Term Structure of Inflation Expectations

Discussion by Scott Joslin

MIT Sloan

September 12, 2008

Overview

In this paper:

1. Develop a macro-term structure model incoporating subjective survey forecasts of inflation
2. Find that yields respond to inflation forecasts
3. Inflation foreacasts offers improved performance in yield forecasting
4. Inflation expectations have become more anchored through time resulting in a flat term structure of inflation expecations

Discussion

1. Subjective forecasts
2. Parameter stability
3. Inflation risk premia

Identification of subjective probabilities

The paper supposes that agent subjective measure is equivalent and they perhaps have incorrect beliefs about future inflation.

$$S_{t+1} = AS_t + b + \epsilon^P_{t+1} \quad \text{under } P$$
$$S_{t+1} = A^*S_t + b^* + \epsilon^*_{t+1} \quad \text{under subjective beliefs}$$

where $S_t = \langle \pi_t, g_t, X^1_t, X^2_t \rangle$

Identification of subjective probabilities

The paper supposes that agent subjective measure is equivalent and they perhaps have incorrect beliefs about future inflation.

$$S_{t+1} = AS_t + b + \epsilon^P_{t+1} \quad \text{under } P$$
$$S_{t+1} = A^*S_t + b^* + \epsilon^*_{t+1} \quad \text{under subjective beliefs}$$

where $S_t = \langle \pi_t, g_t, X^1_t, X^2_t \rangle$

They constrain suppose that investors have correct beliefs about the conditional mean of all variables except inflation:

$$A - A^* = \begin{bmatrix} 0 & 0 & 0 & 0 \\ * & * & * & * \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

1. Such restrictions are incompatible with latent states.
   If we replace S_t with

$$\hat{S}_t = \begin{bmatrix} I_2 & 0 \\ R_{21} & R_{22} \end{bmatrix} S_t$$

   then the new state variable will not satisfy the constraint and be observationally equivalent model. (i.e. if I choose a different normalization and impose the constraint, our models wont be equivalent.)

1. Such restrictions are incompatible with latent states.
   If we replace S_t with

$$\hat{S}_t = \begin{bmatrix} I_2 & 0 \\ R_{21} & R_{22} \end{bmatrix} S_t$$

   then the new state variable will not satisfy the constraint and be observationally equivalent model. (i.e. if I choose a different normalization and impose the constraint, our models wont be equivalent.)
2. In principle, even if investors have correct beliefs about inflation at the 1-quarter horizon, they may have incorrect beliefs about inflation at longer horizons

General Issue

1. To know what can be identified for the subjective measures, we must take a stand on what is in the span of the term structure of inflation expectations.

General Issue

1. To know what can be identified for the subjective measures, we must take a stand on what is in the span of the term structure of inflation expectations.
2. Do we believe that knowledge of the data generating process and perfect observation of inflation forecast would reveal all yield and macro information?

General Issue

1. To know what can be identified for the subjective measures, we must take a stand on what is in the span of the term structure of inflation expectations.
2. Do we believe that knowledge of the data generating process and perfect observation of inflation forecast would reveal all yield and macro information? What is the minmial dimensional process that makes π_t Markov under $\mathbb{P}^i$?

General Issue

1. To know what can be identified for the subjective measures, we must take a stand on what is in the span of the term structure of inflation expectations.
2. Do we believe that knowledge of the data generating process and perfect observation of inflation forecast would reveal all yield and macro information? What is the minmial dimensional process that makes π_t Markov under $\mathbb{P}^i$?
3. The issue is the exact same for the $\mathbb{Q}$ measure as the $\mathbb{P}^i$ measure and more interesting.

Parameter Stability

Some of the "No-Forecast" predictions seem counterintuitive. For example, in 2001, the model predicts inflation will rise above 5% in the next year. Why is this?

Parameter Stability

Some of the "No-Forecast" predictions seem counterintuitive. For example, in 2001, the model predicts inflation will rise above 5% in the next year. Why is this?

Let's see if we can replicate this result in less sophisticated ways...

Predictive regressions

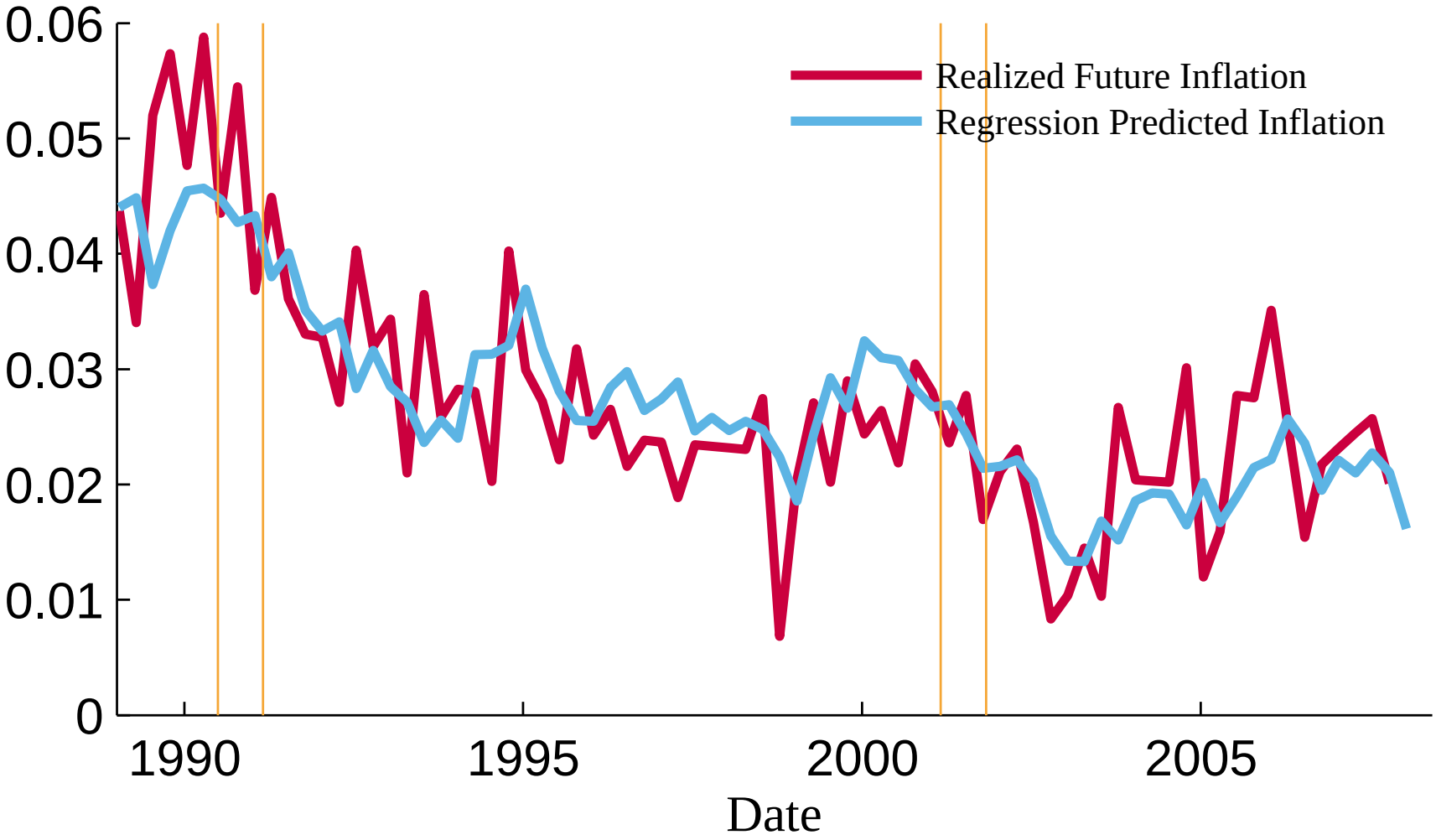
Form a VAR:

$$X_{t+1} = AX_t + b + \epsilon_{t+1}$$

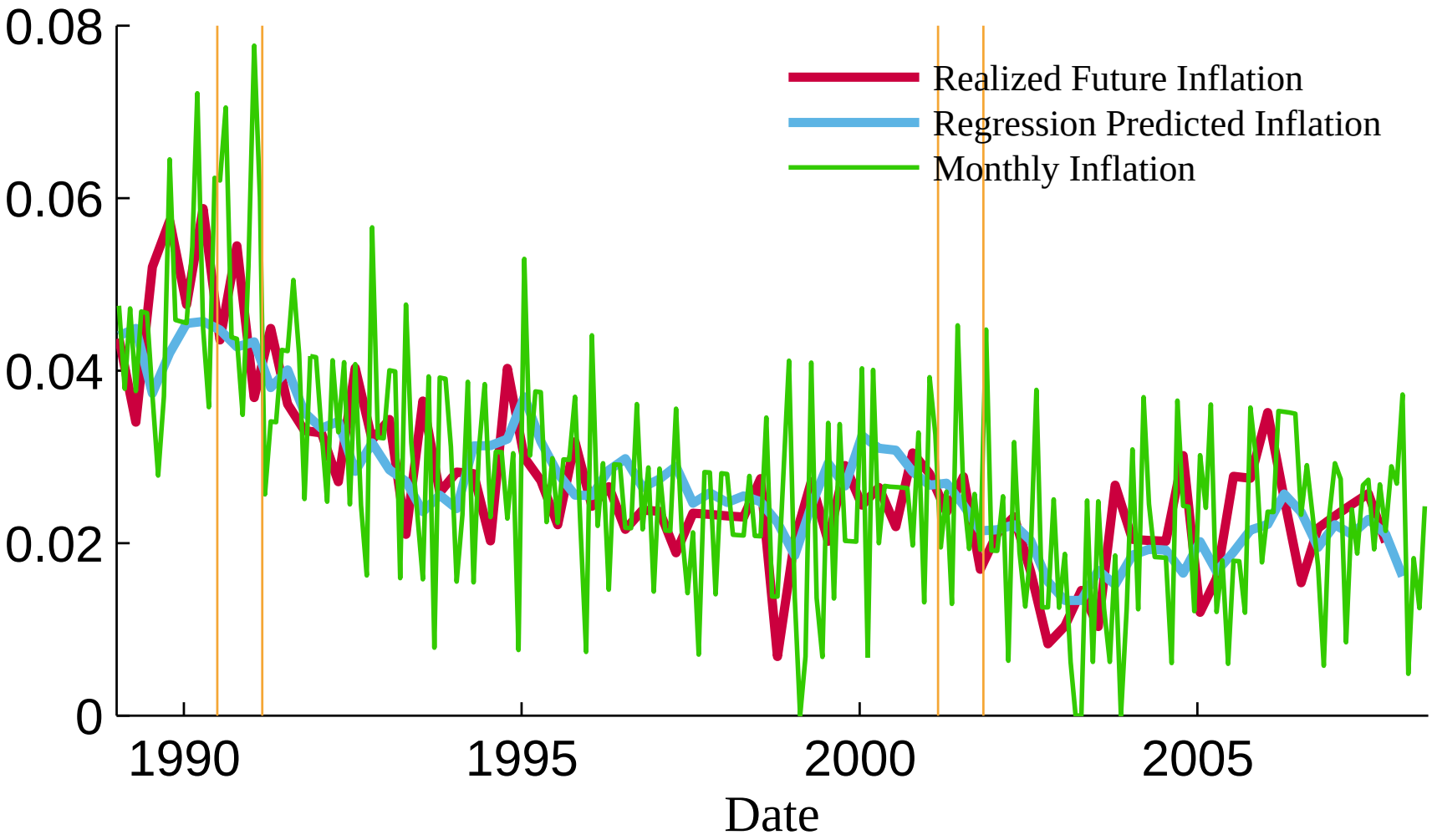
X_t includes:

- CPI inflation
- Industrial production
- First two principal components of zero curve

Predictive Regressions and Swap Data : 1 Quarter Ahead



Predictive Regressions and Swap Data : 1 Quarter Ahead



Aside

The model gives inflation and growth preferred status: they are the only two variables which are observed without error in the estimation.

Aside

The model gives inflation and growth preferred status: they are the only two variables which are observed without error in the estimation.

One could argue these two are the ones observed with the *most* error.

Possible issues

- This framework is too simple and somehow focuses on this moment.
- Swap data is different?
- Short time series $\Rightarrow$ overfit?

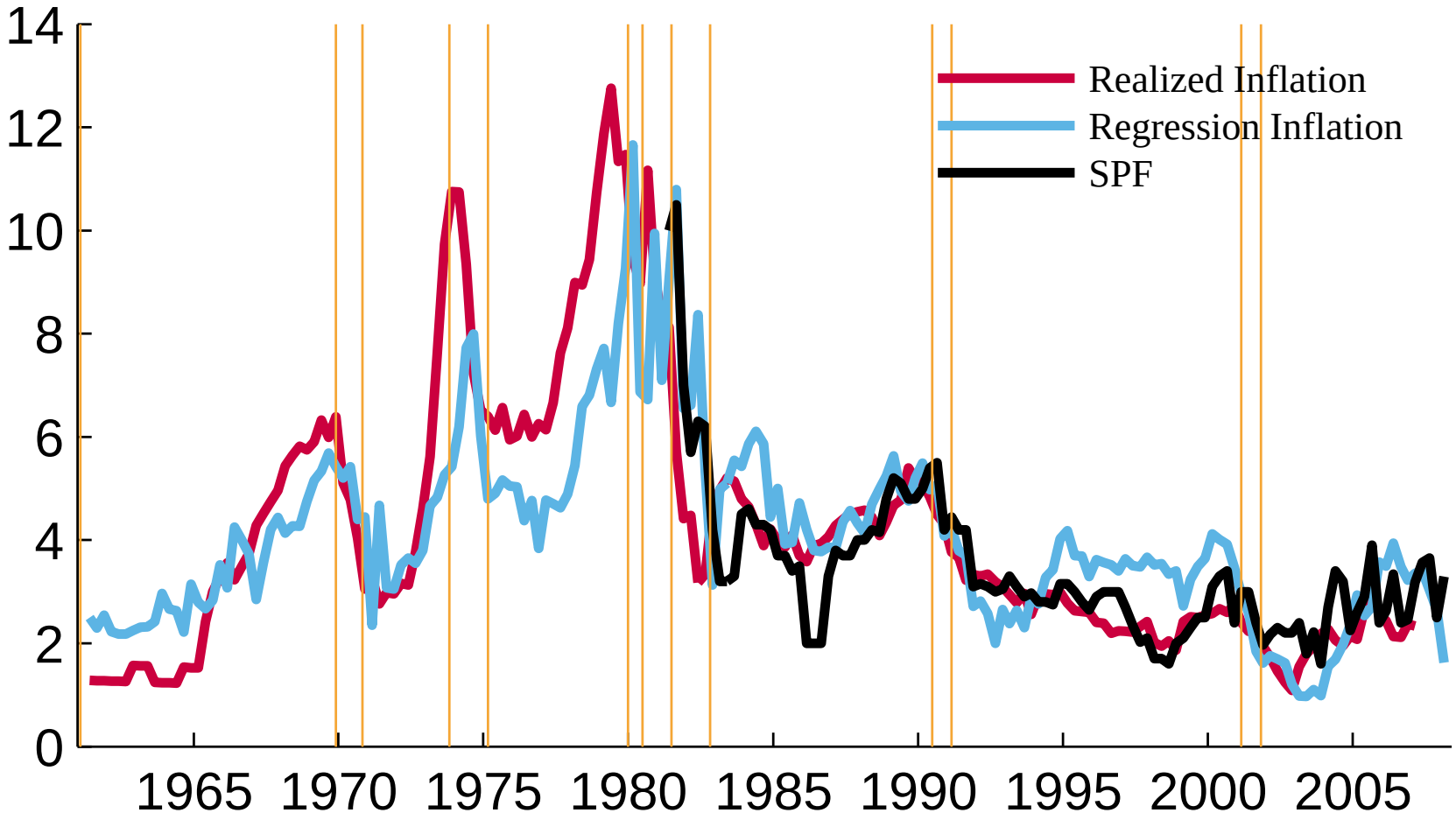
Possible issues

- This framework is too simple and somehow focuses on this moment.
- Swap data is different?
- Short time series $\Rightarrow$ overfit?

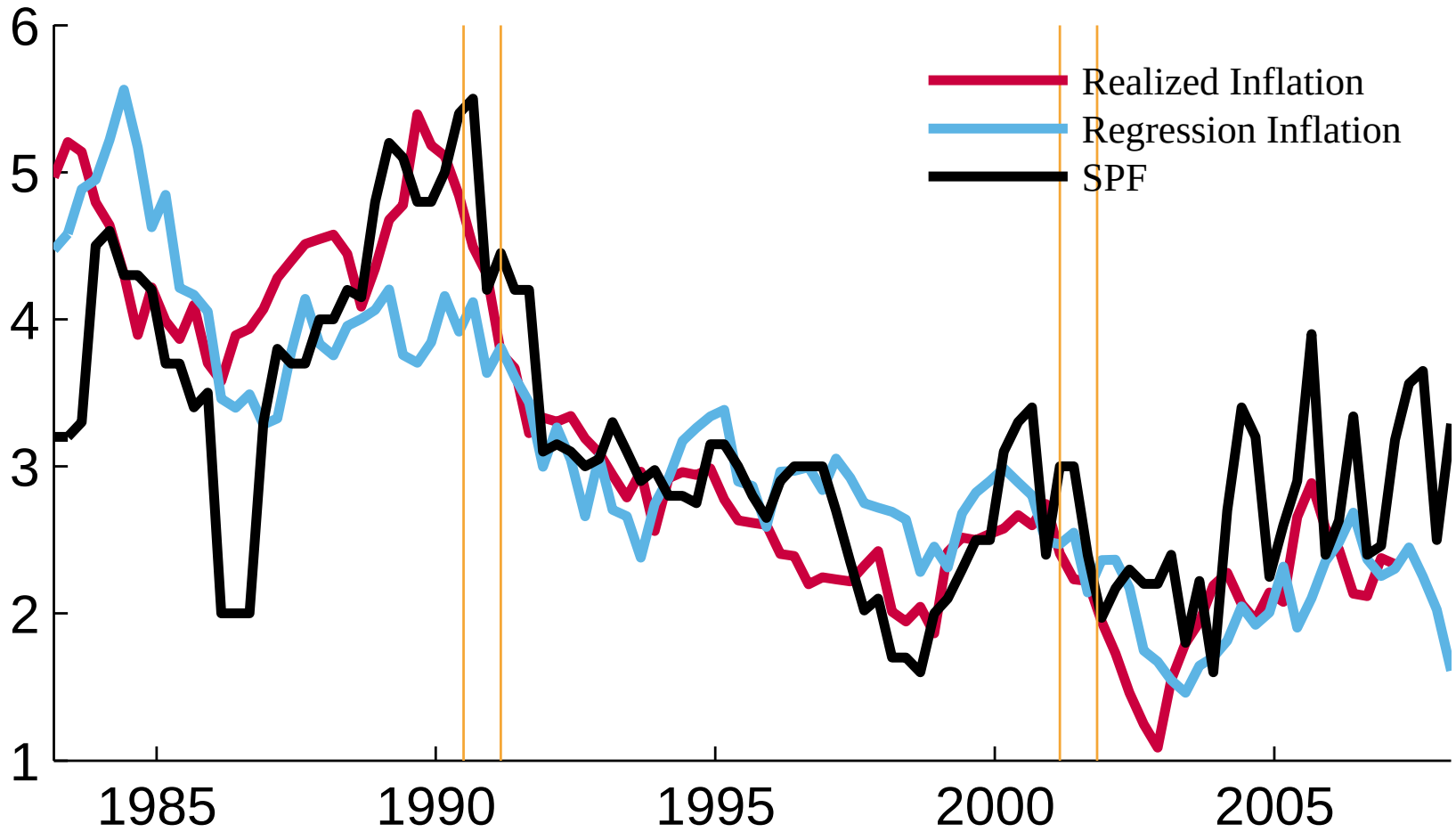
Let's try again with Gurkaynak, Sack, Wright dataset of splined treasury zeros used by Federal Reserve.

- Use PCs for 1- to 7-year zeros to get very long sample

Predictive Regressions and GSW Data : 1 Year Ahead



Post-monetary experiment regression



Regression parameters vary greatly over sample period:

$$S_{t+1} = AS_t + b + \epsilon_t$$

- Loadings for inflation:

	π_t	g_t	$pc_{1,t}$	$pc_{2,t}$
Full	0.608	0.0676	0.0894	-0.434
61-78	0.432	0.0009	0.328	-0.474
83-08	0.34	-0.0211	0.0986	0.0581

Regression parameters vary greatly over sample period:

$$S_{t+1} = AS_t + b + \epsilon_t$$

- Loadings for inflation:

	π_t	g_t	$pc_{1,t}$	$pc_{2,t}$
Full	0.608	0.0676	0.0894	-0.434
61-78	0.432	0.0009	0.328	-0.474
83-08	0.34	-0.0211	0.0986	0.0581

Likelihood ratio tests extremely strongly reject the pre-monetary experiment VAR is the same as the post-monetary experiment VAR.

Regression parameters vary greatly over sample period:

$$S_{t+1} = AS_t + b + \epsilon_t$$

- Loadings for inflation:

	π_t	g_t	$pc_{1,t}$	$pc_{2,t}$
Full	0.608	0.0676	0.0894	−0.434
61-78	0.432	0.0009	0.328	-0.474
83-08	0.34	-0.0211	0.0986	0.0581

Likelihood ratio tests extremely strongly reject the pre-monetary experiment VAR is the same as the post-monetary experiment VAR.

This suggests either a more sophisticated time series model or a more sophisticated learning model.

Inflation Risk Premia

The paper claims to back out inflation risk premia and concludes that they are low and declining.

This requires a key assumption:

Inflation Risk Premia

The paper claims to back out inflation risk premia and concludes that they are low and declining.

This requires a key assumption:

Is inflation must be in the span of yields?

Inflation Risk Premia

The paper claims to back out inflation risk premia and concludes that they are low and declining.

This requires a key assumption:

Is inflation must be in the span of yields?

1. If we believe inflation is spanned by yields, we are fine to compute inflation risk premium.

Inflation Risk Premia

The paper claims to back out inflation risk premia and concludes that they are low and declining.

This requires a key assumption:

Is inflation must be in the span of yields?

1. If we believe inflation is spanned by yields, we are fine to compute inflation risk premium.
2. On the other hand, in this case we just need to figure out the spanning relationship and we can compute inflation premia from bond premia.

Inflation Residuals

If we think the truth is regressing correctly measured inflation on yields won't give a 100% R^2, then there is an unspanned inflation residual.

Inflation Residuals

If we think the truth is regressing correctly measured inflation on yields won't give a 100% R^2, then there is an unspanned inflation residual.

ANY risk neutral process for such a residual is consistent with no arbitrage!

On a high level: only the projection of the pricing kernel on traded asset prices is unique. If M_T is a valid pricing kernel:

$$p_t = E_t[M_T \text{payoff}_T]$$

and ϵ_T is orthogonal to all prices, $M_T + \epsilon_T$ is also a valid pricing kernel.

In Joslin, Priebsch, Singleton (2008) we show how to construct such models and implications for bond premia.

General Suggestions

- Include model parameters in appendix.
- Express RMSE in terms of basis points rather than ratios.
- The 50bp pricing errors in the AO model are a bit unsettling.