Journal of Empirical Finance 17 (2010) 157–167

Contents lists available at ScienceDirect

Journal of Empirical Finance

journal homepage: www.elsevier.com/locate/jempfin

Modeling the dynamics of inflation compensation[☆]

Markus Jochmann [a], Gary Koop [a,*], Simon M. Potter [b]

[a] Department of Economics, University of Strathclyde, United Kingdom
[b] Macroeconomics and Monetary Studies Function, Federal Reserve Bank of New York, United States

ARTICLE INFO

Article history:
Received 20 August 2008
Received in revised form 11 August 2009
Accepted 14 August 2009
Available online 23 August 2009

JEL classification:
E31
C11
G12
G14
E58

Keywords:
Inflation compensation
Bayesian
Nonlinear time series
State space model

ABSTRACT

This paper investigates the relationship between short-term and long-term inflation expectations using daily data on inflation compensation derived from the term structure of real and nominal interest rates. We use a flexible econometric model which allows us to uncover this relationship in a data-based manner. We relate our findings to the issue of whether inflation expectations are anchored, unmoored or contained. Our empirical results indicate no support for either unmoored or firmly anchored inflation expectations. Most evidence indicates that inflation expectations are contained.

1. Introduction

Many decisions in finance and macroeconomics depend on an understanding of how agents form expectations about inflation. In this paper, we shed light on this issue using data on inflation compensation derived from real and nominal U.S. Treasury securities. With some qualifications, one can interpret inflation compensation as a measure of expected inflation. Of particular interest is inflation pass through: how changes in short-term inflation expectations influence long-term expectations. We show how different models of inflation expectations, which we refer to as anchored, unmoored and contained, imply different forms for inflation pass through. We then investigate whether there is empirical support for any of these models. These different models for inflation expectations have strong implications for the possible dynamics of the nominal term structure.

Our empirical work uses a flexible parametric econometric framework developed in Koop and Potter (2007). This framework combines some of the benefits of a nonparametric approach (i.e. it lets the data speak rather than enforcing a parametric, often linear, functional form) with the benefits of a parametric model rooted in the considerations of economic theory. That is, different theoretical models of inflation expectations imply that the inflation pass through coefficient should have various forms. We discuss how, if inflation expectations are anchored, the inflation pass through coefficient should be constant and small (and certainly less than one). Unmoored inflation expectations imply that the pass through coefficient should be near one. However, if inflation expectations are contained, then the magnitude of the pass through coefficient should vary with the level of short-term

[☆] The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of New York or the Federal Reserve System. Markus Jochmann and Gary Koop are Fellows of the Rimini Center for Economic Analysis.

* Corresponding author.
E-mail addresses: Markus.Jochmann@strath.ac.uk (M. Jochmann), Gary.Koop@strath.ac.uk (G. Koop), Simon.Potter@ny.frb.org (S.M. Potter).

0927-5398/$ – see front matter © 2009 Elsevier B.V. All rights reserved.
doi:10.1016/j.jempfin.2009.08.002

inflation expectations in a particular way. Such theoretical considerations can be incorporated in our flexible parametric framework and allow the data to tell us which (if any) specification is preferred.

Our empirical results, using daily data, indicate support for contained inflation expectations. We provide strong evidence that the inflation pass through coefficient is not constant, but does tend to be quite small. These findings are not consistent with either unmoored or anchored inflation expectations, but are consistent with the idea that inflation expectations are contained in some way. The particular theoretical model of contained expectations discussed in this paper suggests that the inflation pass through coefficient should depend on the absolute deviation of short-term inflation expectations from a central value. Furthermore, it should have a certain functional form. We find empirical evidence in support of both these features of this theoretical model. Further, these findings are also consistent with the type of nonlinearity in nominal interest rates first presented in Ait-Sahalia (1996) and suggest the dynamics of inflation as one possible source for the presence of this nonlinearity.

The paper is organized as follows. In the next section we define basic concepts and discuss the implications of various models of inflation expectations for the inflation pass through coefficient. In the third section, we describe and motivate our econometric methods (with technical details available in an appendix). The fourth section presents empirical results and the fifth section concludes.

2. Modeling inflation pass through

In this paper we investigate the relationship between long-term expected inflation (y_t) and short-term expected inflation (x_t) using daily time series data ($t = 1, ..., T$). We use inflation compensation as a measure of these expectations. Appendix B describes the calculation of inflation compensation and motivates our use of $y = ei^{(9,10)}$ and $x = ei^{(2,5)}$ where $ei^{(h1,h2)}$ is the expected inflation between h_1 and h_2.

As a terminological digression, in this paper we informally use the terms expected inflation and inflation compensation (also known as breakeven inflation) interchangeably. Inflation compensation is the compensation that investors require for holding nominal rather than real inflation-indexed bonds. This compensation largely reflects expected inflation (and empirical studies such as ours typically interpret it as such). However, inflation compensation also reflects compensation that investors are demanding for risks associated with the uncertainty about future inflation. But, following most of the literature (e.g. Gurkaynak et al., 2006), we argue that the inflation expectation component will dominate (especially when using differenced data) and simply use the terminology “expected inflation” in this paper.

Knowledge of how agents form inflation expectations is important in many financial decisions. As an extreme example, if agents believed that inflation will forever be kept precisely at a given target, then inflation risk would be zero and nominal bond yields would be exactly equal to real bond yields plus the target. At the other extreme, if agents believe future inflation will evolve according to a random walk then inflation risk will increase with time and will strongly influence the shape of the nominal term structure. Many papers have also emphasized the role of stocks as being a hedge against inflation in strategic (long-run) asset allocation (see, e.g., Fama, 1981, Campbell and Shiller, 1988 and Schotman and Schweitzer, 2000) and insight on how inflation expectations are formed is important to this literature.

As we shall show below, inflation pass through (i.e. how changes in short-term inflation expectations affect long-term expectations) can be used to shed light on how inflation expectations are formed and, thus, sheds light on a crucial issue in financial decision-making and modeling. As a starting point, a simple regression model, of the sort which has been used in the literature (see, e.g., Potter and Rosenberg, 2007), can be used to investigate these issues:

$$\Delta y_t = \beta \Delta x_t + \varepsilon_t, \tag{1}$$

where β is referred to as the pass through coefficient. There are strong theoretical and empirical reasons for thinking that the pass through coefficient might not simply be a constant but might depend on the level of expected inflation or might be varying over time. These reasons motivate the flexible parametric treatment used in this paper which allows for the pass through coefficient to potentially have such properties. Before we describe our statistical model, it is useful to briefly describe some theoretical models of expected inflation (largely taken from Potter and Rosenberg, 2007) and discuss what their implications are for the pass through coefficient. This will allow us to formally define the concepts of anchored, contained and unmoored inflation expectations and help us later when it comes to interpreting our empirical results.

We begin with a standard decomposition of observed inflation (π_t) into permanent (π_t^*) and transitory (c_t) components:

$$\pi_t = \pi_t^* + c_t.$$

It is common to interpret π_t^* as underlying inflation and define it through the properties:

$$E_t(\pi_{t+h}) \rightarrow E_t(\pi_{t+h}^*)$$
$$E_t(c_{t+h}) \rightarrow 0 \text{ as } h \rightarrow \infty.$$

The properties of the pass through coefficient depend on underlying inflation. Potter and Rosenberg (2007) distinguish between anchored, contained and unmoored inflation expectations (and other papers adopt similar terminologies) and work out the implications for the pass through coefficient of several simple theoretical models of the inflation process. Here we briefly summarize some of their results. In this theoretical discussion, we will let $\beta_{h1,h2}$ be the pass through of changes in inflation expectations at horizon h_1 to changes in inflation expectations at horizon h_2 (where h_1 and h_2 are appropriately chosen to be