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COMMENT BY

JAMES H. STOCK[1] It is tempting, particularly in monetary policy circles, to view the relatively modest fall in the rate of inflation during the Great Recession and its aftermath as a successful payoff for hard-won Federal Reserve credibility, which has anchored expectations around a credible implicit long-term target for inflation. It is therefore most welcome to have Laurence Ball and Sandeep Mazumder pit this hypothesis against others in their attempt to solve this "case of the missing disinflation."

Ball and Mazumder's explanation for the missing disinflation has two parts. First, less disinflation is missing than one might initially think: one just needs to measure inflation with median CPI inflation, which has fallen by more than core CPI inflation. Second, the Phillips curve has flattened since the mid-1980s, and the 1985–2007 backward-looking Phillips curve, applied to median CPI inflation, continues to fit after 2007. The authors argue that these two explanations account for the behavior of inflation from the Great Recession through 2010Q4, that a Gordon (1990)-type backward-looking accelerationist Phillips curve is stable over the 1985–2010 period, and that no further appeal to anchored expectations is needed; in short, there is no puzzle. Although the authors do find some evidence in the data of level anchoring, level-anchored expectations are not needed to understand inflation dynamics to date.

My comments consist of five points.

First, Ball and Mazumder are correct to point out that the decline in inflation observed during and since the recent recession is consistent with

1. I thank Mikkel Plagborg-Moller for research assistance in preparing this discussion. This work was supported in part by NSF Grant SES-0617811.

a backward-looking Phillips relation. Absent confounding accommodated supply shocks, inflation falls in recessions, and it fell in the Great Recession. I have made this case in recent work with Mark Watson (Stock and Watson 2010), which focuses on the United States, and André Meier (2010) and Domenico Giannone and coauthors (2010) make this case using international data. It would be wrong to say that all inflation dynamics are explained by a simple Phillips curve—supply shocks matter—but it is equally wrong to say that the Phillips curve does not exist (Atkeson and Ohanian 2001, Uhlig 2010).

Second, one need not invoke median CPI inflation to solve the "missing deflation" puzzle. Backward-looking Phillips curves, fit from 1985 to 2007, explain the behavior of the core personal consumption expenditure price index (PCE-XFE), headline CPI, and headline PCE, as well as median CPI inflation; the outlier is core CPI inflation (CPI-XFE).

Third, there is time variation in the Phillips curve regressions, but that time variation can come about through the expectations formation mechanism just as well as through the slope coefficient itself (α in Ball and Mazumder's equation 3).

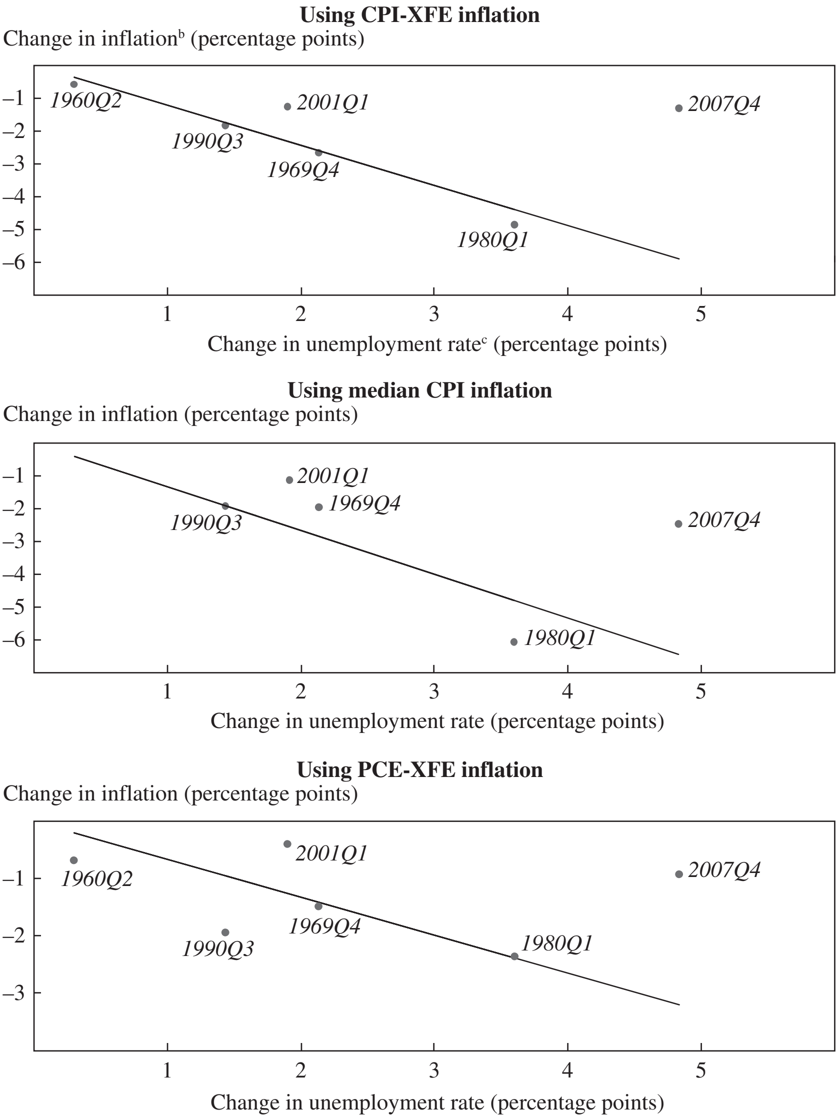
Fourth, Ball and Mazumder's concluding suggestion is to consider gaps constructed using short-term unemployment. Short-term unemployment rose less in the recent recession than usual, relative to total unemployment, and preliminary results suggest that using gaps based on short-term unemployment may provide an alternative, albeit only partial, explanation of the missing disinflation.

Fifth, a loose end in Ball and Mazumder's paper is the need to reconcile their finding that the level anchoring model is supported in the 1985–2010 data with their seemingly contradictory finding that a level-anchored expectations model (their equation 6) does not help to explain the 2007–10 experience. In fact, much of the 1985–2010 empirical support comes from the increase in the rate of inflation in mid-2004, and the empirical evidence of level anchoring wanes in 2005–09. As a result, Phillips curves that ignore level anchoring (in the sense of their equation 6) do a better job of explaining inflation during the 2007 recession than ones that incorporate level anchoring (compare the top panels of Ball and Mazumder's figure 6 and figure 9).

The rest of this discussion elaborates on these points.

THE MISSING DISINFLATION AND VARIOUS MEASURES OF CORE INFLATION. My figure 1 shows both that inflation falls during recessions and that the recession that began in 2007Q4 and its aftermath have missing disinflation. The figure plots, for recessions since 1960, the change in the rate

Figure 1. The "Williams Puzzle"[a]



Source: Author's calculations.

a. Each labeled point represents the change in 4-quarter inflation and unemployment from the indicated quarter (a cyclical peak as identified by the Business Cycle Dating Committee of the National Bureau of Economic Research) to 10 quarters later. The figure omits the supply-shock recession that began in 1973Q4 and combines the recessions that began in 1980Q3 and 1981Q3 because those 10-quarter periods overlap. The regression lines are constrained to pass through the origin and are estimated excluding the 2007Q4 recession.

b. Average quarterly rate over the most recent 4 quarters, $\pi^4_t = (\pi_t + \pi_{t-1} + \pi_{t-2} + \pi_{t-3})/4$.

c. Total civilian unemployment rate.

of 4-quarter inflation—$\pi_t^4 = (\pi_t + \pi_{t-1} + \pi_{t-2} + \pi_{t-3})/4$, where π_t is the annualized quarterly rate of inflation, variously measured by CPI-XFE, median CPI, and PCE-XFE—against the change in the total civilian unemployment rate; both changes are measured from the cyclical peak to 10 quarters later (10 being the number of quarters of data available after the 2007Q4 peak as of September 2010, when John Williams gave the speech quoted in Ball and Mazumder's introduction). The figure omits the supply-shock recession that began in 1973Q4, and it combines the recessions that began in 1980Q3 and 1981Q3 because those 10-quarter periods overlap. The regression line is estimated excluding the most recent recession.

The clear relation between the recessionary increase in the unemployment rate and the decline in inflation is an empirical restatement of the Phillips curve, with a focus on behavior during periods of slack. For the two standard measures of core inflation, PCE-XFE and CPI-XFE, the most recent recession is an outlier: inflation fell by less during and after that recession than predicted by the historical scatterplot—hence the "Williams puzzle" of the missing disinflation. When illustrated this way, the Williams puzzle is not resolved by using median inflation: this recession remains a clear outlier in the middle panel of figure 1.

The first three columns of my table 1 state the missing disinflation puzzle numerically by extending Ball and Mazumder's figure 6 to other inflation measures. The missing disinflation is the difference between the predicted value of 4-quarter inflation in 2010Q4, from the dynamic simulation of Ball and Mazumder's equation 2 estimated over 1985Q1–2007Q4, and the actual value. For 4-quarter CPI-XFE inflation, this gap is −1.68 percentage points, which in absolute value is 3.7 times the root mean squared forecast error (RMSFE). Ball and Mazumder's resolution of this missing disinflation is to replace CPI-XFE with median CPI inflation (constructed as described in their section II.C), which reduces the forecast error to −0.34, only 0.8 times the RMSFE. But median inflation is not the only measure for which the 2010Q4 dynamic forecasts are on track. In particular, using the Federal Reserve's benchmark measure, PCE-XFE, results in a 4-quarter rate of inflation of 0.80 percent in 2010Q4, only narrowly missed by the dynamic forecast of 0.67 percent. The broader inflation measures (headline CPI and PCE) are arguably less useful given the recent large swings in food and energy prices, but even so the 1985–2007 backward-looking Phillips curves yield fairly accurate 2010Q4 dynamic simulations for these broader measures. Indeed, the outlier, that is, the measure with the most missing disinflation, is CPI-XFE; the other standard measures of consumer price inflation have dynamic forecasts that are largely on track. I do not have an

Table 1. Dynamic Simulations of 4-Quarter Inflation in 2010Q4[a]
Percent per year except where noted otherwise

		Unemployment gap (u – u) concept used in dynamic simulation*					
		Total civilian unemployment minus CBO natural rate		*Stock-Watson recession gap using total civilian unemployment*[b]		*Stock-Watson recession gap using short-term unemployment*[c]	
Inflation measure	*Actual inflation, 2010Q4*	*Inflation forecast*	*Forecast error*[d]	*Inflation forecast*	*Forecast error*	*Inflation forecast*	*Forecast error*
CPI-XFE	0.63%	–1.05	–1.68	–0.86	–1.49	–0.31	–0.94
			(0.46)		(0.45)		(0.43)
Median CPI	0.61	0.27	–0.34	–0.33	–0.95	0.30	–0.31
			(0.42)		(0.37)		(0.34)
PCE-XFE	0.80	0.67	–0.14	0.46	–0.34	0.85	0.05
			(0.41)		(0.40)		(0.40)
Headline CPI	1.20	0.75	–0.44	1.37	0.17	0.75	–0.45
			(0.93)		(0.93)		(0.92)
Headline PCE	1.12	1.52	0.40	1.66	0.54	1.34	0.22
			(0.73)		(0.73)		(0.73)

Source: Author's calculations.

a. Simulations start in 2008Q1 and use pre-2008Q1 inflation and the actual path of the unemployment rate through 2010Q4. The Phillips curve is specified as in Ball and Mazumder's equation 2 with constant coefficients for the indicated unemployment measures and unemployment gap concepts, estimated using data from 1985Q1 through 2007Q4.

b. The recession gap is defined as in Stock and Watson (2010), as $u_t - \min(u_t, u_{t-1}, \ldots, u_{t-11})$, where t indicates quarters.

c. The short-term unemployment rate is the rate for those unemployed less than 27 weeks.

d. Forecast minus actual (in percentage points). Estimated root mean squared forecast errors (RMSFE) are in parentheses.

explanation for why CPI-XFE is alone among these inflation measures in this regard. In any event, one need not appeal to median CPI to resolve the missing disinflation.

EXPECTATIONS ANCHORING AND INFLATION DYNAMICS. Ball and Mazumder's Phillips curve has a time-varying slope (time-varying α in equation 3), which they interpret according to Ball, Gregory Mankiw, and David Romer's (1988) implication that α increases in magnitude with the level and variance of inflation. Because α varies over time, the cumulative effect of a sustained unit increase in the unemployment gap in a dynamic simulation varies over time, being greatest in the 1970s (when α is estimated to be greatest) and less in the 1960s and the 2000s. Here I will show by example that this time-varying cumulative effect can be achieved without invoking a time-varying α; instead, one can rely solely on time variation in how inflation expectations are formed. The less expectations drift, the smaller is the cumulative dynamic response to a unit increase in the gap.

I illustrate this point using the Phillips curve specification of Stock and Watson (2010), modified to include a contemporaneous activity term as in Ball and Mazumder's paper. Rewrite their equation 1 as $\pi_t = \pi_t^e + \alpha x_t + \varepsilon_t$, where x_t is the activity gap. In Ball and Mazumder's equation 3, $\pi_t^e = \pi_{t-1}^4$, where π_t^4 is the 4-quarter rate of inflation, $\pi_t^4 = (\pi_t + \pi_{t-1} + \pi_{t-2} + \pi_{t-3})/4$.[2] In the Stock and Watson (2010) model, π_t^e is the filtered estimate of trend inflation obtained from a univariate model with unobserved permanent and transitory components, in which the variances of the two components follow random walks in logarithms. This unobserved components–stochastic volatility (UC-SV) model implies that $\Delta\pi_t$ is approximately a first-order moving-average process with a time-varying coefficient θ_t, where θ_t is large when the variance of the permanent component of inflation is small relative to the variance of the transitory component. As shown in Stock and Watson (2010), this model implies that $\pi_t^e \approx (1 - \theta_t) \sum_{i=0}^{\infty} \theta_t^i \pi_{t-1-i}$, where the approximation holds when θ_t varies slowly. In the model, time variation enters through the coefficients on lagged inflation, not through the slope coefficient α. This time variation derives directly from variation in the fraction of the variance of the change in inflation due to permanent movements in inflation.

Time variation in the coefficients on lagged inflation, combined with a stable value of α, has three implications. First, it implies time variation in the response of inflation to a given path of unemployment in a dynamic

2. Ball and Mazumder's expected inflation forecast is the same as Atkeson and Ohanian's (2001).

simulation. In particular, consider a dynamic simulation in which the output gap is hypothetically increased by 1 unit for k periods. In the UC-SV model, the change in inflation after k periods arising from this hypothetical gap increase is $\alpha[1 - \theta_t(k - 1)/k]$, which, for large k, is approximately $\alpha(1 - \theta_t)$. The larger is θ_t, the less inflation falls in the long run. Large values of θ_t arise when most of the movements of inflation are transitory. In the post-1960 data, this was the case in the 1960s and after 1990. These episodes of mainly transitory changes in inflation can be interpreted as periods of expectations anchoring, which arose because of the recent behavior of inflation (the Federal Reserve's deeds, not its words). This anchoring produces a flatter dynamic response to a given increase in the gap. Second, if the data used in the regressions are temporally aggregated relative to the time horizon at which α is constant (the time horizon relevant for price-setting decisions), then time variation in the inflation lag coefficients will induce time variation in the population value of α in the temporally aggregated regression. Under plausible assumptions (for example, that the first autocovariances of x_t are positive), larger values of θ_t induce smaller time-aggregated values of α. Third, by a standard omitted-variables argument, ignoring this time variation in the coefficients on lagged inflation can induce apparent time variation in α.

My table 2 examines the third of these implications by reporting estimates of α using two alternative measures of π_t^e: $\pi_t^e = \pi_{t-1}^4$ as in Ball and Mazumder's equation 3, and π_t^e measured as $t - 1$ dated filtered trend inflation from the Stock and Watson (2007) UC-SV model, as in Stock and Watson (2010). The slope coefficient is estimated for three subsamples: 1960–72, 1973–84, and 1985–2010. The top panel reports results where the unemployment gap is measured using the CBO natural rate of unemployment series, as in the Ball and Mazumder paper. Consistent with their findings, stability of α is rejected at the 5 percent level for CPI-XFE when their measure of π_t^e is used (first four columns); although it is rejected at only the 10 percent level for median CPI and PCE-XFE, the change in estimated coefficients across subsamples is economically large. In contrast, the magnitude of the instability is reduced and the hypothesis of stability is not rejected at the 10 percent level (p values > 0.25) for both CPI-XFE and PCE-XFE when the UC-SV measure of π_t^e is used (final four columns). Stability is rejected for the median CPI, but perhaps this is related to differences in the construction of the original and revised series, which were spliced together to create the full time series. The gap using the CBO natural rate series is problematic because it is two-sided, so the middle panel provides results for the Stock and Watson (2010) recession gap, in which

Table 2. Stability of Phillips Curve Slope Coefficients, 1960–2010[a]
Percent per year[b]

	Expected inflation π_t^e is measured as in Ball and Mazumder[c]				Expected inflation π_t^e is measured using UC-SV model[d]			
Inflation measure	*1960–72*	*1973–84*	*1985–2010*	*Chow p*[e]	*1960–72*	*1973–84*	*1985–2010*	*Chow p*
	Unemployment gap is total civilian unemployment rate minus CBO natural rate							
CPI-XFE	–0.23	–0.67	–0.13	0.035	–0.13	–0.37	–0.12	0.285
	(0.07)	(0.21)	(0.04)		(0.05)	(0.16)	(0.02)	
Median CPI[f]	–0.26	–0.64	–0.16	0.033	0.02	–0.59	–0.19	0.000
	(0.04)	(0.21)	(0.05)		(0.04)	(0.19)	(0.05)	
PCE-XFE	–0.17	–0.42	–0.10	0.090	–0.08	–0.24	–0.11	0.273
	(0.07)	(0.15)	(0.04)		(0.04)	(0.09)	(0.02)	
	Unemployment gap is Stock-Watson recession gap[g] *using total civilian unemployment rate*							
CPI-XFE	–0.29	–0.50	–0.11	0.003	–0.17	–0.29	–0.10	0.083
	(0.11)	(0.12)	(0.03)		(0.06)	(0.09)	(0.02)	
Median CPI[f]	–0.30	–0.50	–0.15	0.005	–0.22	–0.48	–0.12	0.006
	(0.07)	(0.11)	(0.04)		(0.13)	(0.09)	(0.06)	
PCE-XFE	–0.17	–0.26	–0.09	0.069	–0.10	–0.15	–0.10	0.607
	(0.08)	(0.07)	(0.03)		(0.05)	(0.05)	(0.02)	

Unemployment gap is Stock-Watson recession gap using short-term unemployment rate								
CPI-XFE	–0.34	–0.73	–0.23	0.036	–0.20	–0.48	–0.20	0.113
	(0.14)	(0.18)	(0.06)		(0.07)	(0.13)	(0.04)	
Median CPI[f]	–0.36	–0.73	–0.33	0.068	–0.28	–0.73	–0.22	0.020
	(0.08)	(0.17)	(0.04)		(0.15)	(0.14)	(0.14)	
PCE-XFE	–0.19	–0.36	–0.17	0.309	–0.11	–0.22	–0.17	0.439
	(0.11)	(0.10)	(0.07)		(0.06)	(0.07)	(0.05)	

Source: Author's calculations.

a. The Phillips curve slope α is estimated using the following equation: $\pi_t = \pi_t^e + \alpha(u - u^*)_t + \varepsilon_t$. All estimates use quarterly data from 1960Q1 through 2010Q4 except as noted otherwise. Newey-West standard errors with eight lags are in parentheses.

b. Annualized change in the logarithm of the price level.

c. Measured as the average of quarterly rates of inflation over the previous four quarters: $\pi_t^e = \pi_{t-1}^4 = (\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4})/4$. Estimates may not match those in Ball and Mazumder, this volume, because of minor differences in data vintages and transformations. See the author's website for further details.

d. Measured using the unobserved components–stochastic volatility model of Stock and Watson (2007); see text.

e. p values for the Chow test of equality of the coefficients estimated for the three subsamples for the indicated inflation and unemployment gap combination.

f. Constructed by splicing the original and revised series of the Federal Reserve Bank of Cleveland at January 1983 and calculating quarterly annualized growth rates as described in Ball and Mazumder, this volume, section II.C. Estimates in the first column are based on data for 1967Q2–1972Q4 because earlier data are not available.

g. Defined as in Stock and Watson (2010) as $u_t - \min(u_t, u_{t-1}, \ldots, u_{t-11})$, where t indicates quarters.

the natural rate is the minimum value of the unemployment rate over the current and past 11 quarters. The stability results are broadly similar to those for the CBO gap.[3]

THE NATURAL RATE, GAPS, AND SHORT-TERM UNEMPLOYMENT. A different explanation of the missing disinflation is that the unemployment gap is mismeasured. Movements in the natural rate of unemployment (and in potential GDP) are quite difficult to measure, even with the benefit of many years of hindsight (see, for example, Staiger, Stock, and Watson 1997, Orphanides 2001). Compared with previous recessions, one unfortunate feature of the recent recession and its aftermath is that long-term unemployment is an unusually large fraction of total unemployment. The paper in this volume by Alan Krueger and Andreas Mueller shows that job search intensity (measured as hours per week spent in job search) declines with the duration of unemployment. If the intensity of job search, particularly among those with recent job experience and thus fresh job skills, is what matters for downward wage pressure, then short-term unemployment might provide a better measure of the natural rate than total unemployment.[4]

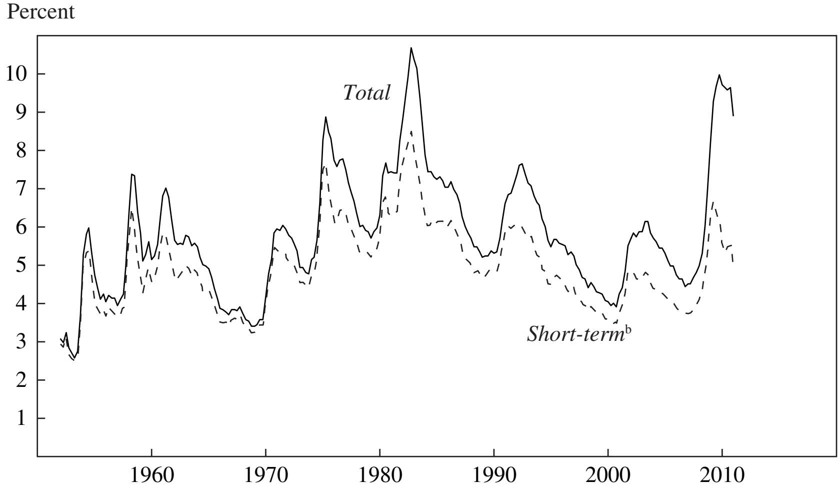
As figure 2 shows, the short-term unemployment rate rose by less than usual during the recent recession, given the increase in total unemployment. Indeed, when figure 1 is recomputed using the short-term unemployment rate, as is done in my figure 3, the "Williams puzzle" disappears entirely. Although this complete disappearance is sensitive to the 10-quarter horizon, figures 2 and 3 suggest that focusing on short-term unemployment, combined with time-varying expectation formation as discussed above, could further stabilize the Phillips relations.

Evidence on this conjecture is reported in the final two columns of table 1 and in the bottom panel of table 2. The estimate in table 1 of the missing disinflation for CPI-XFE of 1.68 percentage points is reduced to 0.94 percentage point (2.2 times the RMSFE) when the short-term unemployment recession gap is used. When short-term unemployment is used, there is virtually no missing disinflation if inflation is measured using PCE-XFE. Moreover, the coefficients in the PCE-XFE Phillips curve using

3. These findings are also robust to using a natural rate computed as a one-sided exponential filter of the unemployment rate. This analysis does not address temporal aggregation. If the time scale for price setting decisions is shorter than a quarter, then because of time aggregation one would still expect instability in α in the regressions in table 2 with UC-SV expectations, even if the UC-SV specification is correct. Exploring the effect of time aggregation is left for future work.

4. Earlier suggestions that the natural rate has risen during the slow recovery include Kocherlakota (2010) and Valletta and Kuang (2010).

Figure 2. Total and Short-Term Unemployment Rates, 1952–2011Q1[a]



Source: Bureau of Labor Statistics.
a. Rates are for all civilian workers.
b. Unemployed less than 27 weeks.

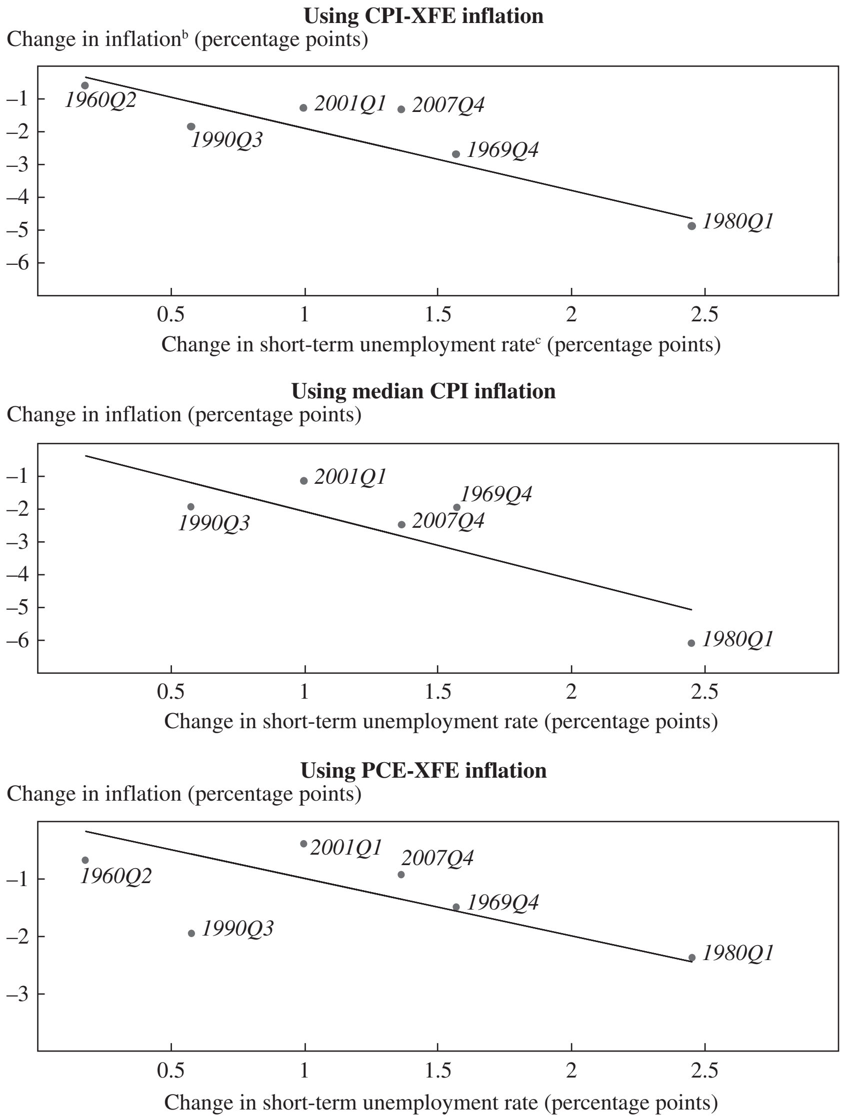
the short-term unemployment recession gap are stable over the three subsamples in table 2, both statistically and economically, and the hypothesis that α is stable cannot be rejected for CPI-XFE when the UC-SV inflation expectation is used (table 2, bottom panel, final four columns).

THE 2004 EPISODE.[5] Inflation picked up sharply in the middle of 2004 despite the sluggish recovery: in 2004Q2, median CPI inflation rose more than 50 basis points even though the CBO unemployment gap was +0.6 percentage point. This increase in the rate of inflation was sustained, and the Federal Reserve put behind it fears of a further "unwelcome fall in inflation" (Bernanke 2003).

The 2004 episode, in particular the data for 2004Q2, plays an important role driving Ball and Mazumder's empirical finding of support for level anchoring, especially the large values of the smoothed estimates of δ in the late 2000s reported in the bottom two panels of their figure 8. These present the estimated path of δ_t from the Kalman smoother, which uses the full dataset. My figure 4 presents both the Kalman smoother estimate and the Kalman filter estimate (the filter uses only data through date *t*, whereas the

5. The ideas in this section stem from communications with Ball and Mazumder. For additional discussion of this episode, see Billi (2009).

Figure 3. The "Williams Puzzle" Using Short-Term Unemployment[a]



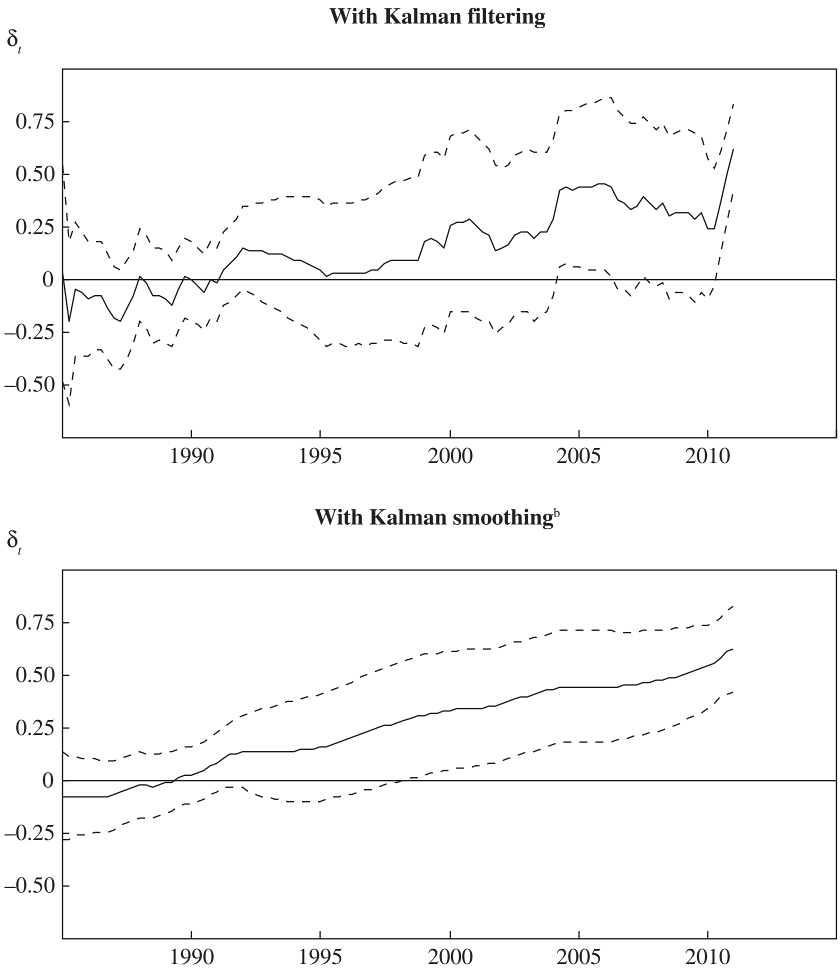
Source: Author's calculations.

a. Each labeled point represents the change in 4-quarter inflation and unemployment from the indicated quarter (a cyclical peak as identified by the Business Cycle Dating Committee of the National Bureau of Economic Research) to 10 quarters thereafter. The figure omits the supply-shock recession that began in 1973Q4 and combines the recessions that began in 1980Q3 and 1981Q3 because those 10-quarter periods overlap. The regression lines are constrained to pass through the origin and are estimated excluding the 2007Q4 recession.

b. Average quarterly rate over the most recent 4 quarters, $\pi_t^4 = (\pi_t + \pi_{t-1} + \pi_{t-2} + \pi_{t-3})/4$.

c. Rate for civilian workers unemployed less than 27 weeks.

Figure 4. Level Anchoring[a]



Sources: Ball and Mazumder (this volume), figure 8, and author's calculations.

a. The figure shows the estimated paths of δ_t, the weight on 2.5 percent annual inflation from Ball and Mazumder's equation 6. The Kalman filter estimate uses only data through date *t*, whereas the Kalman smoother uses the whole dataset.

b. Same as the bottom panel of Ball and Mazumder's figure 8, extended through 2011Q1.

smoother uses the full dataset, that is, is two-sided). Figure 4 also extends the dataset to 2011Q1. Influential observations can be identified by jumps in the filtered estimate of δ_t. A large jump is evident in 2004Q2, indicating that much of the support in the 2000s for level anchoring arises from this observation.[6] Split-sample regressions reinforce this conclusion. When a constant-coefficient version of Ball and Mazumder's equation 6 is estimated for the 5 years 2000Q1–2004Q4, the estimated value of δ is 0.53; for the subsequent 5 years the estimated value of δ falls to 0.25. Evidently, the support for level anchoring is heavily influenced by 2004; from 2005 to 2009, the empirical support for level anchoring diminishes relative to the first half of the decade, so that Phillips curves that ignore level anchoring do better at explaining the 2007–09 period.

CONCLUSION. Ball and Mazumder have written a stimulating and creative paper on a centrally important topic. In my view, they are right on many counts: during the recent recession and its aftermath, inflation has fallen by less than one might initially have expected; notwithstanding this apparent missing disinflation, a clear Phillips relation is evident in these data; and incorporating a modest amount of time variation explains this missing disinflation. It might be that the data are too limited to allow one to ascertain whether this time variation arises through a time-varying expectations formation process or through a direct change in the slope coefficient α. Preliminary results presented in this discussion support Ball and Mazumder's concluding suggestion that the gap might be better measured using short-term unemployment, and more work on this question is warranted. None of these explanations invoke strict level anchoring of expectations.

The real test for the level anchoring theory is just around the corner. Currently, all the unemployment gaps considered here remain positive, with 2011Q1 estimates ranging from +0.6 percentage point for the short-term unemployment rate recession gap to +3.7 percentage points for the CBO unemployment gap. Depending on the gap used, an accelerationist Phillips curve would predict inflation to stabilize at a low rate or to decline further. In contrast, if expectations are anchored at, say, 2 percent, and if these expectations influence price setting, then inflation should begin to climb back to its long-term target value. Recent data hint that such a return to

6. Sbordone and others (2010) reach a similar conclusion about mid-2004 using an approach that seems different from but is actually quite closely related to the simpler approach here. In the context of their model, they interpret mid-2004 as evidence of an increase in the public's perception of the Federal Reserve's inflation target and that, through expectations management, the Fed was able to avoid a slide into deflation.

target is under way; indeed, the final two observations using the Kalman filter in figure 4, for 2010Q4 and 2011Q1, show the sharpest increase yet in the filtered estimate of Ball and Mazumder's δ_t. These most recent data are confounded by sharp energy and food price increases, which might be partially passed through to core inflation, and it is too early to know whether this uptick in inflation is permanent. But there was a return from very low inflation in 2004 despite positive gaps. Whether there will be a second such return will be a test of the expectations anchoring theory in a way that the decline of inflation so far during this episode is not.

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GENERAL DISCUSSION George Perry agreed that a better understanding of the historical Phillips curve and its recent behavior was needed. Although he appreciated the tractability of the authors' model, he believed it had two important problems. One was that it ignored downward nominal wage rigidity, which moderates the effects of high unemployment on inflation and helps explain what is happening today. The other was that the model's unitary elasticity between past and present inflation is not supported by the data except in the high-inflation period around the 1970s. At that time wage setting was dominated by union contracts indexed to inflation, the economy was buffeted by large inflationary shocks from several sources, and inflationary expectations were measurably rising. Because so much of the variance of inflation occurs in those years, they dominate regressions fitted over longer periods that include them. But it is misleading, Perry felt, to use the model to estimate high employment targets or inflation risks at other times, or to assess present developments.

Robert Gordon praised the paper's basic methodology, which was to analyze the performance of equations based on dynamic simulations over a period that excludes the puzzle of the last three years. He went on to compare the paper's results with those of his own triangle model, which had now been exposed to 30 years of additional data. That model differs from the authors' and others both by including four explicit supply shocks—food and energy effects, relative import prices, productivity trend changes, and Nixon-era price control dummies—and by including longer lags on both the unemployment rate and inflation. As the top panel of the authors' figure 1 showed, headline inflation followed a characteristic zigzag in 2008, 2009, and 2010, related to the collapse and then recovery of oil prices. The triangle model simulation mimics that movement and winds up almost exactly on target in 2010. It turned out, Gordon reported, that the key factor in generating these results related to the anchoring of expectations. The unemployment gap pulls inflation down in the last two years, but the six years of lagged