Discussion of Fuhrer, "The Role of Expectations in Inflation Dynamics"

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Rational expectations are at the heart of the DSGE models maintained by central banks. A key equation which governs the evolution of prices in those models is the New Keynesian Phillips (NKPC) curve, in which today's rate of inflation is linked to expected future inflation. Expected future inflation is in turn modeled using rational expectations, which operationally means that forecast errors are unforecastable given current information; this assumption generates the orthogonality condition used to estimate the NKPC parameters by GMM.

Early skeptics of rational expectations, notably Friedman (1979), argued that the information acquisition and processing requirements of rational expectations exceed the capacities of real-world economic actors. Indeed, as Fuhrer (2011) points out in his paper and as I discuss in more detail below, there is ample evidence that even professional forecasts, such as the median inflation forecast from the Survey of Professional Forecasters (SPF), differ from model-based rational expectations forecasts; moreover, SPF forecasts are not rational in the sense that SPF forecast errors are predictable. This raises the question – long overdue in light of Friedman's (1979) early critique – tackled in Fuhrer's paper: what really matters for price setting, rational or other expectations?

Fuhrer's striking finding is that once the SPF forecast of 1-year CPI inflation is included in the NKPC, the coefficient on the rational expectation of future inflation is small and statistically insignificantly different from zero. In short, survey expectations are not rational, and survey expectations are what matter for price setting. The logical consequence of this finding is that it is important to study how the expectations of real people – not a model's rational agents – are actually formed, and in the second part of the paper Fuhrer takes some steps in this direction.

These comments focus primarily on the key empirical evidence on which expectations enter the NKPC. I report some econometric evidence that is consistent with Fuhrer's, however there is substantial difficulty distinguishing between these two expectations measures because of weak identification. I then take a look at SPF forecast errors, which suggest that SPF forecasters act as though there is a less of a Phillips curve gap coefficient than there actually is. These findings underscore the importance of finally pursuing Friedman's (1979) rich set of questions about alternative models of expectations formation and their role in inflation dynamics.

Rational vs. Survey Expectations in the NKPC

I now turn to variations on Fuhrer's NKPC estimates, with an eye on robustness and strength of identification. Fuhrer estimates the NKPC using core CPI inflation, the SPF 1-year ahead CPI inflation forecast, two measures of trend inflation (the Cogley-Sbordone trend and SPF 10-year expectations), and two measures of the output gap (the Gali-Gertler marginal cost series and the CBO unemployment gap). Here, I examine several variations of these regressions, with the aim of assessing the robustness of Fuhrer's main finding that the coefficient on rationally-expected π_{t+1} is small and statistically insignificant. My regressions differ from Furher's in five main ways. First, I use a modified specification in which lagged inflation is replaced by a univariate estimate of trend inflation, constructed using the unobserved components/stochastic volatility model in Stock and Watson (2007). Second, because there is considerable ambiguity about how to measure the output gap, I additionally consider two other measures: the Stock-Watson (2010) so-called "recession gap," which is the deviation of the current unemployment rate from its 12-quarter minimum, and an unemployment gap based on the short-term (< 27 weeks) unemployment rate examined in Stock (2011). Third, because I do not use the 10-year SPF forecast, my regressions start earlier and cover 1982Q1-2010Q4. Fourth, because the SPF forecast is for total CPI, I also consider total CPI instead of core CPI. Fifth, I use GMM estimation instead of the Fuhrer-Olivei (2004) maximum likelihood estimator.

The results are reported in Table 1. The results are generally supportive of those in Fuhrer's Table 2 using the Fuhrer-Olivei (2004) estimator, with considerable weight being placed on the

SPF survey forecast and, in almost all cases, the coefficient on π_{t+1} being statistically insignificantly different from zero. There are, however, several indications that the GMM specifications which include π_{t+1} suffer from weak identification. In particular the first-stage *F*-statistic for π_{t+1} is extremely small, in all cases less than 3, and the GMM estimates using core inflation are all close to the OLS estimates[1]. If identification is weak, the GMM point estimates and confidence intervals are not reliable. One method that is reliable under weak identification is constructing confidence intervals as GMM Anderson-Rubin sets (*S*-sets in the terminology of Stock and Wright (2000)). When this is done for the leading case, model 2 in Table 1, the 90% confidence set includes all economically plausible parts of the parameter space ($\{0 \le \alpha \le 1, -0.50 \le \lambda \le 0.5\}$ in the notation of Table 1). As Fuhrer suggests, this weak identification is a plausible reason for the differences between his (and my) findings and those of Nunes (2010, Table 2). Fuhrer's solution to the weak identification problem is to use the Fuhrer-Olivei (2004) estimator. The motivation for this estimator (imposing the model restrictions to improve precision) is sensible, but as far as I know no formal analysis has been done of this estimator under weak identification. My main conclusion from this analysis is that the amount of information available to pin down the coefficient on π_{t+1} in these regressions is quite limited and that the GMM and ML point estimates and confidence sets (other than the *S*-set) should be viewed with some skepticism, and this question of which expectations matter is in need of additional analysis that is robust to weak instruments.

It is interesting nevertheless to see what happens if one takes the GMM estimates at face value. The final three regressions in Table 1 therefore impose the restriction that the only expectation term appearing in the NKPC is the SPF forecast, as in Roberts (1997). The resulting GMM estimates (which are strongly identified) are remarkably consistent across specifications of the gap, and show coefficients on the SPF forecast around 0.65, coefficients on lagged trend inflation of 0.35, and negative gap coefficients; all estimates are precisely estimated and statistically significant. These specifications underscore the importance of better understanding how SPF forecasts are made.

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[1] When there are many irrelevant instruments in the linear model with homoskedastic serially uncorrelated errors, the GMM estimator concentrates around the OLS estimator.

Empirical Characterization of SPF Forecast Errors

The forecastability of SPF forecast errors is documented by Adam and Padula (2011) and Coibion and Gorodnichenko (2010) and by multiple references therein. At least for the SPF 1-year CPI inflation forecast, there is a rather striking procyclical pattern underlying the violation of forecast rationality.

Figure 1 plots the SPF forecast error (realized inflation minus forecast) and the short-term unemployment gap, with the timing aligned so that at a contemporaneous correlation represents a predictive relation that violates forecast rationality. Evidently there is a strong negative cyclical predictive relation: positive unemployment gaps are associated with negative forecast errors, that is, with SPF forecasts of inflation that are too high.[2] It appears that SPF forecasters understate the Phillips relation, so that inflation overpredicted in recessions and underpredicted in expansions. This is a similar pattern to that found by Zarnowitz and Braun (1993) when they examined earlier data on SPF GNP inflation forecasts and concluded that the forecasters underpredicted increases in inflation and missed disinflationary episodes. What Figure 1 shows is that this is not a simple consequence of optimal forecasts having lower variance than the variable being forecast, instead it appears to be linked to a systematic understatement by the forecasters of the Phillips relation.

Although many explanations for the predictability of SPF forecasts have been proposed, there is no consensus on forecast formation, and Fuhrer's new work on the survey expectations operator is a welcome attempt to provide some structure to forecasts but at the same time to weaken the rational expectations assumption. Work along these lines, in which we attempt to understand how real people make forecasts as called for by Friedman (1979), is long overdue.

[2] The contemporaneous correlation between the SPF forecast error and short-term unemployment gap is -0.36, and the regression coefficient on the gap is significant at the 1% level using Newey-West standard errors.

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Table 1.
Estimates of New Keynesian Phillips Curves, 1982Q1 – 2010Q4

$$\pi_t = (1-\alpha-\beta)\,\pi_{t-1}^{trend} + \alpha\pi_{t+1} + \beta\pi_t^{SPF,1yr} + \lambda\tilde{U}_t + v_t$$

	Inflation measure	Gap series	Estimation method	NKPC coefficients				First-stage F's	
				π_{t-1}^{trend}	π_{t+1}	$\pi_t^{SPF,1yr}$	$\tilde{U}_t$	π_{t+1}	$\tilde{U}_t$
1	Core	CBO	OLS	.217	.237*	.546*	-.095*	–	–
				(.154)	(.089)	(.194)	(.037)		
2	Core	CBO	GMM	.303*	.139	.557*	-.112*	2.39	137.9
				(.109)	(.199)	(.171)	(.031)		
3	Core	recession	GMM	.363*	.026	.611*	-.111*	2.39	530.0
				(.130)	(.238)	(.207)	(.035)		
4	Core	<27 week	GMM	.298*	.340	.632*	-.188*	2.39	278.5
				(.094)	(.166)	(.138)	(.054)		
5	Core	CBO	GMM	.342*	–	.658*	-.120*	–	137.9
				(.091)		(.091)	(.031)		
6	Core	recession	GMM	.333*	–	.667*	-.119*	–	530.0
				(.089)		(.089)	(.031)		
7	Core	<27 week	GMM	.400*	–	.600*	-.213*	–	278.5
				(.095)		(.095)	(.060)		
8	Headline	CBO	OLS	-.069	.128	.941*	-.281*	–	–
				(.236)	(.082)	(.268)	(.031)		
9	Headline	CBO	GMM	.148	.450*	.402*	-.152*	1.65	138.5
				(.122)	(.110)	(.150)	(.059)		

Notes: π_t is measured either by core or headline CPI 1-quarter inflation as indicated in the first column. π_{t-1}^{trend} is the inflation trend component estimated using the Stock-Watson (2007) unobserved components–stochastic volatility (UC-SV) model, $\pi_t^{SPF,1yr}$ is the 1-year ahead SPF median forecast of CPI inflation, and $\tilde{U}_t$ denotes the unemployment gap listed in the second column. GMM estimates use as instruments two lags each of the first difference of the inflation measure used in the specification, the SPF 1-year forecast, the recession gap, and the <27 week unemployment gap, where inflation and SPF forecasts are deviated from the UC-SV trend. Standard errors (in parentheses) and GMM estimates are Newey-West with 8 lags. The final column reports the first-stage F statistic, testing the exclusion restriction on the instruments in the regression of the column endogenous variable on the instruments and $\pi_t^{SPF,1yr}$. The CBO gap is the total unemployment rate minus the CBO NAIRU; the recession gap is the total unemployment rate minus its rolling 12-quarter minimum ($U_t - \min(U_t,\ldots,U_{t-11})$); and the <27 week unemployment gap is the ratio of < 27 week unemployment to the labor force, deviated from a 73-quarter centered moving average (for the moving average, end points are padded using univariate forecasts). *Significant at the 5% level.

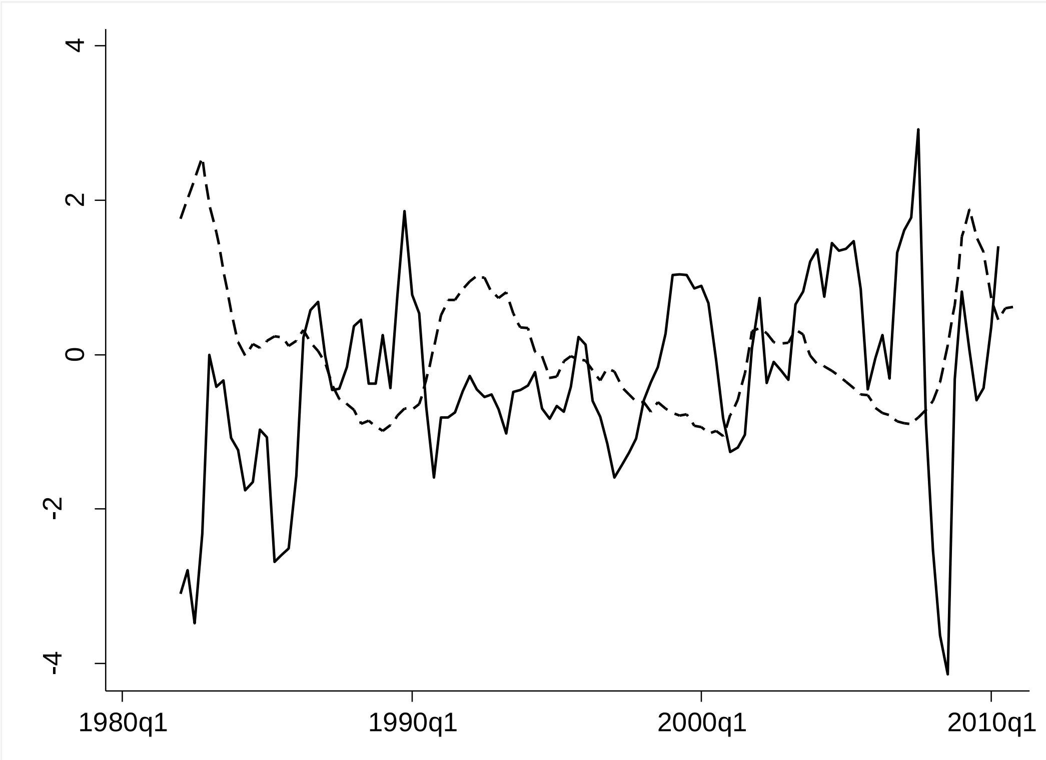

Figure 1. The SPF 1-year head headline CPI forecast error (solid line) and the short-term unemployment gap. The series are aligned so that at a given date the forecast error is the error that will transpire over the next four quarters and the gap is the value of the gap at that date. The forecast error is the actual four-quarter rate of headline CPI inflation over the coming four quarters minus the current SPF forecast of 1-year headline CPI inflation.