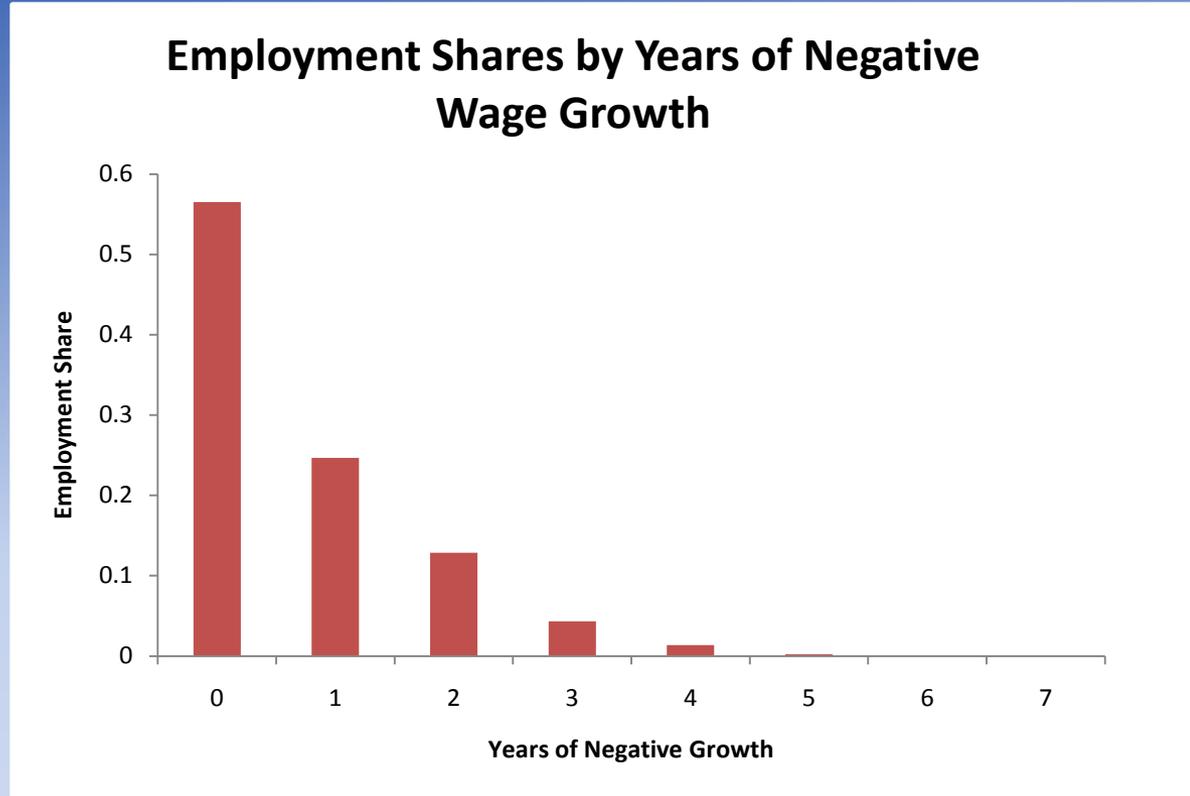
25th Percentile Wage Differences 2009: Weighted by Employment



Wage differentials within an industry/occupation cell suggest these effects can be large

How much scope do firms have to use compositional shifts to affect the wage bill?

2. Wage declines are widespread across jobs



The breadth of decline is a little surprising, which might suggest a measurement issue

Data for the government sector avoids two of the most obvious measurement issues



- Government sector is surveyed every year
- Exact wages are provided

The effect of employment growth on wages in each job, during recessions

MODEL	
Variable	Depends on
Wage Growth	Employment growth, recession years, the interaction of emp. growth and recession, and year dummies

Estimates of Wage Growth		
Coefficient	Estimate	<i>p</i> -value
Employment Growth	-.0001	0.629
Recession Dummy	-1.208	0.00
Rec.Dummy*Emp	-.0021	0.013
Dummy 2009	-.0436	0.283
Dummy 2008	.9678	0.00
Dummy 2006	-.283	0.00
Dummy 2005	-.888	0.00
Dummy 2004	-.842	0.00
Constant	3.279	0.00
R ² : 0.0068; n = 222111		

The growth of the wage bill, holding employment constant, affects industry price inflation – composition seems to matter

MODEL	
Variable	Depends on
Change in Price Index	Lag of Change in Employment Growth, Lag of Change in Wage Growth, Lag in Change in Price Index

Estimates of the Change in Prices		
Coefficient	Estimate	<i>p</i>-value
Constant	-1.158	0.00
Lag Chg. Emp. Growth	-0.261	0.058
Lag Chg. Wage Growth	0.265	0.039
Lag Chg. Price	-0.663	0.00
R ² : 0.222; n = 682		

Summary of the effects of wage rigidity

- Wage rigidity at zero could offset other downward pressures on inflation, particularly as inflation nears zero.
- Though individual data on job-stayers suggest a great deal of downward rigidity, job-leavers and new entrants provide firms leeway to cut their wage bills.
- The wage bill data from employer surveys, though imperfect, suggest that wage bills are more flexible than individual wage rates – which could eliminate a potential floor near zero.

Conclusions

- Inflation is quite low, and its direction is uncertain
 - Forecasts of rising inflation depend on the influence of well-anchored long-run expectations
 - But this effect is uncertain
 - Still, expectations are probably important
- We examine Japanese and US data
 - Empirical link between inflation and LR expectations is weak
 - Link to short-run expectations is much stronger; these are less well-anchored
 - Nominal wage rigidity may not impede the decline of inflation
 - **A key risk:** we could experience a long period of very low inflation, possibly deflation
- **Policy conclusion:**
 - If this risk materializes, macro policy—fiscal and monetary—will need to do more