Are qualitative inflation expectations useful to predict inflation?

Rolf Scheufele

Halle Institute for Economic Research (IWH)

IFO-INSEE-ISAE Macroeconomic Forecasting Conference
Rom

March, 2009

Motivation of the paper

- Properties of inflation expectations obtained from a qualitative survey

Motivation of the paper

- Properties of inflation expectations obtained from a qualitative survey
- Do inflation expectations predict inflation?

Outline

1. Introduction
2. Measuring inflation expectations
3. Properties of inflation expectations
4. Out-of-sample forecasting experiment
5. Summary

Outline

1. Introduction
2. Measuring inflation expectations
3. Properties of inflation expectations
4. Out-of-sample forecasting experiment
5. Summary

Introduction

Why measures for inflation expectations?

- Theoretical models emphasize the role of expectations (expectations matter!)
- Central banks are guided by inflation expectations
- Matter for private actions (price and wage setting, investment decisions)
- Practical problems:
  - generally unobservable
  - may deviate from model consistent expectations (through learning, sticky information)

Outline

Measuring inflation expectations
Data set

- Monthly survey data from the Center for European Economic Research (ZEW), known as Financial Market Survey
- Covers about 300 experts from banks, insurances and large industrial firms
- Available since the early 1990s
- Experts are asked whether they expect “a rise”, “a decline” or “no change” of the annual inflation rate in the medium term (during the next 6 months)
- Advantages compared to other sources:
  - monthly availability
  - fixed time horizon

Qualitative responses ⇒ quantitative inflation expectations?

- Probability approach (Theil, 1952; Carlson and Parkin, 1976; Berk, 1999)
- General idea: aggregate fractions of survey answers tell something about the magnitude of inflation changes
- But, many untestable assumptions involved:
  - same and known probability distribution across respondents
  - indifference interval (which is the same across individuals and constant over time)
  - ...

Modified Carlson-Parkin Method:

$$E\left(\Delta\pi_{t,t+6}^{12}|\Omega_t\right) = E_t\left(\Delta\pi_{t,t+6}^{12}\right) = -\delta_t\left(\frac{a_t + b_t}{a_t - b_t}\right)$$

- with $a_t = \Phi^{-1}(1 - A_t)$, $b_t = \Phi^{-1}(B_t)$, δ_t a scaling parameter and $\Phi(\cdot)$ the inverse of the probability function of a standard normal distribution
- A_t : aggregate fraction of survey answers with “inflation goes up”
- B_t : aggregate fraction of survey answers with “inflation goes down”

Modified Carlson-Parkin Method:

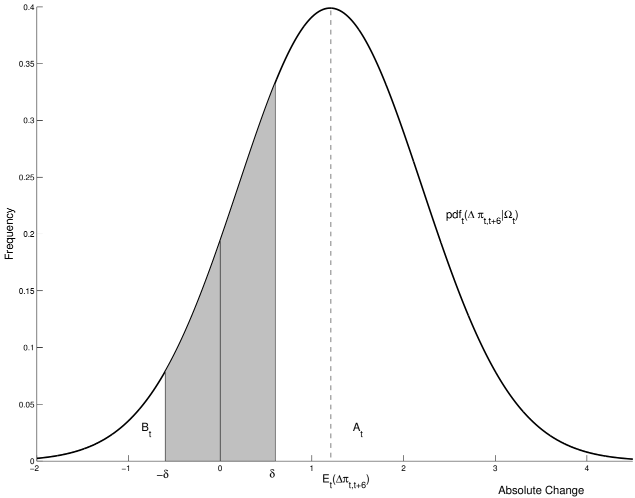
$$E\left(\Delta\pi^{12}_{t,t+6}|\Omega_t\right) = E_t\left(\Delta\pi^{12}_{t,t+6}\right) = -\delta_t\left(\frac{a_t + b_t}{a_t - b_t}\right)$$

- Following Carlson-Parkin: $\delta_t = \delta$ (constant)
- $\hat{\delta}$ is chosen that the average inflation change equals the average change of inflation expectations over the sample period.
- Expected (annual) inflation rate:

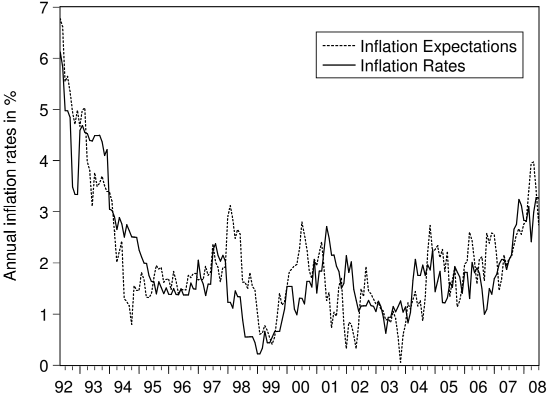
$$E\left(\pi^{12}_{t,t+6}|\Omega_t\right) = E_t\pi^{12}_{t,t+6} = \pi_{t-1} + E_t\left(\Delta\pi^{12}_{t,t+6}\right)$$

- with π_{t-1} the inflation rate of the previous month (since π_t is unknown at t)

Measuring inflation expectations
Quantification



- Expected and realized inflation rates



Outline

Do inflation expectations help to predict inflation?

⇒Granger causality test

Causality hypothesis	Test value	Dist.	p-value
Inflation $\overset{Gr}{\rightarrow}$ Inflation expectations	62.88	$F(9, 183)$	0.00
Inflation expectations $\overset{Gr}{\rightarrow}$ Inflation	4.55	$F(9, 183)$	0.00

Testing the orthogonality assumption

- Idea: The forecasting error $\pi^{12}_{t+6} - E_t\pi^{12}_{t+6}$ should be orthogonal to the (costless) information set available when expectations are formed
- A test can be formulated that checks whether the forecasting error is uncorrelated with past macroeconomic variables
- 3 different variable categories are considered:
  - Real economic activity variables
  - Financial variables
  - Energy prices
- The test is based upon the regression

$$\pi^{12}_{t+6} - E_t\pi^{12}_{t+6} = c + x_t'\beta + u_{t+6}$$

Dependent Variable: $\pi^{12}_{t+6} - E_t\pi^{12}_{t+6}$

	I		II	
Variable	*coef*	*se*	*coef*	*se*
Constant	1.447	(0.22)	0.022	(0.12)
π^{12}_{t-1}	-0.725	(0.12)	–	–
π^{12}_{t-2}	0.219	(0.11)	–	–
$\Delta_{12}r^s_{-1}$	–	–	-0.202	(0.06)
$\Delta_{12}r^s_{-12}$	-0.333	(0.07)	-0.106	(0.06)
$\left(r^l - r^s\right)_{t-7}$	-0.438	(0.11)	–	–
$\left(r^l - r^s\right)_{t-9}$	–	–	-0.230	(0.07)
$\left(r^l - r^s\right)_{t-12}$	-0.209	(0.11)	–	–
$\Delta_{12}p^{raw}_{t-12}$	2.271	(0.28)	–	–
$Ugap_{t-1}$	1.255	(0.12)	–	–
$Ugap_{t-3}$	-0.602	(0.29)	–	–
$\overline{R}^2$	0.56		0.31	
SIC	1.54		1.90	
χ^2-Test	146.2^{***}		49.8^{***}	

Outline

Out-of-sample set up
Ideas

- How do survey expectations perform in forecasting inflation?
- Out-of-sample experiment to assess the relative predictive power of models using survey measures
- Model types: univariate time series models, Phillips curve specifications, term structure models and survey models (Stock and Watson, 1999; Ang, Bakaert and Wei, 2007)
- Model structure:

$$\pi_{t+6}^{6} = \alpha + \beta\left(L^{6}\right)\pi_{t}^{6} + \gamma\left(L\right)x_{t} + u_{t+6}$$

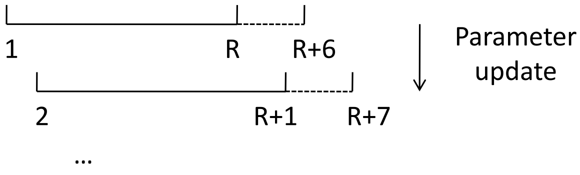
Out-of-sample set up

Models

	Abbr.	Specification (included regressors)
Univariate Time Series Models	AR	π_t^6, π_{t-6}^6
	RW	$1/2\left(\pi_t^6 + \pi_{t-6}^6\right)$
Phillips Curve Models	PC1	π_{t-6}^6, U_{t-2}, *seasonal dummies*
	PC2	π_{t-6}^6, $Ugap_{t-1}$, *seasonal dummies*
	PC3	π_{t-6}^6, $Ogap_{t-1}$, $\Delta iprod_{t-1}$, *seasonal dummies*
Term Structure Models	TS1	π_t^6, r_{t-4}^s, *seasonal dummies*
	TS2	π_{t-6}^6, $(r^l - r^s)_{t-3}$, *seasonal dummies*
	TS3	π_t^6, r_{t-4}^s, $(r^l - r^s)_{t-3}$, *seasonal dummies*
	TS4	π_t^6, π_{t-6}^6, U_{t-2}, U_{t-6}, r_{t-1}^s, r_{t-5}^s, $(r^l - r^s)_{t-1}$, $(r^l - r^s)_{t-6}$, *seasonal dummies*
ZEW inflation expectations	ZEW1	$E_t\pi_{t+6}^6$ (raw data, without estimation)
	ZEW2	$E_t\pi_{t+6}^6$, *constant*
	ZEW3	π_t^6, π_{t-6}^6, $E_t\pi_{t+6}^6$

Out-of-sample experiment

Rolling scheme



- Constant in-sample size R
- P forecast errors
- Total sample $T + 1 = R + P$
- $R = P = 93$

$\Rightarrow$ Guards against moment or parameter drift

Forecast Evaluation

- A symmetric loss function given mean square error (MSE) loss is assumed
- Forecasting models can be ranked due to their root mean squared error (RMSE)
- Test whether these differences are significant:
  - Diebold-Mariano Test (for non-nested models)
  - modified Diebold-Mariano Test (for nested models) as proposed by Clark and West (2005,2006)
  - Giacomini-White (2006) test (for both model types)
- Harvey, Leybourne and Newbold's encompassing test (does a model include additional information not present in the benchmark model?)

$$\hat{e}_t^m = \alpha + \delta \left(\hat{e}_t^m - \hat{e}_t^n \right) + \textit{seasonal dummies}$$

		P-Values				
		Ref: TS2		Ref: ZEW3		Ref: ZEW3
Model	RMSE	DM-Test	GW-Test	DM-Test	GW-Test	ENC-Test
AR	0.9768	0.22	0.24	0.00***,†	0.03**	0.96
RW	1.1824	0.01***	0.01***	0.00***	0.00***	0.70
PC1	0.9450	0.33	0.01***	0.77	0.64	0.29
PC2	0.9336	0.39	0.38	0.86	0.65	0.38
PC3	0.9323	0.11	0.76	0.87	0.69	0.65
TS1	0.9657	0.10*	0.39	0.62	0.99	0.10*
TS2	**0.8922**			0.73	0.73	0.10*
TS3	0.9857	0.08**	0.36	0.44	0.94	0.22
TS4	1.1298	0.01***	0.06**	0.04**	0.02**	0.64
ZEW1	1.2913	0.01***	0.06**	0.01***	0.01***	0.69
ZEW2	0.9823	0.29	0.43	0.14	0.49	
ZEW3	**0.9194**	0.73	0.73			

Outline

Summary

- Rationality is rejected for the ZEW survey
- Granger test indicates that inflation expectations help to predict inflation rates
- Inflation expectations perform well in forecasting inflation (once controlled for serial correlation)
- Experts do not fully take into account information from financial markets
- Model improvements possible

  $\Rightarrow$ Model combination

Thank you!