Journal of Econometrics 167 (2012) 47–60

Contents lists available at SciVerse ScienceDirect

Journal of Econometrics

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

The dynamics of US inflation: Can monetary policy explain the changes?

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ARTICLE INFO

Article history:
Received 6 September 2006
Received in revised form
10 July 2010
Accepted 9 August 2011
Available online 9 November 2011

JEL classification:
E52
E47
C53

Keywords:
New Keynesian model
Bayesian methods
Monetary policy
Inflation dynamics

ABSTRACT

We investigate the relationship between monetary policy and inflation dynamics in the US using a medium scale structural model. The specification is estimated with Bayesian techniques and fits the data reasonably well. Policy shocks account for a part of the decline in inflation volatility; they have been less effective in triggering inflation responses over time and qualitatively account for the rise and fall in the level of inflation. A number of structural parameter variations contribute to these patterns.

1. Introduction

The US economy has gone through a number of important structural changes over the last forty years. For example, the level of inflation and of nominal interest rates shows an inverted U-shaped pattern, rising at the end of the 1970s and falling at the beginning of the 1980s; while the persistence and the volatility of inflation have dramatically declined since the mid-1980s; see e.g. Stock and Watson (2002). These patterns are well documented in the literature. What is still to be determined is the cause of these changes.

The prevailing view suggests that the run-up of inflation occurred because monetary authorities believed that there was an exploitable trade-off between inflation and output. Since output was low following the oil shocks of the 1970s, the temptation to inflate was strong. However, the option of keeping inflation temporarily high was unfeasible: in the medium run, inflation reached a higher level with output settling at its potential. Since the 1980s, central banks learned that the output–inflation trade-off was not exploitable and concentrated on the objective of fighting inflation. A low inflation regime ensued, and the larger predictability of monetary policy made the macroeconomic environment less volatile (see e.g. Sargent (1999), Clarida et al. (2000), and Lubik and Schorfheide (2004)). There are two alternative views as regards this prevailing wisdom: one focuses on "real" causes (see e.g. McConnell and Perez Quiroz (2000), Campbell and Herkovitz (2006)) and the other hinges on "good luck" (see e.g. Bernanke and Mihov (1998), Leeper and Zha (2003), Sims and Zha (2006)) to explain the changes in the level and in the autocovariance function of inflation.

One reason for this heterogeneity of explanations is that the empirical strategy used to study the issue matters. In general, VAR based evidence tends to support the good luck hypothesis; calibration exercises point to real reasons for the changes; and structural econometric analyses favor the idea that monetary policy is responsible for the observed variations (see, e.g., Ireland (2001), Lubik and Schorfheide (2004) and Boivin and Giannoni (2006)). However, while structural VAR exercises allow for time varying coefficients and variances, the evidence produced by more structural calibration or econometric analyses is mostly restricted to arbitrarily chosen subsamples. Because inflation and the nominal rate displayed an inverted U-shaped pattern, subsample evidence may depend on the selected break point. Fernandez Villaverde and Rubio Ramirez (2008) and Justiniano

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[1] The views expressed in this paper do not necessarily reflect those of the Banque de France.

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doi:10.1016/j.jeconom.2011.08.008

and Primiceri (2008) have estimated evolving structural models but their conclusions are only suggestive, because computational complexities force them to consider variations only in a subset of the parameters. Given that one expects important covariations in the evolution of structural parameters, allowing only a subset of the parameters to change may bias inference. Hence, it is of interest to know whether less computationally intensive and yet intuitively appealing structural methods can tell us more about the nature of the changes experienced by US inflation.

This paper provides a step in that direction by estimating a structural model over rolling samples of fixed length with Bayesian techniques. Bayesian methods, which have become popular tools for bringing DSGE models to the data thanks to the work of Smets and Wouters (2003) and Del Negro and Schorfheide (2004) among others, have inferential and computational advantages over traditional limited and full information classical techniques when dealing with models which are known to be a misspecified description of the data. In these situations, unrestricted classical estimates are often unreasonable or on the boundary of the parameter space and tricks must be employed to produce economically sensible estimates. Furthermore, asymptotic standard errors attached to classical estimates – which are constructed assuming that the model is "true" – are meaningless. Rolling samples allow us to use relatively standard techniques to study the nature of the time variations present in interesting parameters while maintaining some form of rationality in the economy and keeping computational costs manageable. For example, in contrast to that of Fernandez Villaverde and Rubio Ramirez (2008), our setup allows the use of Kalman filtering techniques in building the likelihood function and permits time covariations in all the parameters.

The specification that we consider deviates somewhat from what is standard in the literature by allowing money to play a role. The stock of money has been neglected in all recent monetary policy discussions (see e.g. Woodford (2003)) and Ireland (2004) provided some empirical evidence supporting this approach. In our setup real balances can potentially affect the Euler equation and the growth rate of real balances is allowed to enter the monetary policy rule. Since we will use loosely specified but proper priors in the estimation, the data will decide whether these features are important in characterizing the experience. Overall, the statistical fit of the model looks satisfactory, in particular, in comparison with other structural specifications. We estimate the preferred specification a number of times over rolling samples, analyze the time evolution of interesting inflation statistics, measure the contribution of monetary policy to the observed changes and study the evolution of the structural parameters.

Our model captures the fall in inflation volatility over time and attributes part of the changes to monetary policy shocks. We detect level but not shape differences in the transmission of policy shocks which tend to make inflation less reactive to policy disturbances as time goes by. Finally, variations in the level of inflation are qualitatively related to policy shocks: had those been absent, the rise of the 1970s and the fall of 1980s would have been much more modest.

A number of structural changes drive these results. We find support for the conjecture that the Fed had a much stronger dislike for inflation but also notice that in the latest samples the coefficient resembles the one obtained at the beginning of the sample. Moreover, the estimate of the long run coefficient on monetary aggregates has been steadily declining over time. We detect, in agreement with the good luck hypothesis, variations in the posterior mean estimate of the variance of the policy shocks. Nevertheless, as in Sims and Zha (2006), the variations that we discover are typically reversed over time. Finally we also find, in consistency with non-monetary explanations of the facts, that important private sector parameters such as the slope of the Phillips curve and the variability of real demand shocks have significantly changed in the later samples.

In sum, we find, in consistency with the conclusions of Gambetti et al. (2008), that a combination of causes appears to be responsible for the changes in the level and the autocovariance function of US inflation over the last forty years: changes in the variance of the shocks, in the parameters regulating private sector behavior and in the policy rule all more or less contributed to explain why inflation rose and fell, and why inflation volatility subsided.

The rest of the paper is organized as follows. Section 2 describes the model, the estimation technique and the diagnostics used to evaluate the quality of the model's approximation to the data. Section 3 presents estimation results for the full sample. Section 4 reports the time profile of inflation statistics over the rolling samples. Section 5 interprets these time profiles in terms of rolling structural parameter estimates. Section 6 concludes.

2. The framework of the analysis

2.1. The theoretical model

We consider a medium scale model featuring several shocks and frictions. Households maximize a utility function which depends on three arguments (money, consumption and leisure), and money and consumption are potentially non-separable. Labor is differentiated over households, so there is some monopoly over wages. Households allocate wealth between cash and a riskless bond, and bond demand is perturbed by a preference disturbance (as in Smets and Wouters (2007)). Households also rent capital services to firms and decide how much capital to accumulate. As the rental price of capital goes up, the capital stock can be used more intensively according to some schedule cost. There are two kinds of firms: a final good representative firm that aggregates intermediate goods, and a continuum of intermediate producing firms that combine labor and capital in a monopolistic competitive market where price decisions are subject to a Calvo lottery. Prices that cannot be optimally adjusted are assumed to be partially indexed to past inflation. Similarly, in the labor market unions sell differentiated units of labor in a monopolistic competitive environment with a Calvo type scheme. When unions receive positive signals, they are allowed to re-optimize wages; otherwise they adjust wages, indexing them to past inflation. Finally, profits generated from the imperfectly competitive intermediate goods and the labor markets are redistributed to households. The nominal interest rate is controlled by a monetary authority who set it in reaction to inflation, output gap and real balances.

The equations that we employ can be derived from first principles—optimizing and forward looking consumers and firms and general equilibrium considerations. Since derivations of this type exist in the literature (see e.g. Smets and Wouters (2003) and Smets and Wouters (2007)), we simply present the optimality conditions and highlight how they link to the objective functions and the constraints of the agents. The system in log-linear form is

$$\omega_1\theta_t = -c_t + hc_{t-1} - \omega_2 m_t + \omega_2 e_t \tag{1}$$

$$\omega_3 l_t = \theta_t + w_t^{HH} \tag{2}$$

$$\theta_t = -\omega_5 c_t + h\omega_5 c_{t-1} - \omega_4 m_t + \omega_4 e_t - \frac{1}{R-1}(\epsilon_t^b + r_t) \tag{3}$$

$$z_t = a'/a'' r_t^k \tag{4}$$

$$k_t^s = z_t + k_{t-1} \tag{5}$$

$$k_t^s = w_t + l_t - r_t^k \tag{6}$$

$$mc_t = (1-\alpha)w_t + \alpha r_t^k - \epsilon_t^a \tag{7}$$