



Decomposing the declining volatility of long-term inflation expectations

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ABSTRACT

The level and volatility of survey-based measures of long-term inflation expectations have come down dramatically over the past several decades. To capture these changes in inflation dynamics, we embed both short- and long-term expectations into a medium-scale VAR model with stochastic volatility. The model estimates attribute most of the marked decline in the volatility of expectations to smaller shocks to long-run inflation expectations. According to our estimates, the volatility of shocks plummeted in the early to mid-1980s, moved to a somewhat higher level that prevailed for much of the 1990s, and then declined to and remained at very low levels.

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1. Introduction

The level and volatility of survey-based measures of long-term inflation expectations have come down dramatically over the past several decades. In the US, this is apparent by examining survey measures that report expected average inflation over the next 10 years. For example, survey-based expectations of long-term CPI inflation varied between 5.5 and 4 percent from 1982 to 1990. In comparison, they varied between 2.3 and 2.6 percent from 2000 to 2008. From a central bank's standpoint, a low and stable level of long-term expectations produces several desirable benefits. For example, as Ben Bernanke stated in his first speech as Chairman, "When inflation itself is well-controlled, then the public's expectations of inflation will also be low and stable. In a virtuous circle, stable inflation expectations help the central bank to keep inflation low even as it retains substantial freedom to respond to disturbances to the broader economy." To gain insight into this process, this paper examines the sources of the reduced volatility of long-term inflation expectations.

Our empirical approach embeds both short- and long-term expectations into a medium-scale VAR with time-varying parameters (TVP) and stochastic volatility. The set of variables in the VAR includes measures of short- and long-term expectations, inflation, a measure of real economic activity and the federal funds rate. Embedding expectations into a VAR allows us to analyze shocks directly to inflation expectations. For example, shocks to long-term expectations likely reflect movements in the perceived target or long-term inflation goal. These shocks may arise due to central bank communication

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strategies that may, in some instances, affect private sector expectations of inflation. Allowing for time-varying parameters and stochastic volatility allows us to assess the sources of the reduced volatility of long-run inflation expectations.

To assess whether the set of variables and identification strategy captures the salient linkages among expectations, inflation and monetary policy, we begin our analysis with a conventional VAR (with constant parameters and shock variances). With this starting-point specification, we show that a shock to monetary policy that raises the federal funds rate generates a decline in short-term expectations and a more modest decline in long-term expectations. Also, real economic activity and inflation both modestly fall with a three to four quarter lag. These responses are consistent with the results from the VAR in [Leduc et al. \(2007\)](#), which embeds just short-term inflation expectations from the Livingston Survey into a relatively standard VAR.¹ We also find that a shock to long-term expectations produces a significant, commensurate increase in short-term expectations and inflation. In response, monetary policy persistently raises the federal funds rate for several periods. The cumulative increase in the federal funds rate is more than one-for-one with respect to the increase in inflation, as well as to the increase in expected inflation.

We then use a VAR with TVP and stochastic volatility to examine the sources of changes over time in the variability of long-run inflation expectations. Allowing the coefficients of the VAR to vary over time permits us to assess the importance of changes over time in responses of long-run inflation expectations to various shocks. Allowing the shock volatilities to vary allows us to determine their role in the changing volatility of inflation expectations.

The model captures the marked decline in the volatility of long-term expectations and attributes it primarily to smaller shocks to expectations. According to our estimates, the volatility of shocks plummeted in the early to mid-1980s, moved to a somewhat higher level that prevailed for much of the 1990s, and then declined to and remained at very low levels. At the end of the sample in 2008, volatility in long-term expectations is at a very low level, primarily due to smaller shocks to expectations. We interpret these changes as reflecting a shift in monetary policy towards more systematic behavior, which translates into greater stability of the inflation target inferred by the public.

The model also captures broad changes in the volatilities of other variables in the model — sharp declines from 1982 to 2008 for every variable except total inflation. Our estimates show that the greater stability of long-run inflation expectations has helped (albeit modestly) to lower the volatility of short-term inflation expectations and actual inflation. However, smaller shocks to other variables also contributed to the sharp fall in macroeconomic volatility from 1982 to mid-2008. In the latter portion of the sample, the volatility of the innovations for every variable, except total inflation, remains relatively low. The volatility of the inflation innovation, however, rises to its highest level near the end of the sample.

We include in the analysis some important robustness checks. First, we present some estimates from a model using actual inflation measured by core, rather than total, CPI inflation. Second, to provide a further assessment of the roles of coefficient change versus shock volatility change, we report estimates from a model with constant VAR coefficients and stochastic volatility. Making the coefficients constant corroborates our baseline results and emphasizes the role of reduced shock volatility — specifically, smaller shocks to long-run inflation expectations — in accounting for the increased stability of expectations.

Our time-varying parameter and stochastic volatility approach connects to the growing literature that uses Bayesian methods to estimate similar models. For example, U.S. studies such as [Cogley and Sargent \(2005\)](#), [Primiceri \(2005\)](#), and [Cogley et al. \(2010\)](#) allow time-varying parameters and stochastic volatility in trivariate macroeconomic VARs (containing inflation, a measure of economic activity, and a short-term interest rate), for the purposes of assessing changes over time in macroeconomic dynamics. [Benati and Surico \(2008\)](#) consider a similar four-variable model (augmented to include money growth), to assess the sources of the decline in inflation's predictability. In another example, [Canova and Gambetti \(2010\)](#) estimate a time-varying parameter VAR with stochastic volatility for a four-variable model that includes short-term inflation expectations, to assess the role of expectations in the declining volatility of the U.S. economy. Our analysis uses estimation methods similar to these papers, with a key difference being that we focus on a shorter, mostly Great Moderation-period sample and include both short- and long-term expectations.

The paper is organized as follows: Section 2 describes the survey measures of expected inflation. Section 3 describes and reports the results from a benchmark VAR. Section 4 expands the VAR to include time-varying parameters and stochastic volatility. Section 5 presents robustness checks, for core CPI inflation and a VAR with constant parameters but stochastic volatility. Section 6 concludes.

2. Survey-based inflation expectations

To incorporate both short- and long-term expectations of inflation into our analysis, we must use expectations data from two sources. The first is the Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters (SPF).² Respondents to this survey report both 1-year and 10-year ahead forecasts for CPI inflation. The 1-year forecast in period t refers to a forecast of inflation from $t+1$ through $t+4$, made in the middle of quarter t . The 10-year ahead forecast is a projection of the average inflation rate over the next 10 years. For each expectation measure, we use the median forecast from the distribution of respondents.

¹ The [Leduc et al. \(2007\)](#) framework, however, does not include long-term expectations.

² The SPF data is available from the Philadelphia Fed's web site.

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