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In 2009 all ECB publications feature a motif taken from the €200 banknote.

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Abstract

Following Fuhrer and Moore (1995), several authors have proposed alternative mechanisms to 'hardwire' inflation persistence into macroeconomic models, thus making it structural in the sense of Lucas (1976). Drawing on the experience of the European Monetary Union, of inflation-targeting countries, and of the new Swiss monetary policy regime, I show that, in the Phillips curve models proposed by Fuhrer and Moore (1995), Gali and Gertler (1999), Blanchard and Gali (2007), and Sheedy (2007), the parameters encoding the 'intrinsic' component of inflation persistence are not invariant across monetary policy regimes, and under the more recent, stable regimes they are often estimated to be (close to) zero. In line with Cogley and Sbordone (2008), I explore the possibility that the intrinsic component of persistence many researchers have estimated in U.S. post-WWII inflation may result from failure to control for shifts in trend inflation. Evidence from the Euro area, Switzerland, and five inflation-targeting countries is compatible with such hypothesis.

Keywords: New Keynesian models, inflation persistence, Bayesian estimation.

JEL Classification: E30, E32

Non Technical Summary

Since Fuhrer and Moore (1995) first documented the inability of New Keynesian Phillips curve models to replicate the high inflation persistence found in post-WWII U.S. data, building such persistence into macroeconomic models has been high on the macroeconomic research agenda. From Fuhrer and Moore (1995) to Sheedy (2007), several authors have proposed alternative mechanisms to build inflation persistence as a deep, structural feature of the economy, and, as such, largely invariant to changes in monetary policy.

In previous work—see Benati (2008)—it has been documented how estimates of the indexation parameter in hybrid New Keynesian Phillips curves *a-là*-Christiano, Eichenbaum, and Evans (2005) and Smets and Wouters (2003) are either equal to zero, or very low, in all inflation targeting countries; in the Euro area, Germany, Italy, and France under European Monetary Union; and in Switzerland under the new (i.e, post-1999) monetary regime. Although uniquely pertaining to hybrid New Keynesian Phillips curve models featuring indexation, those results nonetheless question the notion that the intrinsic component of inflation persistence many researchers have found in post-WWII U.S. inflation dynamics truly is structural in the sense of Lucas (1976), and naturally suggest that *all* Phillips curve models featuring intrinsic inflation persistence may suffer from the same problem.

This paper applies the same approach of Benati (2008)—i.e., estimating intrinsic inflation persistence specifications under alternative monetary regimes—to the models proposed by Fuhrer and Moore (1995), Gali and Gertler (1999), Blanchard and Gali (2007), and Sheedy (2007). Drawing on the experience of the European Monetary Union, of inflation-targeting regimes, and of the new Swiss monetary policy regime, it is shown that in these models,

(1) the parameters encoding the intrinsic component of inflation persistence are not invariant across monetary policy regimes, and

(2) under the more recent, stable regimes they are often estimated to be (close to) zero.

Taken together with the previous results based on models with indexation *a-là*-Christiano, Eichenbaum, and Evans (2005) and Smets and Wouters (2003), these findings question the *meaningfulness* of 'intrinsic inflation persistence' models, and suggest that the intrinsic component of inflation persistence many researchers have estimated in post-WWII U.S. inflation dynamics might well be the figment of a specification error. In line with Cogley and Sbordone (2008), the paper then explores the possibility that such error may stem from failing to control for shifts in trend inflation. Overall, evidence from the Euro area, Switzerland, and five inflation-targeting countries provides support for such hypothesis.

It is therefore concluded that

(i) intrinsic inflation persistence models are *not* structural in the sense of Lucas (1976), as they fail to successfully describe, conditional on a *single* parameterisation,

the dynamics of inflation under alternative monetary policy regimes. The very fact that such models have been specifically designed to capture and reproduce the highly persistent inflation fluctuations typical of the period comprising the Great Inflation episode—a period characterised by large shifts in equilibrium (i.e., trend) inflation—makes them all but incapable of successfully describing, conditional on the very same parameterisation, inflation dynamics under monetary regimes in which inflation does not exhibit a significant extent of low-frequency variation.

(ii) On the other hand, New Keynesian models log-linearised around a time-varying, non-zero trend inflation, and featuring no intrinsic inflation persistence, appear capable of successfully describing (the evolution of) inflation dynamics across different monetary policy regimes, so that this class of models appears to offer the possibility of identifying a model of inflation dynamics which is truly structural in the sense of Lucas (1976).

1 Introduction

Since Fuhrer and Moore (1995) first documented the inability of New Keynesian Phillips curve models to replicate the high inflation persistence found in post-WWII U.S. data,[1] 'hardwiring' such persistence into macroeconomic models has been high on the macroeconomic research agenda. From Fuhrer and Moore (1995) to Sheedy (2007), several authors have proposed alternative mechanisms to build inflation persistence as a deep, structural feature of the economy, and, as such, largely invariant to changes in monetary policy.[2]

In previous work—see Benati (2008)—I have documented how estimates of the indexation parameter in hybrid New Keynesian Phillips curves *a-là*-Christiano, Eichenbaum, and Evans (2005) and Smets and Wouters (2003) are either equal to zero, or very low, in all inflation targeting countries; in the Euro area, Germany, Italy, and France under European Monetary Union; and in Switzerland under the new (i.e, post-1999) monetary regime. Although uniquely pertaining to hybrid New Keynesian Phillips curve models featuring indexation, these results nonetheless question the notion that the intrinsic component of inflation persistence many researchers have found in post-WWII U.S. inflation dynamics truly is structural in the sense of Lucas (1976), and naturally suggest that *all* Phillips curve models featuring intrinsic inflation persistence may suffer from the same problem.

In this paper I apply the same approach of Benati (2008)—i.e., estimating intrinsic inflation persistence specifications under alternative monetary regimes—to the models proposed by Fuhrer and Moore (1995), Gali and Gertler (1999), Blanchard and Gali (2007), and Sheedy (2007).[3] Drawing on the experience of the European Monetary Union, of inflation-targeting regimes, and of the new Swiss monetary policy regime, I show that—in line with my previous work—in these models,

- the parameters encoding the intrinsic component of inflation persistence are not invariant across monetary policy regimes, and
- under the more recent, stable regimes they are often estimated to be (close to) zero.

Taken together with my previous results, these findings question the *meaningfulness* of 'intrinsic inflation persistence' models, and suggest that the intrinsic component of inflation persistence many researchers have estimated in post-WWII U.S.

[1] On this, see also the extensive discussion in Nelson (1998).

[2] See in particular Fuhrer and Moore (1995), Gali and Gertler (1999), Christiano, Eichenbaum, and Evans (2005), Smets and Wouters (2003), Blanchard and Gali (2007), and Sheedy (2007).

[3] An obvious question is why not also considering another prominent model featuring intrinsic inflation persistence, the 'sticky information' model of Mankiw and Reis—see Mankiw and Reis (2002) and Mankiw and Reis (2007). Although my original plan for the present work also included Mankiw and Reis' model, I have decided to put that material into a separate paper uniquely devoted to an analysis of several issues pertaining sticky information models.

inflation dynamics might well be the figment of a specification error. In line with Cogley and Sbordone (2008), I then explore the possibility that such error may stem from failing to control for shifts in trend inflation. Overall, evidence from the Euro area, Switzerland, and five inflation-targeting countries provides support for such hypothesis.

I therefore conclude that

- intrinsic inflation persistence models are *not* structural in the sense of Lucas (1976), as they fail to successfully describe, conditional on a *single* parameterisation, the dynamics of inflation under alternative monetary policy regimes. The very fact that such models have been specifically designed to capture and reproduce the highly persistent inflation fluctuations typical of the period comprising the Great Inflation episode—a period characterised by large shifts in equilibrium (i.e., trend) inflation—makes them all but incapable of successfully describing, conditional on the very same parameterisation, inflation dynamics under monetary regimes in which inflation does not exhibit a significant extent of low-frequency variation.

- On the other hand, New Keynesian models log-linearised around a time-varying, non-zero trend inflation, and featuring no intrinsic inflation persistence, appear capable of successfully describing (the evolution of) inflation dynamics across different monetary policy regimes, so that this class of models appears to offer the possibility of identifying a model of inflation dynamics which is truly structural in the sense of Lucas (1976).

The paper is organised as follows. The next section discusses the intrinsic inflation persistence models considered in the present work, whereas Section 3 motivates and discusses the Bayesian econometric methodology adopted herein. Section 4 discusses the evidence from estimation of the structural persistence models. Section 5 estimates—in the spirit of Cogley and Sbordone (2008)—a standard New Keynesian model log-linearised around a time-varying non-zero trend inflation. Section 6 concludes.

2 Alternative Models of Intrinsic Inflation Persistence

This section briefly reviews the main features of the 'intrinsic inflation persistence' models we analyse in this paper.

2.1 Phillips curve models

2.1.1 Fuhrer and Moore (1995)

By defining the logarithms of the nominal contract wage and of the overall price level as x_t and p_t, respectively, Fuhrer and Moore (1995) proposed the following contracting specification, in which 'agents care about *relative* real wages over the life of the wage contract':[4]

$$x_t - p_t = \frac{1}{2}[(x_{t-1} - p_{t-1}) + (x_{t+1|t} - p_{t+1|t})] + \gamma y_t \tag{1}$$

where y_t is a measure of excess demand, and $z_{t+1|t}$ is the expectation of variable z_{t+1} conditional on information available at time t. Since a key goal of the present work is to show that this specification is not structural in the sense of Lucas (1976)—as the weights on past and future expected real wages in (1) are not invariant to changes in the monetary regime—we replace (1) with

$$x_t - p_t = \alpha(x_{t-1} - p_{t-1}) + (1-\alpha)(x_{t+1|t} - p_{t+1|t}) + \gamma y_t \tag{2}$$

with 0$\leq \alpha \leq$1. By postulating, as in Fuhrer and Moore (1995), a mark-up of prices over wages equal to one, (2) immediately leads to the Phillips curve model

$$\pi_t = \alpha\pi_{t-1} + (1\text{-}\alpha)\pi_{t+1|t} + \kappa(y_t{+}y_{t-1}) - (1\text{-}\alpha)\eta_t^\pi \tag{3}$$

where π_t is inflation, and $\eta_t^\pi \equiv \pi_t\text{-}\pi_{t|t-1}$ is a forecast error.

2.1.2 Gali and Gertler (1999)

Gali and Gertler (1999) postulated that the economy is populated by two kinds of firms. A fraction (1-ω) is fully forward-looking, and behaves as the firms in the traditional Calvo model, setting prices optimally given the constraint on the timing of adjustment deriving from the Calvo 'lottery'. The remaining firms, on the other hand, are backward-looking, and in each period reset prices based on a simple rule of thumb based on the recent history of past inflation. Gali and Gertler (1999) show that, under this specification, aggregate inflation dynamics is described by

$$\pi_t = \lambda mc_t + \gamma_b\pi_{t-1} + \gamma_f\pi_{t+1|t} \tag{4}$$

where mc_t is the log-deviation of real marginal cost from the value taken in a non-stochastic steady-state with zero trend inflation, and $\lambda \equiv$(1-ω)(1-θ)(1-$\beta\theta$)ϕ^{-1}, $\gamma_b \equiv \omega\phi^{-1}$, $\gamma_f \equiv \beta\theta\phi^{-1}$, $\phi \equiv \theta$+ω[1-θ(1-β)], where θ is the Calvo parameter (i.e., the probability of keeping the price unchanged), and β is the subjective rate of time preference.

[4] Fuhrer and Moore (1995, page 129).

2.1.3 Blanchard and Gali (2007)

Blanchard and Gali (2007) show that the introduction of real wage rigidities into an otherwise entirely standard New Keynesian Phillips curve framework gives rise to the following equation for aggregate inflation dynamics

$$\pi_t = \beta\pi_{t+1|t} + \frac{\lambda}{1 - \varkappa L} x_{2t} \tag{5}$$

where L is the lag operator—i.e. Lz_t=z_{t-1}—$\varkappa$ is a parameter encoding the extent of real wage rigidity, and x_{2t} is a function of the output gap,

$$x_{2t} = (1\text{-}\alpha)^{-1}[(1\text{-}\varkappa)(1\text{+}\phi)y_t + \alpha\varkappa(y_t\text{-}y_{t-1})] \tag{6}$$

with y_t being the output gap, (1-α) being the labor share, and ϕ being the labor supply elasticity. In what follows we set α to 2/3, and—following Ascari and Ropele (2007)—we calibrate ϕ to 1.

2.1.4 Sheedy (2007)

The key idea behind Sheedy (2007) is to relax a peculiar (and unattractive) feature of the Calvo model, i.e. that a firm's probability of changing its price is independent of the time the price was last changed. Sheedy (2007) shows that, by replacing this assumption with the reasonable alternative one that new prices are 'stickier' than older ones—i.e., the probability of a price being changed is higher the longer the price has stayed unchanged—a standard framework with fully forward-looking firms produces the backward- and forward-looking Phillips curve

$$\pi_t = \sum_{i=1}^{N} \gamma_i \pi_{t-i} + \sum_{i=1}^{N+1} \delta_i \pi_{t+i|t} + \kappa_x mc_t \tag{7}$$

where the γ_i's and the δ_i's are the coefficients on lagged and expected inflation, respectively, κ_x is the Phillips curve slope, and N is the order of the recursion defining the price-adjustment probabilities $\{\alpha_i\}_{i=1}^{\infty}$, with

$$\alpha_i = \alpha + \sum_{j=1}^{\mathrm{Min}(i-1,N)} \psi_j \left[\prod_{k=i-j}^{i-1} (1-\alpha_k)\right]^{-1} \tag{8}$$

with α_i>0 for all i = 1, 2, 3 ..., and with the corresponding survival probabilities $\{\varsigma_i\}_{i=1}^{\infty}$, with

$$\varsigma_i = (1-\alpha)\varsigma_{i-1} - \sum_{i=1\psi j}^{\mathrm{Min}(i-1,N)} \varsigma_{i-1-j} \tag{9}$$

with ς_i=1. Expressions for κ_x, the the γ_i's and the δ_i's as functions of α and the ψ_i's can be found in appendix A.6 of Sheedy (2007). With N=1, the case that will be considered herein, we have $\gamma_1 \equiv \psi_1\{1\text{-}\alpha\text{-}\psi_1[1\text{-}\beta(1\text{-}\alpha)]\}^{-1}$, $[\delta_1, \delta_2]' \equiv [\beta(1\text{+}(1\text{-}\beta)\gamma_1), \text{-}\beta^2\gamma_1]'$, and $\kappa_x \equiv \eta_{cx}(\alpha\text{+}\psi_1)[1\text{-}\beta(1\text{-}\alpha)\text{+}\beta^2\psi_1]\{1\text{-}\alpha\text{-}\psi_1[1\text{-}\beta(1\text{-}\alpha)]\}^{-1}$.

2.2 Closing the Phillips curve models

We add a white noise disturbance $\epsilon_{\pi,t} \sim WN(0, \sigma_\pi^2)$ to the Phillips curve equations (3), (4), (5), and (7),[5] and we close the models by adding a monetary policy rule and an intertemporal IS curve. Monetary policy is described by a standard Taylor rule with smoothing,

$$R_t = \rho R_{t-1} + (1-\rho)[\phi_\pi \pi_t + \phi_y y_t] + \epsilon_{R,t}, \qquad \epsilon_{R,t} = \rho_R \epsilon_{R,t-1} + \tilde{\epsilon}_{R,t} \tag{10}$$

where $\epsilon_{R,t}$ is a monetary policy disturbance, whereas the backward- and forward-looking intertemporal IS curve is given by

$$y_t = \gamma y_{t+1|t} + (1-\gamma) y_{t-1} - \sigma^{-1}(R_t - \pi_{t+1|t}) + \epsilon_{y,t}, \qquad \epsilon_{y,t} = \rho_y \epsilon_{y,t-1} + \tilde{\epsilon}_{y,t} \tag{11}$$

where γ is the weight of the forward-looking component, σ is the inverse of the elasticity of intertemporal substitution in consumption, and $\epsilon_{y,t}$ is an AR(1) disturbance.

2.3 Encoding intrinsic inflation persistence

Irrespective of the differences between their specifications, the four models considered herein share one common feature: in each model, a *single* parameter—α in Fuhrer and Moore (1995), ω in Gali and Gertler (1999), $\varkappa$ in Blanchard and Gali (2007), and ψ_1 in Sheedy (2007)—encodes the intrinsic component of inflation persistence. In what follows, our analysis will therefore focus on whether such parameter is structurally stable across alternative monetary regimes, or whether, instead, its variation across regimes exhibits a systematic pattern.

3 Bayesian Estimation

We estimate all models *via* Bayesian methods. Our preference for a Bayesian approach within the present context—as opposed to either the use of Classical methods, or GMM single-equation estimation of the Phillips curve models—is extensively discussed in Benati (2008, Section II.B). Specifically, on the one hand, based on our experience, pure maximum likelihood tends to produce, within the present context, fragile results. On the other hand, we eschew GMM single-equation estimation because the quality of the instruments, and therefore the reliability of the estimates, is in principle not independent of monetary policy, and on the contrary is crucially affected by it. Intuitively, under monetary regimes which are very successful at stabilising inflation—like European Monetary Union, inflation targeting regimes, and

[5] By imposing the white noiseness of $\epsilon_{\pi,t}$ as in Benati (2008) we are essentially 'stacking the cards against ourselves', thus forcing *all* existing persistence to be absorbed by the structural component. Our key result of (near) absence of structural persistence under EMU, inflation-targeting, the new Swiss monetary regime will therefore be all the more striking.

the new Swiss regime—the quality of the instruments for inflation should be logically expected to be low, for the simple reason that any information such variables may contain on future inflation fluctuations will be used by the monetary authority to move interest rates in order to counter deviations of inflation from equilibrium. As a consequence, these variables will exhibit, *ex post*, little informational content, precisely because the monetary authority has already exploited part or all of such information to keep inflation under control.[6] So, given the lack of reliability, in principle, of GMM estimates within the present context, and the previously mentioned fragility or results based on FIML, we regard a full-information Bayesian approach as the only valid alternative left.

Following, e.g., Lubik and Schorfheide (2004) and An and Schorfheide (2007), all structural parameters are assumed, for the sake of simplicity, to be *a priori* independent from one another. Table 1 reports the parameters' prior densities, together with two key objects characterising them, the mode and the standard deviation. For each of the parameters which, within the four models, encode the intrinsic component of inflation persistence, we adopt a perfectly flat (i.e., uniform) prior.

We numerically maximise the log posterior—defined as $\ln L(\theta|Y) + \ln P(\theta)$, where θ is the vector collecting the model's structural parameters, $L(\theta|Y)$ is the likelihood of θ conditional on the data, and $P(\theta)$ is the prior—*via* simulated annealing.[7] We then generate draws from the posterior distribution of the model's structural parameters *via* the Random Walk Metropolis (henceforth, RWM) algorithm as described in, e.g., An and Schorfheide (2007). In implementing the RWM algorithm we exactly follow An and Schorfheide (2006, Section 4.1), with the single exception of the method we use to calibrate the covariance matrix's scale factor—the parameter c below—for which we follow the methodology described in Appendix D.2 of Benati (2008).[8]

[6] This point, which is conceptually in line with Woodford (1994), is extensively analysed by Sophocles Mavroeidis in two recent papers—see Mavroeidis (2004) and Mavroeidis (2005).

[7] Following Goffe, Ferrier, and Rogers (1994) we implement simulated annealing *via* the algorithm proposed by Corana, Marchesi, Martini, and Ridella (1987), setting the key parameters to T_0=100,000, r_T=0.9, N_t=5, N_s=20, $\epsilon=10^{-6}$, N_ϵ=4, where T_0 is the initial temperature, r_T is the temperature reduction factor, N_t is the number of times the algorithm goes through the N_s loops before the temperature starts being reduced, N_s is the number of times the algorithm goes through the function before adjusting the stepsize, ϵ is the convergence (tolerance) criterion, and N_ϵ is number of times convergence is achieved before the algorithm stops. Finally, initial conditions were chosen stochastically by the algorithm itself, while the maximum number of functions evaluations, set to 1,000,000, was never achieved.

[8] In a nutshell, Benati's (2008) idea is to estimate a reasonably good approximation to the inverse relationship between c and the acceptance rate by running a pre-burn-in sample. Specifically, let C be a grid of possible values for c—in what follows, we consider a grid over the interval [0.1, 1] with increments equal to 0.05. For each single value of c in the grid—call it c_j—we run n draws of the RWM algorithm, storing, for each c_j, the corresponding fraction of accepted draws, f_j. We then fit a third-order polynomial to the f_j's *via* least squares, and letting $\hat{a}_0$, $\hat{a}_1$, $\hat{a}_2$, and $\hat{a}_3$ be the estimated coefficients, we choose c by solving numerically the equation $\hat{a}_0+\hat{a}_1c+\hat{a}_2c^2+\hat{a}_3c^3$=0.23. (As found, e.g., in Gelman, Carlin, Stern, and Rubin (1995), 0.23 is the ideal fraction of accepted draws in high dimensions.)

Let then $\hat{\theta}$ and $\hat{\Sigma}$ be the mode of the maximised log posterior and its estimated Hessian, respectively.[9] We start the Markov chain of the RWM algorithm by drawing $\theta^{(0)}$ from $N(\hat{\theta}, c^2\hat{\Sigma})$. For $s = 1, 2, ..., N$ we then draw $\tilde{\theta}$ from the proposal distribution $N(\theta^{(s-1)}, c^2\hat{\Sigma})$, accepting the jump (i.e., $\theta^{(s)} = \tilde{\theta}$) with probability min $\{1, r(\theta^{(s-1)}, \theta|Y)\}$, and rejecting it (i.e., $\theta^{(s)} = \theta^{(s-1)}$) otherwise, where

$$r(\theta^{(s-1)}, \theta|Y) = \frac{L(\theta|Y)\ P(\theta)}{L(\theta^{(s-1)}|Y)\ P(\theta^{(s-1)})}$$

We run a burn-in sample of 200,000 draws which we then discard. After that, we run a sample of 100,000 draws, keeping every draw out of 100 in order to decrease the draws' autocorrelation, thus ending up with a sample of 1,000 draws from the ergodic distribution.

4 Empirical Evidence

Tables 2, 3, 4 and 5 report the modes and the 90%-coverage percentiles of the posterior distributions of the estimated parameters for the models of Fuhrer and Moore (1995), Gali and Gertler (1999), Blanchard and Gali (2007) and Sheedy (2007), respectively, whereas Figures 1, 2, 3, and 5 show the posterior distributions of the parameters which, in either of these models, encode the intrinsic component of inflation persistence: α in Fuhrer and Moore's model, ω in Gali and Gertler's, γ in Blanchard and Gali's, and ψ_1 in Sheedy's. Finally, Figures 4 and 6 show the posterior distributions of α and of the estimated hazard function for the Sheedy (2007) model. In order to correctly interpret the results presented in both the Tables and the Figures, it is important to keep in mind that, as previously stressed, for all the parameters encoding the intrinsic component of inflation persistence the prior distributions are completely uninformative, so that the posteriors *uniquely* reflect the information contained in the data.

In line with Benati (2008), both in the tables and in the figures we contrast two alternative regimes/periods,[10]

- a comparatively more stable and recent one, in red (EMU for the Euro area, Germany, France, Italy, and Finland; the period following the end of the Volcker stabilisation for the United States; the 'new monetary policy concept' for Switzerland; and inflation targeting regimes for all other countries); and

- a previous and significantly less stable period (in black) comprising, for all countries, the Great Inflation episode, with its large low-frequency inflation fluctuations. For the Euro area, Germany, France, Italy, and Finland, this is

[9] We compute $\hat{\Sigma}$ numerically as in An and Schorfheide (2007).

[10] For further details on the specific dates, see Appendix B.

the period between the collapse of Bretton Woods and the start of EMU; for the United States—following Clarida, Gali, and Gertler (2000)—it is the period before the beginning of the Volcker disinflation, in October 1979; for Switzerland, it is the period between the collapse of Bretton Woods and the introduction of the 'new monetary policy concept'; for the United Kingdom it is the period between the floating of the pound *vis-à-vis* the U.S. dollar, in June 1972, and U.K.'s entry into the Exchange Rate Mechanism of the European Monetary System, in October 1990; and for all other countries it is the period between the collapse of Bretton Woods and the introduction of inflation targeting.

4.1 Fuhrer and Moore (1995), Gali and Gertler (1999), and Blanchard and Gali (2007)

Overall, the evidence emerging from both Tables 2-4 and Figures 1-3 is in line with that found in Benati (2008) for New Keynesian Phillips curve models with indexation *a-là*-Christiano, Eichenbaum, and Evans (2005) and Smets and Wouters (2003). First, in most cases the parameters encoding the intrinsic component of inflation persistence clearly appear not to be structural in the sense of Lucas (1976), as they exhibit an often dramatic extent of variation across monetary regimes. This is especially clear for the Euro area, France, Italy, the United States, the United Kingdom, and Canada, whereas for other countries—for example, Germany and Australia—evidence is mixed. Second, under the current, and more stable monetary regime the parameter encoding the intrinsic component of inflation persistence is estimated, in many cases, to be (close to) zero. This is especially clear for the Euro area, France, Italy, the United Kingdom, and Canada. In line with Benati's (2008) evidence for New Keynesian Phillips curve models with indexation *a-là*-CEE and Smets and Wouters (2003, 2007), *first*, these results question the notion that 'intrinsic inflation persistence' truly is structural in the sense of Lucas (1976). *Second*, they show that, under stable monetary regimes with clearly defined nominal anchors, most of the times intrinsic persistence is not necessary to fit the data, so that purely forward-looking models fare (near) perfectly well. *Finally*, they naturally suggest that the intrinsic component of inflation persistence many researchers have estimated in post-WWII U.S. inflation data might well be the figment of a specification error. In line with Cogley and Sbordone (2008), in Section 5 I then explore the possibility that such error may stem from failure to control for shifts in trend inflation.[11]

[11] The same point is made (e.g.) by Kiley (2007):

> '[...] empirical findings such as those in Christiano, Eichenbaum, and Evans (2005)—which suggest a role for indexation across long samples of U.S. history—should be interpreted carefully, as their econometric work clearly mixes data from at least two different periods of trend inflation, [...] while their theoretical model is a linearised approximation of a model around a single rate of trend inflation.'

4.2 Sheedy (2007)

Evidence for the model of Sheedy (2007) deserves a special discussion, since, as a matter of principle, instability across regimes/periods in the structural parameters characterising the hazard function—as documented in Table 5, and especially in Figure 5—should not be regarded as a problematic feature of the model, but should rather be *expected*. In particular, the move from periods characterised by comparatively higher equilibrium inflation to the more recent, and comparatively more stable regimes (EMU, inflation targeting, ...) characterised by uniformly lower inflation levels, should logically be expected to lead to an *increase* in price stickiness across the board, and therefore to downward shifts in the hazard functions. As Figure 6 shows, this is indeed what seems to have happened in several cases. For either the Euro area considered as a whole, France, and the United States, and—to a lesser (i.e., not statistically significant) extent—for Italy, the United Kingdom, Canada, and Australia, estimated hazard functions appear

(i) to have shifted downwards under the more recent regimes, thus pointing towards a generalised increase in price stickiness, and

(ii) to have *flattened*—to the point that, in several cases, the hazard function under the current regime appears indistinguishable from the one associated with the Calvo model (that is a perfectly flat one)—thus causing intrinsic persistence, in several cases, to all but disappear.

Unsurprisingly, evidence for Germany and Switzerland—countries which, over the entire post-WWII era, consistently pursued 'hard-money, low-inflation' monetary policies—points towards virtually no change across regimes/periods in estimated hazard functions, which for both countries are estimated to have been, and to currently be, quite flat. Evidence analogous to that for Germany and Switzerland also holds for Sweden, although in this case the intuition is less straightforward, as this country has not been systematically associated, over the entire post-WWII era, with a consistent counter-inflationary policy. Finally, evidence for Finland is unexpected, and definitely counter-intuitive, as the hazard function is estimated to have significantly shifted *upwards*—rather than downwards—under EMU. Evidence for New Zealand is qualitatively the same, but it is not statistically significant.

5 Estimating a Calvo Model with Time-Varying Trend Inflation

As previously mentioned, one possible explanation for the sometimes dramatic variation in the estimated extent of intrinsic inflation persistence across regimes is that—as conjectured by Cogley and Sbordone (2008)—a significant extent of estimated intrinsic persistence is nothing but the spurious product of failure to control for shifts in trend inflation. An attractive feature of such explanation is that not only it rationalizes why intrinsic persistence is estimated for sample periods characterised by large fluctuations in trend inflation (such as the whole of the post-WWII era), but also—and crucially—it explains why, as both Benati's (2008) and the present results show, intrinsic persistence systematically tends to vanish under the more recent and stable regimes. Given that, under such regimes, inflation has exhibited, so far, very little low-frequency variation—displaying instead strong mean-reversion towards the central bank's inflation objective—estimates of the intrinsic persistence parameters do not get artificially 'blown up' by fluctuations in trend inflation, and intrinsic persistence is instead correctly identified to be virtually *nil*.

If Cogley and Sbordone's conjecture is correct, we should expect that, once controlling for shifts in trend inflation, the estimated intrinsic component of inflation persistence should essentially vanish. Cogley and Sbordone (2008) show that, for the post-WWII United States, this is indeed the case. They first estimate a Bayesian time-varying parameters VAR with stochastic volatility for U.S. post-WWII data, and then apply Sbordone's minimum-distance approach on a quarter-by-quarter basis in order to recover time-varying estimates of the key objects of interest. As they show, once controlling for trend inflation the estimated distributions of the indexation parameter are systematically clustered towards zero, and the null that inflation is purely forward-looking cannot be rejected for the entire sample.

In this Section I tackle the same issue based on an approach different from Cogley and Sbordone's, that is by performing full-system estimation, *via* Bayesian methods, of a standard New Keynesian model log-linearised around a time-varying, non-zero trend inflation.

5.1 The model

The model I use is the one proposed by Ascari and Ropele (2007), which generalises the standard New Keynesian model analysed by Clarida, Gali, and Gertler (2000) and Woodford (2003) to the case of non-zero trend inflation, nesting it as a particular case.

The Phillips curve block of the model is given by

$$\Delta_t = \psi\Delta_{t+1|t} + \eta\phi_{t+1|t} + \kappa\frac{\sigma_N}{1+\sigma_N}s_t + \kappa y_t + \epsilon_{\pi,t} \tag{12}$$

$$\phi_t = \chi\phi_{t+1|t} + \chi(\theta\text{-}1)\Delta_{t+1|t} \tag{13}$$

$$s_t = \xi\Delta_t + \alpha\bar{\pi}^{\theta(1\text{-}\epsilon)}s_{t-1} \tag{14}$$

where $\Delta_t \equiv \pi_t\text{-}\tau\epsilon\pi_{t-1}$; π_t, y_t, and s_t are the log-deviations of inflation, the output gap, and the dispersion of relative prices, respectively, from the non-stochastic steady-state; θ>1 is the elasticity parameter in the aggregator function turning intermediate inputs into the final good; α is the Calvo parameter; $\epsilon \in$[0,1] is the degree of indexation; $\tau \in$[0,1] parameterises the extent to which indexation is to past inflation as opposed to trend inflation (with τ=1 indexation is to past inflation, whereas with τ=0 indexation is to trend inflation); Δ_t and ϕ_t are auxiliary variables; σ_N is the inverse of the elasticity of intertemporal substitution of labor, which, following Ascari and Ropele (2007), I calibrate to 1; and $\psi \equiv \beta\bar{\pi}^{1-\epsilon}+\eta(\theta\text{-}1)$, $\chi \equiv \alpha\beta\bar{\pi}^{(\theta\text{-}1)(1\text{-}\epsilon)}$, $\xi \equiv (\bar{\pi}^{1-\epsilon}\text{-}1)\theta\alpha\bar{\pi}^{(\theta\text{-}1)(1\text{-}\epsilon)}[1\text{-}\alpha\bar{\pi}^{(\theta\text{-}1)(1\text{-}\epsilon)}]^{-1}$, $\eta \equiv \beta(\bar{\pi}^{1-\epsilon}\text{-}1)[1\text{-}\alpha\bar{\pi}^{(\theta\text{-}1)(1\text{-}\epsilon)}]$, and $\kappa \equiv (1+\sigma_N)[\alpha\bar{\pi}^{(\theta\text{-}1)(1\text{-}\epsilon)}]^{-1}[1\text{-}\alpha\beta\bar{\pi}^{\theta(1\text{-}\epsilon)}][1\text{-}\alpha\bar{\pi}^{(\theta\text{-}1)(1\text{-}\epsilon)}]$, where $\bar{\pi}$ is gross trend inflation measured on a quarter-on-quarter basis.[12] In what follows we uniquely consider the case of indexation to *past* inflation, and we therefore set τ=1. We close the model with the intertemporal IS curve (11) and the monetary policy rule (10), and we estimate it, once again, *via* the Bayesian methods described in Section 3 above.

5.2 The issue of indeterminacy

An important issue in estimation concerns how to handle the possibility of indeterminacy. In a string of papers,[13] Guido Ascari has indeed shown that, when standard New Keynesian models are log-linearised around a non-zero steady-state inflation rate, the size of the determinacy region is, for a given parameterisation, 'shrinking' (i.e., decreasing) in the level of trend inflation.[14] Ascari and Ropele (2007) in particular show that, conditional on their calibration, it is very difficult to obtain a determinate equilibrium for values of trend inflation beyond 4 to 6 per cent. Given that, for all of the countries in our sample, inflation has been beyond this threshold for a significant portion of the sample period (first and foremost, during the Great Inflation episode), the imposition of determinacy in estimation over the entire sample, which is what is routinely done in the literature—and it is what we have done up until now—(i) is, *ex ante*, hard to justify, and (ii) might end up distorting the estimates of the parameters encoding the intrinsic component of inflation persistence. The reason is that, as extensively discussed by Lubik and Schorfheide (2004), under indeterminacy the economy exhibits greater volatility and greater persistence across the board, so that part of the high inflation persistence characterising a significant portion of the post-WWII era may simply originate from the fact that, during those years, the economy was operating under indeterminacy. If this is true, but the econometrician imposes, in estimation, determinacy over the entire sample period, the immediate consequence will be, quite obviously, to artificially 'blow up' the estimated extent of intrinsic persistence. In what follows we therefore estimate the model given by (11), (10), and (12)-(14) by allowing for the possibility of one-dimensional indeterminacy,[15] and further imposing the constraint that, when trend inflation is lower than 3 per

[12] To be clear, this implies that (e.g.) a steady-state inflation rate of 4 per cent per year maps into a value of $\bar{\pi}$ equal to $1.04^{1/4}$=1.00985.

[13] See in particular Ascari (2004) and Ascari and Ropele (2007).

[14] On this, see also Kiley (2007).

[15] This is in line with Justiniano and Primiceri (2008). As they stress (see Section 8.2.1), '[t]his means that we effectively truncate our prior at the boundary of a multi-dimensional indeterminacy region'.

cent, the economy is within the determinacy region.[16]

5.3 Modelling time-variation in trend inflation

Within the present context, an important modelling choice is how to specify time-variation in trend inflation. My first choice of modelling it as a random walk—conceptually in line with the work of, e.g., Stock and Watson (2007) and Cogley, Primiceri, and Sargent (2006)—entails, unfortunately, a staggering computational burden, as it implies that trend inflation takes a different value in each single quarter. Since the model's solution crucially depends on the specific value taken by trend inflation—through its impact on the parameters ψ, χ, ξ, η, and κ in (12)-(14)—this means that the model has to be solved *for each single quarter*, which (e.g.) in the case of the United States implies that it takes about 30 seconds to compute the log-likelihood under determinacy.[17] Although unwillingly, in what follows I have therefore adopted the shortcut of modelling trend inflation as a step function, allowing it to change every five years, both in the first quarter of each decade, and in the first quarter of the middle year of each decade[18] At first sight, a better alternative might have seemed to run tests for structural breaks at unknown points in the sample in the mean of inflation—based, e.g., on the Bai and Perron (1998) and Bai and Perron (2003) method—and then to impose these breaks in estimation of the New Keynesian model. This, however, would violate the rules of the Bayesian game, as the sample would be used twice, first to get the breaks in the mean of inflation, and then to estimate the model. The solution I devised, on the other hand, does not suffer from this shortcoming because the rule for choosing the break dates in the mean of inflation is independent of the data, and it uniquely depends on calendar time. Further, it produces very reasonable estimates of trend inflation. For the United States, for example, Cogley and Sargent (2002) estimate trend inflation to have reached about 8 per cent in the second half of the 1970s,[19] whereas Cogley and Sargent (2005) estimate it between 7 and 8 per cent. By comparison, the methodology adopted herein estimates it slightly above 7 per cent, which provides *prima facie* evidence—admittedly, however, only *prima facie* evidence—that the time-profile of trend inflation produced by the specification adopted herein is broadly in line with the one that would result from a

[16] The constraint that, below 3 per cent trend inflation, the economy is under determinacy was imposed in order to rule out a few highly implausible estimates we obtained when no such constraint was imposed. In particular, without imposing any constraint, in a few cases estimates would point towards the economy being under indeterminacy even within the current low-inflation environment, which we find *a priori* hard to believe. These results originate from the fact that, as stressed e.g. by Lubik and Schorfheide (2004), (in)determinacy is a *system* property, crucially depending on the interaction between *all* of the (policy or non-policy) structural parameters, so that parameters' configurations which, within the comparatively simple New Keynesian model used herein, produce the best fit to the data may produce such undesirable 'side effects'.

[17] Under indeterminacy it takes even more.

[18] So, to be clear, e.g., in 1950Q1, 1955Q1, 1960Q1, etc..

[19] See their Figure 3.1.

more appropriate random-walk specification. Finally, I assume that each 'jump' in the step function which represents trend inflation is (*i*) unanticipated by economic agents, (*ii*) immediately and perfectly understood when it takes place,[20] and (*iii*) expected to last forever. Although such assumptions are quite obviously extreme, two things ought to be stressed. First, assumptions (*i*) and (*iii*) are compatible with the trend inflation specification upon which the macroeconomic profession has converged upon, i.e. a random-walk. Second, although relaxing (*ii*) is in principle possible, it would introduce severe complications into the analysis, as (*a*) it would introduce a distinction between actual trend inflation and the inflation trend which is perceived by economic agents, which would most likely be constantly learning about the time-varying trend; and (*b*) since such learning would in general imply that the perceived trend changes from one quarter to the next, it would imply the same staggering computational burden of a random-walk specification.

5.4 Empirical evidence

Table 6 reports the modes and the 90%-coverage percentiles of the posterior distributions of the estimated parameters. Within the Euro area indexation is estimated to be virtuall *nil* both at the aggregate level, and for each of the individual countries considered herein, with the only exception of France, for which the modal estimate is a still comparatively low 0.13. Analogous results hold for both Switzerland and all inflation-targeting countries. In line with Cogley and Sbordone's (2008) evidence for the United States, our results therefore show that, once controlling for shifts in trend inflation, no intrinsic inflation persistence component is necessary to fit the data.

6 Implications

In this Section I briefly discuss two problems associated with the use, for policy-making purposes, of models featuring intrinsic inflation persistence estimated over long sample periods exhibiting a significant extent of low-frequency variation in inflation rates. First, the extent of uncertainty associated with model-generated macroeconomic projections is, in general, greater than it is in reality, sometimes markedly so. Second, 'optimal' monetary policies computed conditional on such models turn out to be quite different from the authentic optimal policies.

[20] So I rule out, by assumption, the need, on the part of economic agents, to learn about shifts in trend inflation, which, on the other hand, might have played a non-trivial role in reality.

6.1 The extent of uncertainty associated with model-generated macroeconomic projections

Figure 7 shows the standards deviation at horizon k, for $k = 1, 2, ..., 12$, of the model-generated distributions of *annual* inflation,[21] the nominal rate, and the output gap, based on 5,000 stochastic simulations of the estimated Blanchard and Gali (2007) model for the Euro area considered as a whole, the United States, Switzerland, and the five inflation-targeting countries.[22] Specifically, the continuous lines show the standard deviations of the distributions generated based on the modal estimates for the more recent, and comparatively more stable, sample periods, whereas the dotted lines show the standard deviations of the distributions generated conditional on the very same modal estimates *for all parameters except* γ (i.e., the one encoding the extent of intrinsic inflation persistence), which has now been set equal to the modal estimate for the first, less stable period. By construction, the difference between the results shown with the continuous and the dotted lines therefore *entirely* originates from the different estimates of γ for the two periods. As it clearly emerges from the figure, whereas a higher value of γ makes almost no difference for the extent of uncertainty associated with projections of the output gap, it makes, in general, a dramatic difference for the uncertainty pertaining to both inflation and the nominal rate. Focusing on Euro area inflation, for example, uncertainty three years ahead—a horizon at which, as Figure 7 shows, the extent of uncertainty has essentially reached its asymptotic value—maps into a standard deviation of the stochastically-generated projections slightly below half a percentage point under EMU (for which the modal estimate of γ is equal to 0.00), whereas it maps to a standard deviation slightly below *two* per cent based on the modal estimate for γ for the previous period, 0.58. As the figure shows, qualitatively similar results also hold for the nominal rate, and for all the eight countries we consider. These results clearly suggest that estimating New Keynesian models over the most recent, and more stable regimes—during which the intrinsic inflation persistence component has all but disappeared—produces, in general, a dramatically different extent of uncertainty associated with model-generated projections than the one produced by models estimated over sample periods comprising previous, and comparatively less stable years. The explanation for this is straightforward. The higher the extent of intrinsic inflation persistence in the New Keynesian model, the higher the extent of *statistical* persistence for both inflation and the nominal rate in the reduced-form VAR representation of the model, and as a result the greater, *ceteris paribus*, the extent of uncertainty associates with future

[21] Since all models have been estimated based on the theory-consistent measure of inflation (i.e. the log-difference of the price level) simulated annual inflation rates have been computed by first stochastically simulating the models into the future—thus obtaining simulated quarter-on-quarter inflation—and then computing annual inflation simply as the convolution of quarter-on-quarter inflation rates in four successive quarters.

[22] We restrict our attention to eight countries uniquely for ease of exposition.

projections for both variables.[23] These results therefore suggest that, for policymaking purposes, a careful choice of the sample period used for the estimation of New Keynesian models is of paramount importance, as choosing the wrong sample period—e.g., choosing a sample comprising data generated under a previous, comparatively less stable regime—may make a material difference in terms of the extent of uncertainty associated with macroeconomic projections, giving the erroneous impression that uncertainty is significantly larger than it is in reality.

6.2 Computing optimal monetary policies

A second important issue is the computation of optimal monetary policies. Given that, different from simple monetary rules like (e.g.) the Taylor rule, optimal policies depend on the entire structure of the economy, differences in the extent of intrinsic inflation persistence will automatically map, in general, into differences in the parameters of the optimal rule. A simple illustration of this issue can be provided based on Benati's (2008) estimates for the following New Keynesian Phillips curve with indexation *a-là*-Christiano, Eichenbaum, and Evans (2005) and Smets and Wouters (2007)

$$\pi_t = \frac{\beta}{1+\alpha\beta}\pi_{t+1|t} + \frac{\alpha}{1+\alpha\beta}\pi_{t-1} + \kappa y_t + \epsilon_{\pi,t}, \qquad \epsilon_{\pi,t} \sim WN(0, \sigma^2_\pi) \tag{15}$$

where α is price setters' extent of indexation to past inflation, and $\epsilon_{\pi,t}$ is a reduced-form disturbance to inflation. Benati (2008) closed the model with equations (11) and (10), and estimated it *via* the same Bayesian methodology discussed in Section 3 above. Conceptually in line with the previous sub-section, we consider, for the Euro area, the United States, the United Kingdom, Canada, and Switzerland, two parameterisations of the model. The first parameterisation is based on the modal estimates from Benati's (2008) Table XII for the more recent regime/period, whereas the second one is based on the very same estimates for all parameters except α, which is set equal to the modal estimate for the full sample. The central bank is then postulated—just for the sake of the argument—to minimise the following loss function

$$\mathcal{L} = \sum_{t=0}^{\infty} \beta^t \left[\pi_t^2 + y_t^2 + (R_t - R_{t-1})^2\right] \tag{16}$$

by setting the interest rate R_t as a function of the state variables π_{t-1}, y_{t-1}, R_{t-1}, $\epsilon_{\pi,t}$, and $\epsilon_{y,t}$. Table 7 reports, for the five countries, the coefficients on the five state

[23] The intuition behind this result is straightforward, and can be immediately grasped by considering the two polar cases of a white noise and a random walk with the same innovation variance, which for the sake of simplicity is normalised to one. Whereas the variance of the conditional forecast is constant at one for the white noise process, in the case of the random walk it starts at one at the one step-ahead horizon, and then it increases linearly with the length of the forecast horizon.

variables in the optimal monetary rule. The coefficients corresponding to the two parameterisations have been labelled as 'High indexation' and 'Low indexation'. As the table makes clear, an increase in α causes significant changes in the optimal monetary rule. Focusing on the Euro area, for example, Benati (2008) estimated α at 0.026 under EMU, and at 0.864 during the entire post-1969 sample period. As the first column of Table 7 shows, the disappearance of an intrinsic persistence component in (15) under EMU causes the coefficients on π_{t-1} and $\epsilon_{\pi,t}$ in the optimal rule to drop from 0.40 to 0.00, and from 0.85 to 0.04, respectively. The intuition behind this result is straightforward. If intrinsic inflation persistence is high, any deviation of inflation from target today implies a corresponding, albeit smaller, deviation from target tomorrow, and for the policymaker it will therefore be optimal to respond to both past inflation, and current inflation shocks. If, on the other hand, inflation dynamics does not contain any intrinsic persistence component, neither current deviations of inflation from target, nor inflation shocks, signal problems down the road, and as a result an optimal policy will give little to no weight to both past inflation and current inflation shocks.

7 Conclusions

Following Fuhrer and Moore (1995), several authors have proposed alternative mechanisms to 'hardwire' inflation persistence into macroeconomic models, thus making it structural in the sense of Lucas (1976). Drawing on the experience of the European Monetary Union, of inflation-targeting countries, and of the new Swiss monetary policy regime, I have shown that, in the Phillips curve models proposed by Fuhrer and Moore (1995), Gali and Gertler (1999), Blanchard and Gali (2007), and Sheedy (2007) (1) the parameters encoding the 'intrinsic' component of inflation persistence are not invariant across monetary policy regimes, and (2) under the more recent, stable regimes they are often estimated to be (close to) zero. These results suggest that the intrinsic component of inflation persistence many researchers have estimated in U.S. post-WWII inflation might be the figment of a specification error. In line with Cogley and Sbordone (2008), I have explored the possibility that such error may result from failure to control for shifts in trend inflation. Overall, evidence from the Euro area, Switzerland, and five inflation-targeting countries provides support for such hypothesis. I have discussed two problems associated with the use, for policy-making purposes, of models featuring intrinsic inflation persistence. First, the extent of uncertainty associated with model-generated macroeconomic projections is, in general, greater than in reality, sometimes markedly so. Second, 'optimal' monetary policies computed conditional on such models turn out to be quite different from the authentic optimal policies.

References

An, S., and F. Schorfheide (2007): "Bayesian Analysis of DSGE Models," *Econometric Reviews*, 26(2-4), 113–172.

Ascari, G. (2004): "Staggered Prices and Trend Inflation: Some Nuisances," *Review of Economic Dynamics*, 7, 642–667.

Ascari, G., and T. Ropele (2007): "Trend Inflation, Taylor Principle, and Indeterminacy," University of Pavia, mimeo.

Bai, J., and P. Perron (1998): "Estimating and Testing Linear Models with Multiple Structural Changes.," *Econometrica*, 66(1), 47–78.

——— (2003): "Computation and Analysis of Multiple Structural Change Models," *Journal of Applied Econometrics*, 18(1), 1–22.

Benati, L. (2008): "Investigating Inflation Persistence Across Monetary Regimes," *Quarterly Journal of Economics*, 123(3), 1005–1060.

Bernanke, B. S., T. Laubach, F. S. Mishkin, and A. Posen (1999): *Inflation Targeting: Lessons from the International Experience*. Princeton University Press.

Blanchard, O. J., and J. Gali (2007): "Real Wage Rigidities and the New Keynesian Model," *Journal of Money, Credit and Banking*, 39(1), 35–65.

Christiano, L., M. Eichenbaum, and C. Evans (2005): "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy," *Journal of Political Economy*, 113(1), 1–45.

Clarida, R., J. Gali, and M. Gertler (2000): "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory," *Quarterly Journal of Economics*, CXV(1), 147–180.

Cogley, T., and T. J. Sargent (2002): "Evolving Post-WWII U.S. Inflation Dynamics," *in B. Bernanke and K. Rogoff, eds. (2002), NBER Macroeconomics Annuals 2001.*

——— (2005): "Drifts and Volatilities: Monetary Policies and Outcomes in the Post WWII U.S.," *Review of Economic Dynamics*, 8(April), 262–302.

Cogley, T., and A. Sbordone (2008): "Trend Inflation, Indexation, and Inflation Persistence in the New Keynesian Phillips Curve," *American Economic Review*, forthcoming.

Cogley, T. W., G. E. Primiceri, and T. J. Sargent (2006): "Inflation-Gap Persistence in the U.S.," University of California at Davis, Northwestern University, and New York University, mimeo.

Corana, A., M. Marchesi, C. Martini, and S. Ridella (1987): "Minimizing Multimodal Functions of Continuous Variables with the Simulated Annealing Algorithm," *ACM Transactions on Mathematical Software*, 13, 262–80.

Fuhrer, J., and G. Moore (1995): "Inflation Persistence," *Quarterly Journal of Economics*, 109, 127–159.

Gali, J., and M. Gertler (1999): "Inflation Dynamics: A Structural Econometric Analysis," *Journal of Monetary Economics*, 44(2), 195–222.

Gelman, A., J. Carlin, H. Stern, and D. Rubin (1995): *Bayesian Data Analysis*. Chapman and Hall, New York.

Goffe, W. L., G. Ferrier, and J. Rogers (1994): "Global Optimization of Statistical Functions with Simulated Annealing," *Journal of Econometrics*, 60,(1/2), 65–99.

Justiniano, A., and G. Primiceri (2008): "The Time-Varying Volatility of Macroeconomic Fluctuations," *American Economic Review*, 98(3), 604–641.

Kiley, M. T. (2007): "Is Moderately-To-High Inflation Ineherently Unstable?," *International Journal of Cental Banking*, 3(2), 173–201.

Lubik, T., and F. Schorfheide (2003): "Computing Sunspot Equilibria in Linear Rational Expectations Models," *Journal of Economic Dynamics and Control*, 28(2), 273–285.

——— (2004): "Testing for Indeterminacy: An Application to U.S. Monetary Policy," *American Economic Review*, 94(1), 190–217.

Lucas, R. E. (1976): "Econometric Policy Evaluation: A Critique," *Carnegie-Rochester Conference Series on Public Policy*, 1, 19–46.

Mankiw, N. G., and R. Reis (2002): "Sticky Information Versus Sticky Prices: A Proposal to Replace the New Keynesian Phillips Curve," *Quarterly Journal of Economics*, 117(4), 1295–1328.

Mankiw, N. G., and R. Reis (2007): "Sticky Information in General Equilibrium," Princeton University, mimeo.

Mavroeidis, S. (2004): "Weak Identification of Forward-Looking Models in Monetary Economics," *Oxford Bulletin of Economics and Statistics*, 66, 609–635.

——— (2005): "Identification Issues in Forward-Looking Models Estimated by GMM, with an Application to the Phillips Curve," *Journal of Money, Credit, and Banking*, 37(3), 421–448.

Nelson, E. (1998): "Sluggish Inflation and Optimising Models of the Business Cycle," *Journal of Monetary Economics*, 42, 303–322.

Sheedy, K. D. (2007): "Intrinsic Inflation Persistence," working paper, London School of Economics.

Sims, C. (2002): "Solving Linear Rational Expectations Models," *Computational Economics*, 20, 1–20.

Smets, F., and R. Wouters (2003): "An Estimated Stochastic Dynamic General Equilibrium Model of the Euro Area," *Journal of the European Economic Association*, 1(5), 1123–1175.

Smets, F., and R. Wouters (2007): "Shocks and Frictions in U.S. Business Cycles: A Bayesian DSGE Approach," *American Economic Review*, 97(3), 586–606.

Stock, J. H., and M. W. Watson (2007): "Why Has U.S. Inflation Become Harder to Forecast?," *Journal of Money, Credit, and Banking*, 39(1), 3–33.

Woodford, M. (1994): "Nonstandard Indicators for Monetary Policy: Can Their Usefulness Be Judged from Forecasting Regressions?," in Mankiw, N.G., ed., 'Monetary Policy', University of Chicago Press for the National Bureau of Economic Research, 95–115.

Woodford, M. (2003): *Interest and Prices*. Princeton University Press.

A The Data

A.1 Euro area

Quarterly seasonally adjusted series for real GDP, the GDP deflator, and the short-term rate are from the Area Wide Model (henceforth, AWM) Database maintained at the European Central Bank. A measure of the labor share has been constructed as in Cogley and Sbordone (2008, equation 18), as $WIN/(YED*YER*0.7)$, where *WIN*, *YED*, and *YER* are the AWM database acronyms for overall compensation of employees, the GDP deflator, and real GDP. For all series the sample period is 1970:1-2006:4.

A.2 Germany

A quarterly seasonally unadjusted series for the Treasury bill rate is from the *International Monetary Fund*'s *International Financial Statistics* (henceforth, *IMF* and *IFS* respectively). Quarterly seasonally adjusted series for real GDP and the GDP deflator are from the *OECD*'s *Economic Outlook* database. The acronyms are QNA.Q.DEW.EXPGDP.LNBQRSA.1991_S1 and QNA.Q.DEW.EXPGDP.DNBSA.1991_S1, respectively, for West Germany, and QNA.Q. DEU.EXPGDP.LNBQRSA.2000_S1 and QNA.Q.DEU.EXPGDP.DNBSA.2000_S1, respectively, for Germany. The overall sample periods are 1970:1-1991:4 for West Germany, and 1991:1-2007:3 for Germany.

A.3 France

A quarterly seasonally unadjusted series for the call money rate is from the *IMF*'s *IFS* (acronym is 13260B..ZF...). Quarterly seasonally adjusted series for real GDP and the GDP deflator are from the *OECD*'s *Economic Outlook* database. The acronyms are OEO.Q.FRA.GDPV and QNA.Q.FRA.CMPGDP.DOBSA.2000_S1, respectively. The overall sample period is 1970:1-2007:3.

A.4 Italy

A quarterly seasonally unadjusted series for the money market rate is from the *IMF*'s *IFS* (acronym is 13660B..ZF...). Quarterly seasonally adjusted series for real GDP and the GDP deflator are from the *OECD*'s *Economic Outlook* database. The acronyms are OEO.Q.ITA.GDPV and QNA.Q.ITA.CMPGDP.DOBSA.2000_S1, respectively. The overall sample period is 1971:1-2007:3.

A.5 Finland

A quarterly seasonally unadjusted series for the money market rate is from the *IMF*'s *IFS*. Quarterly seasonally adjusted series for real GDP and the GDP deflator are from the *OECD*'s *Economic Outlook* database. The acronyms are OEO.Q.FIN.GDPV and QNA.Q.FIN.EXPGDP.DNBSA.2000_S1, respectively. The overall sample period is 1978:1-2007:3.

A.6 United States

Quarterly seasonally adjusted series for real GDP ('GDPC96, Real Gross Domestic Product, 3 Decimal, Seasonally Adjusted Annual Rate, Quarterly, Billions of Chained 2000 Dollars') and the GDP deflator ('GDPCTPI, Gross Domestic Product: Chain-type Price Index, Seasonally Adjusted, Quarterly') are from the U.S. Department of Commerce, Bureau of Economic Analysis. For both series the sample period is 1947:1-2007:4. A monthly seasonally unadjusted series for the Federal Funds Rate, available since July 1954, is from the Federal Reserve of St. Louis database on the web. The series has been converted to the quarterly frequency by taking averages within the quarter. The labor share measure has been constructed as in Cogley and Sbordone (2008, equation 18).

A.7 Canada

A quarterly seasonally unadjusted series for the Bank rate is from the *IMF*'s *IFS*. The acronym for the series is 15660...ZF... . Quarterly seasonally adjusted series for the GDP deflator and a volume index of real GDP are from the OECD's Main Economic Indicators (henceforth, MEI) database. The acronyms for the two series are MEI.Q.CAN.EXPGDP.DNBSA and MEI.Q.CAN.CMPGDP.VIXOBSA, respectively. A labor share measure has been constructed as in Cogley and Sbordone (2008, equation 18), based on series for the overall compensation of employees ('OEO.Q.CAN.WSSS, compensation of employees, value') and nominal GDP ('BISM.Q.RBGB.CA.01, GDP at market prices - current prices, SAAR') from the Bank for International Settlements database.

A.8 New Zealand

A monthly seasonally unadjusted series for the variable first mortgage housing rate is from the Reserve Bank of New Zealand, and has been converted to the quarterly frequency by taking averages within the quarter. Quarterly seasonally adjusted series for the GDP deflator and real GDP are from the OECD Economic Outlook dataset. The overall sample period is 1970:1-2007:4.

A.9 Sweden

A quarterly seasonally unadjusted series for the Bank rate is from the International Monetary Fund's International Financial Statistics (henceforth, IMF and IFS respectively). The acronym for the series is 14460...ZF... . Quarterly seasonally adjusted series for the GDP deflator and real GDP are from the Bank for International Settlements' database. The overall sample period is 1970:1-2007:4.

A.10 Switzerland

Quarterly seasonally adjusted series for real GDP, the GDP deflator, and the discount rate are from the IMF's IFS database. The sample period is 1970:1-2007:4.

A.11 United Kingdom

A monthly seasonally unadjusted series for the Treasury Bill Rate is from the IMF's IFS database (the acronym is 11260C..ZF...). The series has been converted to the quarterly frequency by taking averages within the quarter. Quarterly seasonally adjusted series for real GDP and the GDP deflator are from the Office for National Statistics. A labor share measure has been constructed as in Cogley and Sbordone (2008, equation 18). The overall sample period is 1963:1-2007:3.

B Identifying Monetary Regimes

This appendix discusses and motivates our choices of how to break the overall sample periods by monetary regimes.

For the Euro area data are available starting from 1970:1. We divide the post-1969 era into the period betwen the collapse of Bretton Woods and the start of EMU, on January 1, 1999, and EMU.

Following Clarida, Gali, and Gertler (2000) for the United States we consider two regimes/periods, the one up to October 1979, and the one following the end of the Volcker stabilisation, which, as in Clarida *et al.* (2000), we date in the fourth quarter of 1982.

For the United Kingdom we contrast two periods, the one between the floating of the pound *vis-a-vis* the U.S. dollar (in June 1972) and the U.K.'s entry into the Exchange Rate Mechanism of the European Monetary System (in October 1990); and the post-October 1992 inflation-targeting regime.

As for Canada, Australia, Sweden, and New Zealand, we consider the period between the collapse of Bretton Woods and the introduction of inflation targeting,[24] and the inflation-targeting regime.

As for Switzerland we consider the period between the collapse of Bretton Woods and the introduction of the 'new monetary policy concept', in January 2000, and the post-1999 regime.

[24] On January 15, 1993 in Sweden; on February 1, 1990 in New Zealand; and on February 26, 1991 in Canada; and in the third quarter of 1994 for Australia (here we are following Bernanke, Laubach, Mishkin, and Posen (1999)).

C Model Solution for the Ascari and Ropele (2007) Model Under Determinacy and Indeterminacy

By defining the state vector as $\xi_t \equiv [R_t,\ \pi_t,\ y_t,\ \phi_t,\ s_t,\ \pi_{t+1|t},\ y_{t+1|t},\ \phi_{t+1|t},\ \epsilon_{R,t},\ \epsilon_{y,t}]'$, the vector collecting the structural shocks as $\epsilon_t \equiv [\tilde{\epsilon}_{R,t},\ \tilde{\epsilon}_{\pi,t},\ \tilde{\epsilon}_{y,t}]'$, and the vector of forecast errors as $\eta_t \equiv [\eta_t^{\pi}, \eta_t^{y}, \eta_t^{\phi}]'$—where $\eta_t^{\pi} \equiv \pi_t$-$\pi_{t|t-1}$, $\eta_t^{y} \equiv y_t$-$y_{t|t-1}$, and $\eta_t^{\phi} \equiv \phi_t$-$\phi_{t|t-1}$, the model can then be put into the 'Sims canonical form'[25]

$$\Gamma_0 \xi_t = \Gamma_1 \xi_{t-1} + \Psi \epsilon_t + \Pi \eta_t \tag{D.1}$$

where Γ_0, Γ_1, Ψ and Π are matrices conformable to ξ_t, ϵ_t and η_t.

In order to solve the model under both determinacy and indeterminacy, following Lubik and Schorfheide (2003) we exploit the QZ decomposition of the matrix pencil (Γ_0-$\lambda\Gamma_1$). Specifically, given a pencil (Γ_0-$\lambda\Gamma_1$), there exist matrices Q, Z, Λ, and Ω such that QQ'=$Q'Q$=ZZ'=$Z'Z$=I_n, Λ and Ω are upper triangular, Λ=$Q\Gamma_0 Z$, and Ω=$Q\Gamma_1 Z$. By defining w_t=$Q'\xi_t$, and by premultiplying (D.1) by Q, we have:

$$\left[\begin{array}{c|c} \Lambda_{11} & \Lambda_{12} \\ \hline 0 & \Lambda_{22} \end{array}\right] \left[\begin{array}{c} w_{1,t} \\ w_{2,t} \end{array}\right] = \left[\begin{array}{c|c} \Omega_{11} & \Omega_{12} \\ \hline 0 & \Omega_{22} \end{array}\right] \left[\begin{array}{c} w_{1,t-1} \\ w_{2,t-1} \end{array}\right] + \left[\begin{array}{c} Q_{1\cdot} \\ \hline Q_{2\cdot} \end{array}\right] (\Psi \epsilon_t + \Pi \eta_t) \tag{D.2}$$

where the vector of generalised eigenvalues, λ (equal to the ratio between the diagonal elements of Ω and Λ) has been partitioned as λ=$[\lambda_1',\ \lambda_2']'$, with λ_2 collecting all the explosive eigenvalues, and Ω, Λ, and Q have been partitioned accordingly. In particular, $Q_{j\cdot}$ collects the blocks of rows corresponding to the stable (j=1) and, respectively, unstable (j=2) eigenvalues. The explosive block of (D.2) can then be rewritten as

$$w_{2,t} = \Lambda_{22}^{-1} \Omega_{22} w_{2,t-1} + \Lambda_{22}^{-1} \left(\Psi_x^* \epsilon_t + \Pi_x^* \eta_t \right) \tag{D.3}$$

where Ψ_x^*=$Q_{2\cdot}\Psi$, and Π_x^*=$Q_{2\cdot}\Pi$. Given that λ_2 is purely explosive, obtaining a stable solution to (D.1) requires $w_{2,t}$ to be equal to 0 for any $t \geq 0$. This can be accomplished by setting $w_{2,0}$=0, and by selecting, for each $t >0$, the forecast error vector η_t in such a way that $\Psi_x^* \epsilon_t + \Pi_x^* \eta_t$=0.

Under determinacy, the dimension of η_t is exactly equal to the number of unstable eigenvalues, and η_t is therefore uniquely determined. Under indeterminacy, on the other hand, the number of unstable eigenvalues falls short of the number of forecast errors, and the forecast error vector η_t is therefore not uniquely determined, which is at the root of the possibility of sunspot fluctuations. Lubik and Schorfheide (2003), however, prove the following. By defining UDV'=Π_x^* as the singular value decomposition of Π_x^*, and by assuming that for each ϵ_t there always exists an η_t such that $\Psi_x^* \epsilon_t + \Pi_x^* \eta_t$=0 is satisfied, the general solution for η_t is given by

$$\eta_t = \left[-V_{\cdot 1} D_{11}^{-1} U_{\cdot 1}' \Psi_x^* + V_{\cdot 2} M_1 \right] \epsilon_t + V_{\cdot 2} M_2 s_t^* \tag{D.4}$$

[25] See Sims (2002).

where D_{11} is the upper-left diagonal block of D, containing the square roots of the non-zero singular values of Π_x^* in decreasing order; s_t^* is a vector of sunspot shocks; and M_1 and M_2 are matrices whose entries are not determined by the solution procedure, and which basically 'index' (or parameterise) the model's solution under indeterminacy. Concerning M_1 and M_2 we follow Lubik and Schorfheide (2004), first, by setting $M_2 s_t^*=s_t$, where s_t can therefore be interpreted as a vector of 'reduced-form' sunspot shocks. Second, we choose the matrix M_1 in such a way as to preserve continuity of the impact matrices of the impulse-responses of the model at the boundary between the determinacy and the indeterminacy region. Specifically, let θ be the parameters' vector, and let Θ_I and Θ_D be the sets of all the θ's corresponding to the indeterminacy and, respectively, to the determinacy regions. For every $\theta \in \Theta_I$ we identify a corresponding vector $\tilde{\theta} \in \Theta_D$ laying just on the boundary between the two regions.[26] By definition, the two impact matrices for the impulse-responses of the model conditional on θ and $\tilde{\theta}$ are given by

$$\frac{\partial \xi_t(\theta, M_1)}{\partial \epsilon_t} = \Psi^*(\theta)\text{-}\Pi^*(\theta)V_{\cdot 1}(\theta)D_{11}^{-1}(\theta)U_{\cdot 1}'(\theta)\Psi_x^*(\theta)+\Pi^*(\theta)V_{\cdot 2}(\theta)M_1 \equiv$$

$$\equiv B_1(\theta) + B_2(\theta)M_1 \tag{D.5}$$

and, respectively,

$$\frac{\partial \xi_t(\tilde{\theta})}{\partial \epsilon_t} = \Psi^*(\tilde{\theta}) - \Pi^*(\tilde{\theta})V_{\cdot 1}(\tilde{\theta})D_{11}^{-1}(\tilde{\theta})U_{\cdot 1}'(\tilde{\theta})\Psi_x^*(\tilde{\theta}) \equiv B_1(\tilde{\theta}) \tag{D.6}$$

where $\Psi^*(\cdot) \equiv Q\Psi(\cdot)$, and $\Pi^*(\cdot) \equiv Q\Pi(\cdot)$. We minimise the difference between the two impact matrices, $B_1(\tilde{\theta})\text{-}[B_1(\theta)+B_2(\theta)M_1]=[B_1(\tilde{\theta})\text{-}B_1(\theta)]\text{-}B_2(\theta)M_1$ by means of a least-squares regression of $[B_1(\tilde{\theta})\text{-}B_1(\theta)]$ on $B_2(\theta)$, thus obtaining $\tilde{M}_1=[B_2(\theta)'B_2(\theta)]^{-1}\times B_2(\theta)'[B_1(\tilde{\theta})\text{-}B_1(\theta)]$.

The model solution is now completely characterised. The forecast error η_t can be substituted into the law of motion for $w_{1,t}$,

$$w_{1,t} = \Lambda_{11}^{-1}\Omega_{11}w_{1,t-1} + \Lambda_{11}^{-1}Q_{1\cdot}(\Psi\epsilon_t + \Pi\eta_t) \tag{D.7}$$

thus obtaining, under both regimes, a VAR(1) representation for ξ_t,

$$\xi_t = A_0\xi_{t-1} + B_0 u_t \tag{D.8}$$

where u_t is vector standard white noise. Finally, the state-space representation of the model in terms of the three observable variables, R_t, π_t, y_t, implies the following observation equation

$$Y_t = C_0\xi_t \tag{D.9}$$

[26] Specifically, for any $[\phi_\pi,\ \phi_y]'$ such that $\theta \in \Theta_I$, we choose the vector $[\tilde{\phi}_\pi,\ \tilde{\phi}_y]'$, such that the resulting $\tilde{\theta} \in \Theta_D$ lies just on the boundary between the two regions, by minimising the criterion $\tilde{C}=[(\phi_\pi\text{-}\tilde{\phi}_\pi)^2+(\phi_y\text{-}\tilde{\phi}_y)^2]^{1/2}$. It is important to stress that, in general, there is no clear-cut criterion for choosing a specific vector on the boundary. Minimisation of $\tilde{C}$ is based on the intuitive notion of taking, as the 'benchmark' $\tilde{\theta}$, the one that is closest in vector 2-norm to θ.

with $Y_t \equiv [R_t, \pi_t, y_t]'$ and C_0=$[I_3 \; 0_{3\times(N_0-3)}]$, where N_0 is the dimension of the state vector. (Notice that, in terms of the canonical 'A-B-C-D' representation of a state-space form, the matrix D_0 is here equal to D_0=$0_{3\times3}$.)

Table 1 Prior distributions for the structural parameters for the models of Gali and Gertler (1999), Blanchard and Gali (2007), and Sheedy (2007)

Parameter	Domain	Density	Mode	Standard deviation
	Common parameters:			
σ_R^2	$\mathbb{R}^+$	Inverse Gamma	1	2
σ_π^2	$\mathbb{R}^+$	Inverse Gamma	1	2
σ_y^2	$\mathbb{R}^+$	Inverse Gamma	1	2
ρ, ρ_x	[0, 1]	Beta	0.25	0.1
ϕ_π	$\mathbb{R}^+$	Gamma	1.5	0.25
ϕ_y	$\mathbb{R}^+$	Gamma	0.5	0.1
γ	[0, 1]	Uniform	–	0.2887
σ	$\mathbb{R}^+$	Gamma	10	2
	Fuhrer and Moore (1995) model:			
α	[0, 1]	Uniform	–	0.2887
κ	$\mathbb{R}^+$	Gamma	0.05	0.01
	Gali and Gertler (1999) model:			
ω	[0, 1]	Uniform	–	0.2887
θ	$\mathbb{R}^+$	Gamma	0.65	0.05
	Blanchard and Gali (2007) model:			
$\varkappa$	[0, 1]	Uniform	–	0.2887
θ	$\mathbb{R}^+$	Gamma	0.65	0.05
	Sheedy (2007) model:			
α	(0, 1]	Beta	0.4	0.05
ψ_1	[0, 1]	Uniform	–	0.2887

$x = R, \pi, y$

Table 2 Bayesian estimates for the Fuhrer and Moore (1995) model, posterior mode and 90%-coverage percentiles

	Euro area	Germany	France	Italy	Finland
	Before European Monetary Union				
σ_R	0.72 [0.65; 0.80]	1.14 [0.99; 1.32]	0.98 [0.90; 1.10]	1.27 [1.12; 1.45]	1.14 [1.00; 1.32]
σ_π	1.85 [1.78; 2.20]	3.68 [3.15; 4.45]	2.01 [1.81; 2.26]	5.49 [5.39; 6.29]	7.77 [7.30; 8.82]
σ_y	0.61 [0.55; 0.69]	0.89 [0.73; 1.02]	0.57 [0.51; 0.62]	0.55 [0.44; 0.63]	1.06 [0.88; 1.18]
σ	13.94 [11.75; 18.09]	11.14 [8.78; 15.44]	14.13 [12.32; 18.28]	22.90 [17.81; 26.93]	14.27 [10.40; 16.24]
α	0.98 [0.75; 0.99]	0.21 [0.07; 0.29]	0.98 [0.73; 0.99]	0.36 [0.30; 0.40]	0.17 [0.08; 0.26]
γ	0.01 [0.00; 0.07]	0.06 [0.01; 0.20]	0.00 [0.00; 0.05]	0.99 [0.80; 1.00]	0.02 [0.01; 0.16]
κ	0.02 [0.01; 0.03]	0.02 [0.01; 0.03]	0.02 [0.01; 0.04]	0.03 [0.02; 0.04]	0.01 [0.00; 0.02]
ρ	0.84 [0.81; 0.89]	0.75 [0.70; 0.82]	0.80 [0.74; 0.85]	0.81 [0.77; 0.85]	0.88 [0.84; 0.90]
ϕ_π	1.04 [1.01; 1.23]	1.03 [1.01; 1.38]	1.03 [1.01; 1.21]	1.01 [1.01; 1.38]	1.11 [1.02; 1.43]
ϕ_y	0.61 [0.45; 0.81]	0.58 [0.45; 0.81]	0.56 [0.43; 0.77]	0.46 [0.36; 0.71]	0.61 [0.47; 0.85]
ρ_R	0.40 [0.25; 0.50]	0.20 [0.11; 0.32]	0.46 [0.26; 0.54]	0.30 [0.20; 0.42]	0.18 [0.11; 0.31]
ρ_y	0.24 [0.12; 0.36]	0.12 [0.06; 0.23]	0.30 [0.18; 0.42]	0.56 [0.46; 0.62]	0.11 [0.06; 0.23]
	European Monetary Union				
σ_R	0.63 [0.54; 0.84]	0.60 [0.54; 0.84]	0.59 [0.50; 0.76]	0.75 [0.60; 1.03]	0.67 [0.52; 0.86]
σ_π	1.37 [1.17; 1.77]	1.97 [1.59; 2.60]	0.99 [0.86; 1.42]	3.85 [3.42; 4.64]	3.21 [2.62; 3.83]
σ_y	0.52 [0.44; 0.64]	0.54 [0.49; 0.71]	0.57 [0.46; 0.67]	0.62 [0.53; 0.85]	0.72 [0.61; 0.89]
σ	8.99 [6.51; 11.77]	8.26 [6.76; 12.82]	7.56 [6.37; 12.00]	11.13 [8.80; 16.44]	10.38 [7.56; 13.77]
α	0.04 [0.01; 0.26]	0.11 [0.04; 0.29]	0.16 [0.04; 0.37]	0.02 [0.01; 0.19]	0.04 [0.01; 0.22]
γ	0.01 [0.00; 0.13]	0.03 [0.00; 0.14]	0.02 [0.00; 0.15]	0.98 [0.67; 0.99]	0.00 [0.01; 0.16]
κ	0.02 [0.01; 0.03]	0.01 [0.01; 0.03]	0.01 [0.01; 0.03]	0.02 [0.01; 0.05]	0.03 [0.02; 0.05]
ρ	0.70 [0.46; 0.77]	0.80 [0.66; 0.85]	0.65 [0.40; 0.73]	0.81 [0.71; 0.86]	0.84 [0.75; 0.88]
ϕ_π	1.26 [1.04; 1.58]	1.20 [1.03; 1.56]	1.32 [1.06; 1.66]	1.06 [1.02; 1.36]	1.15 [1.02; 1.44]
ϕ_y	0.61 [0.43; 0.78]	0.56 [0.41; 0.76]	0.60 [0.44; 0.82]	0.56 [0.40; 0.75]	0.52 [0.36; 0.67]
ρ_R	0.26 [0.13; 0.46]	0.27 [0.16; 0.50]	0.27 [0.16; 0.47]	0.21 [0.11; 0.35]	0.22 [0.11; 0.39]
ρ_y	0.24 [0.11; 0.38]	0.24 [0.11; 0.39]	0.18 [0.10; 0.36]	0.29 [0.17; 0.44]	0.16 [0.08; 0.31]

Table 2 (continued) Bayesian estimates for the Fuhrer and Moore (1995) model, posterior mode and 90%-coverage percentiles

	United States	United Kingdom	Canada	Australia
	First period[a]			
σ_R	0.79 [0.71; 0.91]	1.40 [1.23; 1.61]	1.46 [1.28; 1.70]	1.84 [1.65; 2.10]
σ_π	1.39 [1.27; 1.64]	6.68 [6.40; 6.90]	3.07 [2.78; 3.81]	5.64 [5.34; 6.13]
σ_y	0.55 [0.47; 0.67]	1.16 [0.99; 1.38]	0.87 [0.72; 0.98]	0.97 [0.88; 1.14]
σ	15.81 [11.91; 19.53]	13.18 [10.52; 16.00]	12.08 [10.16; 15.68]	13.94 [11.27; 17.44]
α	0.45 [0.42; 0.48]	0.37 [0.32; 0.42]	0.41 [0.35; 0.45]	0.33 [0.29; 0.39]
γ	0.65 [0.61; 0.93]	0.03 [0.00; 0.17]	0.01 [0.01; 0.14]	0.02 [0.00; 0.12]
κ	0.02 [0.01; 0.03]	0.01 [0.01; 0.02]	0.01 [0.01; 0.02]	0.01 [0.01; 0.02]
ρ	0.64 [0.55; 0.70]	0.88 [0.85; 0.92]	0.83 [0.75; 0.87]	0.86 [0.79; 0.88]
ϕ_π	1.10 [1.02; 1.24]	1.07 [1.02; 1.41]	1.31 [1.04; 1.60]	1.13 [1.03; 1.44]
ϕ_y	0.61 [0.47; 0.82]	0.60 [0.46; 0.83]	0.59 [0.46; 0.83]	0.55 [0.45; 0.82]
ρ_R	0.28 [0.20; 0.44]	0.30 [0.18; 0.44]	0.23 [0.14; 0.39]	0.15 [0.10; 0.32]
ρ_y	0.39 [0.26; 0.56]	0.14 [0.07; 0.26]	0.22 [0.12; 0.35]	0.13 [0.08; 0.26]
	Second period[b]			
σ_R	0.56 [0.50; 0.65]	0.55 [0.45; 0.64]	0.84 [0.75; 1.03]	0.55 [0.45; 0.65]
σ_π	1.12 [1.02; 1.36]	2.98 [2.70; 3.71]	4.08 [3.43; 4.77]	3.34 [2.83; 4.45]
σ_y	0.50 [0.40; 0.56]	0.42 [0.38; 0.51]	0.47 [0.42; 0.55]	0.54 [0.49; 0.69]
σ	17.41 [13.89; 21.48]	10.26 [7.94; 14.01]	12.46 [9.20; 15.02]	10.19 [7.55; 13.54]
α	0.31 [0.24; 0.38]	0.03 [0.01; 0.16]	0.08 [0.02; 0.21]	0.17 [0.03; 0.28]
γ	0.99 [0.85; 1.00]	0.01 [0.00; 0.07]	0.00 [0.00; 0.06]	0.00 [0.00; 0.14]
κ	0.02 [0.01; 0.03]	0.01 [0.01; 0.03]	0.02 [0.01; 0.03]	0.01 [0.01; 0.03]
ρ	0.76 [0.69 0.80]	0.88 [0.83; 0.91]	0.87 [0.82; 0.90]	0.86 [0.82; 0.91]
ϕ_π	1.31 [1.12; 1.60]	1.05 [1.02; 1.50]	1.14 [1.02; 1.50]	1.10 [1.03; 1.48]
ϕ_y	0.58 [0.45; 0.81]	0.61 [0.44; 0.80]	0.57 [0.42; 0.77]	0.60 [0.45; 0.80]
ρ_R	0.44 [0.34; 0.59]	0.27 [0.16; 0.46]	0.15 [0.09; 0.32]	0.24 [0.13; 0.40]
ρ_y	0.50 [0.41; 0.57]	0.28 [0.13; 0.41]	0.33 [0.23; 0.52]	0.18 [0.08; 0.29]

[a] *First period* United States: before October 1979; United Kingdom: floating of the pound to entry into ERM; Canada and Australia:collapse of Bretton Woods to introduction of of inflation targeting.
[b] *Second period* United States: after the Volcker stabilisation; United Kingdom, Canada and Australia: inflation targeting regime.

Table 2 (continued) Bayesian estimates for the Fuhrer and Moore (1995) model, posterior mode and 90%-coverage percentiles

	Sweden	New Zealand	Switzerland
		First period[a]	
σ_R	0.89 [0.83; 1.09]	0.86 [0.76; 1.06]	0.47 [0.43; 0.54]
σ_π	8.19 [7.17; 8.33]	6.07 [5.77; 6.11]	6.20 [5.86; 7.00]
σ_y	0.74 [0.61; 0.95]	1.44 [0.99; 1.74]	0.94 [0.83; 1.14]
σ	17.09 [12.98; 20.59]	17.26 [14.51; 22.44]	11.37 [8.70; 15.56]
α	0.19 [0.10; 0.26]	0.46 [0.43; 0.51]	0.23 [0.15; 0.31]
γ	1.00 [0.88; 1.00]	1.00 [0.91; 1.00]	0.01 [0.01; 0.19]
κ	0.03 [0.02; 0.05]	0.02 [0.01; 0.03]	0.01 [0.00; 0.02]
ρ	0.91 [0.89; 0.93]	0.97 [0.95; 0.97]	0.93 [0.92; 0.95]
ϕ_π	1.01 [1.00; 1.22]	1.01 [1.01; 1.36]	1.01 [1.01; 1.31]
ϕ_y	0.59 [0.46; 0.85]	0.54 [0.39; 0.75]	0.67 [0.48; 0.84]
ρ_R	0.13 [0.06; 0.22]	0.17 [0.11; 0.31]	0.24 [0.13; 0.35]
ρ_y	0.51 [0.37; 0.58]	0.65 [0.53; 0.74]	0.15 [0.08; 0.27]
		Second period[b]	
σ_R	0.80 [0.69; 0.98]	0.71 [0.63; 0.86]	0.60 [0.50; 0.77]
σ_π	7.52 [5.99; 7.70]	6.05 [5.26; 7.37]	1.21 [1.05; 1.67]
σ_y	0.49 [0.44; 0.59]	0.77 [0.69; 0.99]	0.54 [0.49; 0.72]
σ	11.19 [8.69; 14.43]	10.05 [7.61; 13.47]	8.79 [6.13; 12.00]
α	0.01 [0.00; 0.10]	0.01 [0.01; 0.12]	0.07 [0.02; 0.26]
γ	0.00 [0.00; 0.07]	0.09 [0.01; 0.22]	0.00 [0.00; 0.19]
κ	0.01 [0.01; 0.02]	0.01 [0.01; 0.02]	0.01 [0.01; 0.03]
ρ	0.91 [0.86; 0.92]	0.92 [0.89; 0.94]	0.66 [0.47; 0.76]
ϕ_π	1.00 [1.01; 1.37]	1.05 [1.01; 1.40]	1.31 [1.06; 1.67]
ϕ_y	0.60 [0.47; 0.81]	0.61 [0.47; 0.84]	0.60 [0.44; 0.78]
ρ_R	0.18 [0.09; 0.32]	0.23 [0.13; 0.38]	0.24 [0.14; 0.44]
ρ_y	0.39 [0.24; 0.54]	0.13 [0.08; 0.27]	0.21 [0.11; 0.40]

[a] *First period* Sweden, and New Zealand: collapse of Bretton Woods to introduction of inflation targeting; Switzerland: before introduction of 'new monetary policy concept'.

[b] *Second period* Sweden, and New Zealand: inflation targeting regime; Switzerland: 'new monetary policy concept'.

Table 3 Bayesian estimates for the Gali and Gertler (1999) model, posterior mode and 90%-coverage percentiles

	Euro area	United States	United Kingdom	Canada	Australia
			First period[a]		
σ_R	0.69 [0.62; 0.78]	0.71[0.65; 0.82]	1.31 [1.17; 1.56]	1.42 [1.25; 1.65]	1.74 [1.59; 2.02]
σ_π	1.05 [0.97; 1.24]	0.77[0.68; 0.90]	3.81 [3.44; 4.84]	1.68 [1.41; 1.92]	2.99 [2.69; 3.61]
σ_y	0.60 [0.54; 0.68]	0.80[0.68; 1.07]	1.17 [0.96; 1.39]	0.87 [0.75; 1.01]	1.03 [0.87; 1.17]
σ	12.81 [10.63; 16.51]	10.11 [7.55; 13.79]	11.72 [9.61; 16.14]	13.07 [10.19; 16.80]	13.84 [10.30; 16.76]
ω	0.53 [0.44; 0.61]	0.55 [0.47; 0.94]	0.24 [0.16; 0.36]	0.42 [0.33; 0.54]	0.29 [0.20; 0.38]
θ	0.63 [0.54; 0.68]	0.62 [0.54; 0.69]	0.56 [0.50; 0.66]	0.60 [0.54; 0.69]	0.59 [0.53; 0.69]
κ	0.01 [0.00; 0.08]	0.06 [0.01; 0.32]	0.02 [0.01; 0.22]	0.01 [0.00; 0.14]	0.03 [0.01; 0.16]
ρ	0.84 [0.77; 0.89]	0.64 [0.55; 0.72]	0.87 [0.78; 0.91]	0.81 [0.72; 0.86]	0.86 [0.78; 0.89]
ϕ_π	0.88 [0.68; 1.14]	0.84 [0.70; 0.99]	0.75 [0.56; 1.16]	1.01 [0.78; 1.36]	0.97 [0.69; 1.28]
ϕ_y	0.58 [0.41; 0.77]	0.73 [0.51; 0.83]	0.56 [0.39; 0.73]	0.51 [0.40; 0.74]	0.58 [0.39; 0.72]
ρ_R	0.39 [0.26; 0.50]	0.32 [0.19; 0.44]	0.31 [0.17; 0.42]	0.24 [0.12; 0.39]	0.16 [0.10; 0.30]
ρ_y	0.18 [0.12; 0.35]	0.20 [0.12; 0.35]	0.13 [0.07; 0.26]	0.22 [0.13; 0.37]	0.14 [0.07; 0.27]
			Second period[b]		
σ_R	0.62 [0.53; 0.83]	0.51 [0.46; 0.58]	0.51 [0.44; 0.61]	0.79 [0.73; 0.97]	0.53 [0.44; 0.62]
σ_π	0.77 [0.68; 1.02]	0.63 [0.55; 0.73]	1.53 [1.33; 1.85]	1.87 [1.65; 2.40]	1.51 [1.28; 2.01]
σ_y	0.51 [0.45; 0.65]	0.57 [0.51; 0.66]	0.44 [0.38; 0.51]	0.48 [0.43; 0.56]	0.60 [0.51; 0.71]
σ	9.37 [7.16; 13.53]	12.59 [9.93; 16.00]	10.75 [7.86; 14.07]	10.35 [8.59; 15.27]	10.52 [7.64; 14.26]
ω	0.02 [0.01; 0.18]	0.27 [0.21; 0.40]	0.03 [0.01; 0.13]	0.12 [0.05; 0.24]	0.12 [0.05; 0.28]
θ	0.60 [0.52; 0.68]	0.64 [0.57; 0.70]	0.64 [0.55; 0.69]	0.60 [0.53; 0.67]	0.59 [0.53; 0.68]
κ	0.01 [0.00; 0.11]	0.00 [0.00; 0.07]	0.00 [0.00; 0.07]	0.00 [0.00; 0.07]	0.00 [0.00; 0.13]
ρ	0.61 [0.37; 0.72]	0.83 [0.77; 0.88]	0.87 [0.78; 0.91]	0.84 [0.79; 0.90]	0.86 [0.79; 0.91]
ϕ_π	1.05 [0.77; 1.37]	1.24 [0.94; 1.61]	0.98 [0.67; 1.30]	1.01 [0.71; 1.32]	0.94 [0.71; 1.30]
ϕ_y	0.53 [0.40; 0.75]	0.55 [0.41; 0.77]	0.55 [0.40; 0.74]	0.46 [0.38; 0.70]	0.47 [0.40; 0.73]
ρ_R	0.19 [0.13; 0.41]	0.43 [0.34; 0.61]	0.34 [0.16; 0.45]	0.16 [0.09; 0.30]	0.21 [0.13; 0.40]
ρ_y	0.21 [0.14; 0.47]	0.29 [0.16; 0.42]	0.23 [0.15; 0.45]	0.37 [0.20; 0.49]	0.20 [0.09; 0.33]

[a] *First period* Euro area: before European Monetary Union; United States: before October 1979; United Kingdom: floating of the pound to entry into ERM; Canada, Australia: collapse of Bretton Woods to introduction of inflation targeting. [b] *Second period* Euro area: European Monetary Union; United States: after the Volcker stabilisation; United Kingdom, Canada, Australia: inflation targeting regime.

Table 4 Bayesian estimates for the Blanchard and Gali (2007) model, posterior mode and 90%-coverage percentiles

	Euro area	Germany	France	Italy	Finland
	Before European Monetary Union				
σ_R	0.84 [0.71; 0.97]	0.67 [0.54; 0.83]	1.22 [1.06; 1.45]	1.24 [1.12; 1.47]	1.20 [1.07; 1.49]
σ_π	0.58 [0.49; 0.73]	0.73 [0.65; 1.14]	0.61 [0.50; 0.75]	1.06 [0.96; 1.56]	2.21 [1.58; 3.21]
σ_y	0.59 [0.51; 0.67]	0.57 [0.49; 0.76]	0.54 [0.48; 0.62]	0.66 [0.62; 0.81]	0.60 [0.56; 1.15]
σ	11.69 [9.48; 14.34]	7.00 [5.23; 10.95]	11.68 [9.94; 15.04]	13.65 [10.88; 16.57]	13.60 [10.26; 18.17]
θ	0.76 [0.72; 0.82]	0.66 [0.60; 0.73]	0.74 [0.69; 0.80]	0.78 [0.72; 0.83]	0.84 [0.60; 0.86]
γ	0.66 [0.60; 0.72]	0.05 [0.02; 0.34]	0.68 [0.61; 0.73]	0.69 [0.60; 0.75]	0.47 [0.28; 0.63]
δ	0.02 [0.00; 0.14]	0.30 [0.14; 0.54]	0.00 [0.00; 0.11]	0.01 [0.00; 0.13]	0.04 [0.03; 0.98]
ρ	0.82 [0.74; 0.85]	0.82 [0.73; 0.87]	0.67 [0.62; 0.78]	0.83 [0.78; 0.87]	0.85 [0.80; 0.89]
ϕ_π	1.51 [1.12; 1.82]	1.25 [1.07; 1.73]	1.62 [1.27; 1.93]	1.27 [1.08; 1.66]	1.17 [1.00; 1.55]
ϕ_y	0.60 [0.46; 0.90]	0.47 [0.38; 0.71]	0.56 [0.43; 0.81]	0.65 [0.48; 0.88]	0.63 [0.48; 0.91]
ρ_R	0.60 [0.41; 0.70]	0.48 [0.30; 0.63]	0.65 [0.52; 0.77]	0.39 [0.26; 0.57]	0.20 [0.11; 0.33]
ρ_y	0.12 [0.07; 0.24]	0.14 [0.07; 0.26]	0.18 [0.11; 0.31]	0.27 [0.16; 0.36]	0.10 [0.05; 0.65]
	European Monetary Union				
σ_R	0.60 [0.53; 0.82]	0.67 [0.54; 0.83]	0.60 [0.51; 0.78]	0.75 [0.60; 0.95]	0.73 [0.61; 1.01]
σ_π	0.70 [0.59; 1.03]	0.73 [0.65; 1.14]	0.69 [0.57; 0.96]	1.27 [1.04; 1.97]	1.04 [0.89; 1.61]
σ_y	0.53 [0.46; 0.72]	0.57 [0.49; 0.76]	0.52 [0.45; 0.71]	0.60 [0.50; 0.75]	0.55 [0.50; 0.74]
σ	6.28 [4.39; 10.20]	7.00 [5.23; 10.95]	6.96 [4.45; 10.90]	7.57 [6.02; 11.08]	6.85 [4.91; 10.58]
θ	0.66 [0.58; 0.73]	0.66 [0.60; 0.73]	0.66 [0.60; 0.73]	0.65 [0.53; 0.71]	0.60 [0.54; 0.67]
γ	0.00 [0.01; 0.24]	0.05 [0.02; 0.34]	0.16 [0.02; 0.31]	0.03 [0.02; 0.30]	0.09 [0.01; 0.28]
δ	0.32 [0.06; 0.66]	0.30 [0.14; 0.54]	0.54 [0.09; 0.88]	0.09 [0.02; 0.46]	0.44 [0.21; 0.58]
ρ	0.72 [0.57; 0.82]	0.82 [0.73; 0.87]	0.60 [0.45; 0.73]	0.82 [0.79; 0.89]	0.78 [0.72; 0.84]
ϕ_π	1.41 [1.10; 1.80]	1.25 [1.07; 1.73]	1.49 [1.14; 1.87]	1.26 [1.05; 1.67]	1.20 [1.04; 1.65]
ϕ_y	0.58 [0.38; 0.75]	0.47 [0.38; 0.71]	0.55 [0.41; 0.76]	0.55 [0.39; 0.74]	0.54 [0.37; 0.70]
ρ_R	0.50 [0.24; 0.64]	0.48 [0.30; 0.63]	0.32 [0.17; 0.52]	0.48 [0.26; 0.60]	0.42 [0.21; 0.57]
ρ_y	0.12 [0.07; 0.25]	0.14 [0.07; 0.26]	0.13 [0.07; 0.29]	0.13 [0.08; 0.28]	0.15 [0.07; 0.25]

Table 4 (continued) Bayesian estimates for the Blanchard and Gali (2007) model, posterior mode and 90%-coverage percentiles

	United States	United Kingdom	Canada	Australia
	First period[a]			
σ_R	0.76 [0.71; 0.93]	1.70 [1.40; 1.99]	1.67 [1.45; 2.02]	2.03 [1.83; 2.63]
σ_π	0.54 [0.46; 0.68]	1.63 [1.36; 2.78]	1.00 [0.82; 1.39]	1.73 [1.40; 3.19]
σ_y	0.61 [0.54; 0.73]	0.78 [0.68; 1.01]	0.64 [0.55; 0.91]	0.65 [0.58; 1.10]
σ	10.13 [7.06; 12.93]	14.49 [12.41; 19.94]	10.79 [9.19; 17.19]	13.30 [10.24; 19.12]
θ	0.69 [0.65; 0.76]	0.57 [0.50; 0.64]	0.77 [0.60; 0.81]	0.78 [0.54; 0.82]
γ	0.64 [0.57; 0.71]	0.63 [0.49; 0.77]	0.58 [0.45; 0.68]	0.47 [0.29; 0.62]
δ	0.47 [0.41; 0.57]	0.68 [0.54; 0.92]	0.12 [0.04; 0.57]	0.10 [0.02; 0.92]
ρ	0.59 [0.52; 0.68]	0.82 [0.78; 0.86]	0.74 [0.66; 0.82]	0.79 [0.70; 0.85]
ϕ_π	1.08 [0.99; 1.34]	1.09 [1.01; 1.41]	1.53 [1.20; 1.89]	1.29 [1.05; 1.68]
ϕ_y	0.69 [0.53; 0.90]	0.54 [0.43; 0.79]	0.62 [0.46; 0.84]	0.62 [0.46; 0.85]
ρ_R	0.40 [0.25; 0.53]	0.28 [0.18; 0.41]	0.36 [0.20; 0.53]	0.26 [0.15; 0.42]
ρ_y	0.17 [0.12; 0.33]	0.19 [0.13; 0.48]	0.16 [0.10; 0.33]	0.11 [0.07; 0.55]
	Second period[b]			
σ_R	0.54 [0.49; 0.63]	0.55 [0.50; 0.75]	0.92 [0.80; 1.13]	0.58 [0.50; 0.74]
σ_π	0.56 [0.48; 0.74]	0.82 [0.71; 1.84]	1.34 [0.99; 2.00]	0.96 [0.80; 1.47]
σ_y	0.56 [0.48; 0.62]	0.45 [0.39; 0.54]	0.49 [0.42; 0.57]	0.55 [0.48; 0.71]
σ	10.82 [8.34; 13.70]	8.94 [7.16; 11.74]	10.95 [8.54; 14.02]	12.02 [8.75; 15.35]
θ	0.87 [0.84; 0.90]	0.76 [0.69; 0.82]	0.79 [0.74; 0.84]	0.58 [0.50; 0.65]
γ	0.38 [0.21; 0.42]	0.14 [0.05; 0.50]	0.30 [0.11; 0.51]	0.40 [0.23; 0.56]
δ	0.00 [0.00; 0.12]	0.01 [0.00; 0.10]	0.00 [0.00; 0.09]	1.00 [0.70; 0.99]
ρ	0.76 [0.72; 0.82]	0.86 [0.80; 0.89]	0.84 [0.80; 0.88]	0.83 [0.77; 0.87]
ϕ_π	1.60 [1.22; 1.95]	1.39 [1.10; 1.79]	1.48 [1.10; 1.82]	1.19 [1.01; 1.51]
ϕ_y	0.76 [0.55; 0.98]	0.59 [0.44; 0.84]	0.65 [0.47; 0.84]	0.58 [0.41; 0.78]
ρ_R	0.50 [0.36; 0.61]	0.43 [0.26; 0.71]	0.20 [0.11; 0.39]	0.25 [0.13; 0.42]
ρ_y	0.33 [0.21; 0.46]	0.24 [0.12; 0.38]	0.28 [0.18; 0.46]	0.16 [0.11; 0.33]

Table 4 (continued) Bayesian estimates for the Blanchard and Gali (2007) model, posterior mode and 90%-coverage percentiles

	Sweden	New Zealand	Switzerland
		First period[a]	
σ_R	1.02 [0.89; 1.19]	0.90 [0.79; 1.21]	0.51 [0.47; 0.75]
σ_π	4.15 [3.10; 5.90]	7.71 [6.37; 8.74]	1.44 [1.14; 1.96]
σ_y	0.81 [0.67; 1.06]	1.09 [0.95; 1.70]	0.63 [0.54; 1.04]
σ	15.45 [11.70; 18.51]	15.25 [12.08; 19.62]	10.22 [9.34; 19.95]
θ	0.61 [0.53; 0.66]	0.59 [0.53; 0.68]	0.80 [0.53; 0.83]
γ	0.04 [0.02; 0.35]	0.46 [0.32; 0.57]	0.57 [0.40; 0.67]
δ	0.99 [0.86; 1.00]	0.99 [0.91; 1.00]	0.50 [0.05; 0.62]
ρ	0.89 [0.87; 0.92]	0.96 [0.95; 0.97]	0.92 [0.87; 0.94]
ϕ_π	1.04 [1.00; 1.34]	1.09 [1.00; 1.37]	1.00 [0.99; 1.42]
ϕ_y	0.54 [0.44; 0.80]	0.51 [0.40; 0.75]	0.64 [0.48; 0.88]
ρ_R	0.14 [0.09; 0.27]	0.27 [0.14; 0.40]	0.41 [0.21; 0.56]
ρ_y	0.44 [0.33; 0.55]	0.69 [0.56; 0.76]	0.11 [0.08; 0.44]
		Second period[b]	
σ_R	0.83 [0.73; 1.09]	0.89 [0.74; 1.04]	0.59 [0.51; 0.79]
σ_π	2.10 [1.29; 3.14]	2.33 [1.63; 3.29]	0.75 [0.65; 1.07]
σ_y	0.50 [0.42; 0.58]	0.60 [0.52; 0.78]	0.54 [0.48; 0.77]
σ	11.32 [8.79; 14.22]	13.06 [11.28; 18.44]	6.52 [4.85; 12.02]
θ	0.81 [0.75; 0.86]	0.66 [0.58; 0.72]	0.69 [0.63; 0.76]
γ	0.20 [0.06; 0.59]	0.20 [0.05; 0.46]	0.09 [0.01; 0.28]
δ	0.00 [0.00; 0.07]	0.65 [0.56; 0.95]	0.49 [0.21; 0.74]
ρ	0.87 [0.83; 0.91]	0.85 [0.81; 0.89]	0.66 [0.51; 0.78]
ϕ_π	1.26 [1.00; 1.56]	1.02 [1.00; 1.38]	1.41 [1.13; 1.81]
ϕ_y	0.67 [0.51; 0.89]	0.62 [0.44; 0.84]	0.58 [0.41; 0.76]
ρ_R	0.18 [0.10; 0.41]	0.18 [0.11; 0.34]	0.31 [0.15; 0.49]
ρ_y	0.38 [0.27; 0.58]	0.32 [0.19; 0.50]	0.14 [0.08; 0.30]

[a] *First period* Sweden and New Zealand: collapse of Bretton Woods to introduction of inflation targeting; Switzerland: before introduction of 'new monetary policy concept'.
[b] *Second period* Sweden and New Zealand: inflation targeting regime; Switzerland: 'new monetary policy concept'.

Table 5 Bayesian estimates for the Sheedy (2007) model, posterior mode and 90%-coverage percentiles

	Euro area	Germany	France	Italy	Finland
	Before European Monetary Union				
σ_R	0.76 [0.68; 1.25]	0.65 [0.53; 0.83]	1.54 [1.35; 1.87]	1.24 [1.07; 1.38]	1.10 [1.02; 1.35]
σ_π	2.31 [1.36; 2.70]	1.09 [0.72; 1.37]	1.46 [1.23; 1.78]	5.03 [4.26; 5.69]	5.04 [4.35; 5.64]
σ_y	0.58 [0.51; 0.65]	0.57 [0.48; 0.72]	0.55 [0.49; 0.62]	0.69 [0.60; 0.77]	1.03 [0.87; 1.19]
σ	13.35 [10.70; 16.65]	8.26 [6.11; 11.45]	13.59 [11.49; 17.34]	13.02 [10.65; 16.63]	12.43 [9.59; 16.00]
ψ	0.13 [0.09; 0.15]	0.06 [0.01; 0.09]	0.10 [0.08; 0.13]	0.11 [0.09; 0.15]	0.01 [0.00; 0.06]
α	0.26 [0.21; 0.37]	0.39 [0.32; 0.48]	0.34 [0.27; 0.41]	0.25 [0.21; 0.34]	0.30 [0.24; 0.36]
γ	0.01 [0.00; 0.08]	0.00 [0.01; 0.18]	0.01 [0.00; 0.07]	0.02 [0.00; 0.09]	0.02 [0.01; 0.18]
ρ	0.79 [0.71; 0.82]	0.80 [0.70; 0.88]	0.67 [0.61; 0.73]	0.80 [0.77; 0.85]	0.86 [0.82; 0.89]
ϕ_π	1.08 [0.93; 2.08]	1.17 [0.98; 1.59]	2.18 [1.76; 2.57]	0.97 [0.91; 1.28]	1.10 [0.82; 1.34]
ϕ_y	0.65 [0.47; 0.91]	0.44 [0.35; 0.70]	0.50 [0.38; 0.70]	0.71 [0.51; 0.91]	0.65 [0.49; 0.85]
ρ_R	0.55 [0.39; 0.94]	0.40 [0.24; 0.80]	0.95 [0.92; 0.96]	0.38 [0.24; 0.51]	0.22 [0.12; 0.35]
ρ_y	0.20 [0.12; 0.33]	0.21 [0.10; 0.34]	0.32 [0.19; 0.42]	0.41 [0.27; 0.52]	0.10 [0.06; 0.23]
	European Monetary Union				
σ_R	0.66 [0.53; 0.84]	0.65 [0.53; 0.83]	0.57 [0.50; 0.77]	0.67 [0.54; 0.87]	0.60 [0.52; 0.80]
σ_π	0.86 [0.73; 1.05]	1.09 [0.72; 1.37]	0.72 [0.63; 0.96]	1.79 [1.55; 2.32]	1.31 [1.15; 1.76]
σ_y	0.52 [0.44; 0.65]	0.57 [0.48; 0.72]	0.52 [0.46; 0.67]	0.52 [0.47; 0.69]	0.68 [0.59; 0.91]
σ	7.09 [6.36; 12.87]	8.26 [6.11; 11.45]	8.68 [6.13; 12.44]	9.59 [7.22; 14.50]	9.94 [7.61; 13.50]
ψ	0.01 [0.00; 0.07]	0.06 [0.01; 0.09]	0.04 [0.00; 0.08]	0.01 [0.00; 0.07]	0.04 [0.01; 0.08]
α	0.36 [0.29; 0.44]	0.39 [0.32; 0.48]	0.36 [0.29; 0.42]	0.40 [0.32; 0.48]	0.44 [0.36; 0.53]
γ	0.00 [0.00; 0.12]	0.00 [0.01; 0.18]	0.02 [0.01; 0.16]	0.01 [0.00; 0.11]	0.03 [0.01; 0.18]
ρ	0.65 [0.45; 0.77]	0.80 [0.70; 0.88]	0.56 [0.40; 0.72]	0.86 [0.79; 0.91]	0.81 [0.75; 0.88]
ϕ_π	1.23 [0.95; 1.56]	1.17 [0.98; 1.59]	1.30 [1.01; 1.65]	1.15 [0.95; 1.48]	1.12 [0.97; 1.44]
ϕ_y	0.50 [0.42; 0.79]	0.44 [0.35; 0.70]	0.55 [0.44; 0.81]	0.54 [0.37; 0.70]	0.46 [0.33; 0.65]
ρ_R	0.25 [0.15; 0.49]	0.40 [0.24; 0.80]	0.24 [0.15; 0.49]	0.30 [0.16; 0.55]	0.24 [0.13; 0.53]
ρ_y	0.18 [0.11; 0.37]	0.21 [0.10; 0.34]	0.23 [0.09; 0.34]	0.24 [0.12; 0.37]	0.18 [0.09; 0.33]

Table 5 (continued) Bayesian estimates for the Sheedy (2007) model, posterior mode and 90%-coverage percentiles

	United States	United Kingdom	Canada	Australia
	First period[a]			
σ_R	0.78 [0.68; 0.87]	1.44 [1.24; 1.70]	1.46 [1.32; 1.80]	1.82 [1.69; 2.23]
σ_π	1.84 [1.54; 2.07]	6.23 [5.12; 7.19]	2.71 [2.36; 3.36]	4.06 [3.72; 5.32]
σ_y	0.62 [0.54; 0.83]	0.97 [0.85; 1.26]	0.79 [0.68; 0.94]	0.91 [0.82; 1.09]
σ	8.27 [6.78; 13.58]	10.88 [8.37; 14.16]	10.97 [8.74; 14.41]	12.03 [10.50; 16.23]
ψ	0.13 [0.10; 0.15]	0.06 [0.02; 0.11]	0.09 [0.06; 0.13]	0.09 [0.03; 0.12]
α	0.25 [0.21; 0.34]	0.31 [0.26; 0.40]	0.33 [0.25; 0.38]	0.33 [0.26; 0.41]
γ	0.39 [0.17; 0.49]	0.08 [0.01; 0.26]	0.02 [0.01; 0.18]	0.04 [0.01; 0.15]
ρ	0.59 [0.49; 0.66]	0.86 [0.82; 0.90]	0.80 [0.70; 0.84]	0.83 [0.76; 0.86]
ϕ_π	0.94 [0.90; 1.07]	1.00 [0.88; 1.38]	1.24 [1.00; 1.58]	1.17 [0.94; 1.44]
ϕ_y	0.71 [0.61; 0.94]	0.63 [0.46; 0.84]	0.65 [0.46; 0.84]	0.61 [0.43; 0.82]
ρ_R	0.31 [0.22; 0.48]	0.39 [0.20; 0.53]	0.25 [0.18; 0.52]	0.26 [0.13; 0.39]
ρ_y	0.21 [0.13; 0.36]	0.11 [0.06; 0.23]	0.22 [0.12; 0.34]	0.15 [0.08; 0.26]
	Second period[b]			
σ_R	0.52 [0.47; 0.61]	0.52 [0.45; 0.64]	0.84 [0.74; 1.02]	0.51 [0.46; 0.65]
σ_π	1.02 [0.89; 1.15]	1.56 [1.43; 1.94]	2.15 [1.88; 2.58]	1.99 [1.66; 2.37]
σ_y	0.52 [0.48; 0.62]	0.43 [0.38; 0.50]	0.50 [0.42; 0.55]	0.55 [0.49; 0.68]
σ	11.36 [8.92; 15.47]	9.64 [7.60; 13.72]	11.50 [9.11; 14.92]	9.25 [6.87; 12.87]
ψ	0.01 [0.00; 0.07]	0.00 [0.00; 0.05]	0.02 [0.00; 0.07]	0.02 [0.00; 0.09]
α	0.24 [0.20; 0.31]	0.31 [0.27; 0.41]	0.34 [0.29; 0.42]	0.33 [0.27; 0.41]
γ	0.02 [0.00; 0.07]	0.00 [0.00; 0.07]	0.01 [0.00; 0.06]	0.03 [0.00; 0.15]
ρ	0.77 [0.71; 0.83]	0.85 [0.80; 0.91]	0.86 [0.81; 0.90]	0.87 [0.80; 0.90]
ϕ_π	1.26 [1.03; 1.69]	1.07 [0.85; 1.44]	1.13 [0.91; 1.52]	1.10 [0.89; 1.43]
ϕ_y	0.70 [0.53; 0.91]	0.64 [0.44; 0.79]	0.58 [0.41; 0.74]	0.51 [0.45; 0.81]
ρ_R	0.51 [0.37; 0.63]	0.32 [0.19; 0.53]	0.19 [0.10; 0.34]	0.27 [0.13; 0.44]
ρ_y	0.33 [0.24; 0.52]	0.25 [0.14; 0.40]	0.35 [0.23; 0.49]	0.14 [0.08; 0.29]

Table 5 (continued) Bayesian estimates for the Sheedy (2007) model, posterior mode and 90%-coverage percentiles

	Sweden	New Zealand	Switzerland
	First period[a]		
σ_R	0.83 [0.75; 1.00]	0.75 [0.65; 0.89]	0.50 [0.44; 0.57]
σ_π	5.59 [4.96; 6.02]	13.01 [12.64; 13.39]	3.85 [3.28; 4.21]
σ_y	1.15 [0.99; 1.52]	2.88 [2.52; 3.80]	1.01 [0.85; 1.15]
σ	11.90 [8.36; 15.48]	10.19 [8.76; 15.29]	13.59 [9.46; 16.54]
ψ	0.00 [0.00; 0.04]	0.01 [0.00; 0.04]	0.05 [0.02; 0.10]
α	0.33 [0.28; 0.40]	0.27 [0.22; 0.33]	0.33 [0.25; 0.38]
γ	0.03 [0.01; 0.25]	0.11 [0.03; 0.30]	0.00 [0.01; 0.17]
ρ	0.94 [0.91; 0.95]	0.97 [0.96; 0.98]	0.92 [0.90; 0.94]
ϕ_π	0.94 [0.82; 1.31]	0.85 [0.71; 1.17]	0.92 [0.85; 1.24]
ϕ_y	0.58 [0.45; 0.81]	0.64 [0.50; 0.84]	0.59 [0.48; 0.84]
ρ_R	0.18 [0.10; 0.32]	0.31 [0.17; 0.46]	0.23 [0.14; 0.41]
ρ_y	0.06 [0.04; 0.17]	0.14 [0.07; 0.24]	0.14 [0.08; 0.24]
	Second period[b]		
σ_R	0.83 [0.69; 0.97]	0.71 [0.64; 0.85]	0.57 [0.50; 0.75]
σ_π	3.09 [2.74; 3.71]	3.04 [2.77; 3.66]	0.77 [0.69; 1.02]
σ_y	0.51 [0.43; 0.59]	0.80 [0.69; 0.99]	0.56 [0.49; 0.73]
σ	11.99 [8.75; 14.94]	9.75 [7.50; 13.70]	7.47 [6.03; 11.54]
ψ	0.00 [0.00; 0.04]	0.00 [0.00; 0.04]	0.01 [0.00; 0.06]
α	0.31 [0.26; 0.37]	0.34 [0.26; 0.38]	0.34 [0.29; 0.42]
γ	0.00 [0.00; 0.07]	0.09 [0.01; 0.22]	0.00 [0.01; 0.19]
ρ	0.88 [0.83; 0.92]	0.90 [0.87; 0.93]	0.63 [0.47; 0.76]
ϕ_π	0.95 [0.80; 1.32]	1.03 [0.81; 1.33]	1.13 [0.99; 1.66]
ϕ_y	0.60 [0.46; 0.81]	0.61 [0.48; 0.83]	0.63 [0.43; 0.77]
ρ_R	0.21 [0.10; 0.35]	0.24 [0.15; 0.41]	0.26 [0.14; 0.46]
ρ_y	0.37 [0.26; 0.57]	0.14 [0.08; 0.28]	0.23 [0.11; 0.38]

[a] *First period* Sweden and New Zealand: collapse of Bretton Woods to introduction of inflation targeting; Switzerland: before introduction of 'new monetary policy concept'.

[b] *Second period* Sweden and New Zealand: inflation targeting regime; Switzerland: 'new monetary policy concept'.

Table 6 Bayesian estimates for the Ascari and Ropele (2007) model, posterior mode and 90%-coverage percentiles

	Euro area (1970:1-2006:4)	West Germany (1970:1-1989:3)	Germany (1991:1-2007:3)
σ_R	0.87 [0.79; 1.05]	1.13 [1.05; 1.42]	0.56 [0.48; 0.70]
σ_π	1.75 [1.60; 2.00]	3.22 [2.68; 3.61]	1.62 [1.46; 2.00]
σ_y	0.41 [0.35; 0.56]	0.57 [0.52 ; 1.05]	0.44 [0.34; 0.53]
θ	4.27 [3.01; 7.70]	7.18 [4.53; 18.72]	6.72 [3.91; 13.83]
α	0.59 [0.57; 0.63]	0.59 [0.56; 0.62]	0.59 [0.56; 0.62]
ϵ	0.02 [0.01; 0.11]	0.00 [0.00; 0.06]	0.00 [0.00; 0.10]
σ	2.80 [2.19; 4.61]	3.92 [3.10; 7.48]	1.66 [1.23; 2.69]
δ	0.15 [0.02; 0.38]	0.04 [0.02; 0.89]	0.60 [0.15; 0.93]
ρ	0.76 [0.72; 0.82]	0.78 [0.74; 0.85]	0.79 [0.73; 0.84]
ϕ_π	1.40 [1.22; 1.86]	1.31 [1.15; 1.68]	1.21 [1.13; 1.53]
ϕ_y	3.28 [2.68; 4.43]	2.25 [1.48; 3.53]	2.20 [1.49; 3.18]
ρ_R	0.44 [0.32; 0.54]	0.19 [0.09; 0.30]	0.23 [0.14; 0.38]
ρ_y	0.80 [0.73; 0.84]	0.66 [0.11; 0.72]	0.81 [0.74; 0.85]
	France (1970:1-2007:3)	Italy (1970:1-2007:3)	Finland (1978:1-2007:3)
σ_R	1.01 [0.95; 1.15]	1.34 [1.22; 1.55]	1.05 [0.94; 1.20]
σ_π	2.14 [1.94; 2.39]	4.39 [4.00; 5.00]	4.17 [3.81; 4.65]
σ_y	0.51 [0.48; 0.59]	0.46 [0.41; 0.59]	0.98 [0.88; 1.12]
θ	20.80 [19.81; 24.85]	2.65 [2.13; 4.90]	10.32 [8.08; 12.02]
α	0.65 [0.62; 0.68]	0.60 [0.57; 0.63]	0.65 [0.63; 0.68]
ϵ	0.13 [0.07; 0.21]	0.01 [0.00; 0.11]	0.00 [0.00; 0.03]
σ	9.74 [7.97; 11.45]	6.31 [5.22; 8.59]	8.04 [6.16; 9.99]
δ	0.00 [0.00; 0.00]	0.01 [0.00; 0.15]	0.02 [0.01; 0.14]
ρ	0.85 [0.81; 0.88]	0.84 [0.80; 0.86]	0.90 [0.88; 0.92]
ϕ_π	2.35 [2.05; 2.87]	1.79 [1.33; 2.15]	1.72 [1.52; 1.97]
ϕ_y	2.35 [1.64; 3.07]	2.46 [1.48; 3.18]	3.09 [2.31; 4.11]
ρ_R	0.28 [0.20; 0.40]	0.31 [0.20; 0.42]	0.18 [0.11; 0.32]
ρ_y	0.37 [0.27; 0.48]	0.75 [0.67; 0.82]	0.15 [0.07; 0.26]

Table 6 (continued) Bayesian estimates for the Ascari and Ropele (2007) model, posterior mode and 90%-coverage percentiles

	United Kingdom (1957:1-2007:3)	Canada (1961:1-2007:4)	Sweden (1970:1-2007:4)
σ_R	1.55 [1.41; 1.78]	1.36 [1.27; 1.63]	0.94 [0.87; 1.09]
σ_π	4.51 [4.02; 4.94]	3.12 [2.71; 3.50]	4.66 [4.39; 5.29]
σ_y	0.43 [0.39; 0.56]	0.61 [0.43; 0.77]	0.47 [0.42; 0.59]
θ	4.66 [2.85; 6.84]	5.64 [3.28; 10.28]	5.14 [3.40; 8.44]
α	0.58 [0.55; 0.62]	0.63 [0.59; 0.66]	0.59 [0.56; 0.61]
ϵ	0.01 [0.00; 0.09]	0.03 [0.01; 0.13]	0.00 [0.00; 0.02]
σ	6.90 [5.95;11.69]	6.93 [4.68; 9.12]	7.17 [4.65; 10.26]
δ	0.99 [0.79; 0.99]	0.15 [0.02; 0.41]	0.99 [0.91; 1.00]
ρ	0.84 [0.80; 0.87]	0.81 [0.77; 0.86]	0.91 [0.89; 0.93]
ϕ_π	1.29 [1.17; 1.65]	1.46 [1.32; 2.15]	1.26 [1.11; 1.39]
ϕ_y	4.04 [3.30; 5.93]	2.93 [2.30; 4.06]	4.26 [3.07; 5.67]
ρ_R	0.24 [0.16; 0.37]	0.20 [0.12; 0.34]	0.15 [0.08; 0.24]
ρ_y	0.75 [0.66; 0.78]	0.62 [0.39; 0.72]	0.73 [0.67; 0.81]
	Australia (1969:3-2007:4)	New Zealand (1970:1-2007:4)	Switzerland (1970:1-2007:4)
σ_R	1.66 [1.54; 1.94]	1.42 [1.28; 1.66]	0.60 [0.55; 0.71]
σ_π	3.67 [3.36; 4.07]	10.48 [10.36; 10.71]	3.40 [3.12; 3.76]
σ_y	0.44 [0.37; 0.52]	0.98 [0.77; 1.13]	0.37 [0.32; 0.45]
θ	5.26 [3.19; 7.87]	5.01 [3.74; 6.90]	3.76 [2.85; 9.33]
α	0.59 [0.56; 0.62]	0.61 [0.57; 0.63]	0.58 [0.55; 0.61]
ϵ	0.01 [0.00; 0.07]	0.00 [0.00; 0.02]	0.00 [0.00; 0.07]
σ	7.66 [5.71;11.45]	5.33 [4.05; 9.67]	5.83 [3.84; 8.73]
δ	1.00 [0.74; 0.99]	1.00 [0.93; 1.00]	0.84 [0.64; 0.97]
ρ	0.83 [0.78; 0.85]	0.95 [0.93; 0.96]	0.91 [0.89; 0.93]
ϕ_π	1.19 [1.12; 1.51]	1.27 [1.18; 1.45]	1.17 [1.10; 1.40]
ϕ_y	3.83 [2.66; 4.98]	3.37 [2.93; 5.69]	2.27 [1.54; 3.37]
ρ_R	0.14 [0.08; 0.25]	0.20 [0.11; 0.31]	0.28 [0.17; 0.40]
ρ_y	0.74 [0.66; 0.79]	0.84 [0.74; 0.85]	0.79 [0.72; 0.84]

Table 7 Coefficients on the state variables in the optimal monetary rule under high and low indexation

State variable:	Euro area	United States	United Kingdom	Canada	Switzerland
			High indexation		
$\epsilon_{y,t}$	3.21	2.28	3.44	3.75	1.37
$\epsilon_{\pi,t}$	0.85	0.63	0.40	0.44	0.20
y_{t-1}	0.69	0.09	0.44	0.46	0.55
π_{t-1}	0.40	0.30	0.15	0.18	0.06
R_{t-1}	0.49	0.58	0.54	0.57	0.49
			Low indexation		
$\epsilon_{y,t}$	2.50	2.19	2.99	3.19	1.28
$\epsilon_{\pi,t}$	0.04	0.30	0.04	0.09	0.04
y_{t-1}	0.53	0.09	0.39	0.39	0.51
π_{t-1}	0.00	0.11	0.00	0.01	0.00
R_{t-1}	0.57	0.59	0.58	0.62	0.51

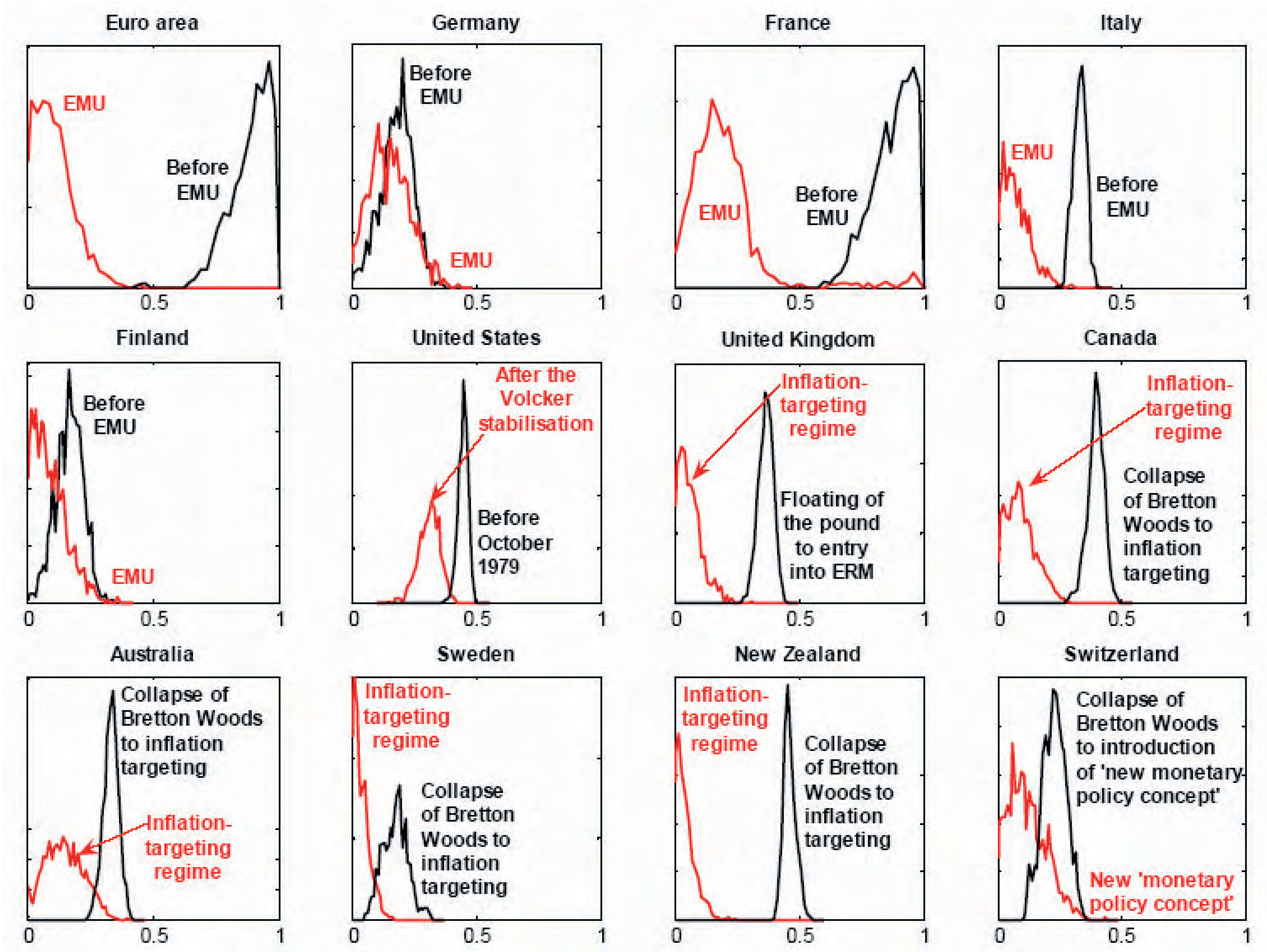

Figure 1 Posterior distribution of α in the model of Fuhrer and Moore (1995)

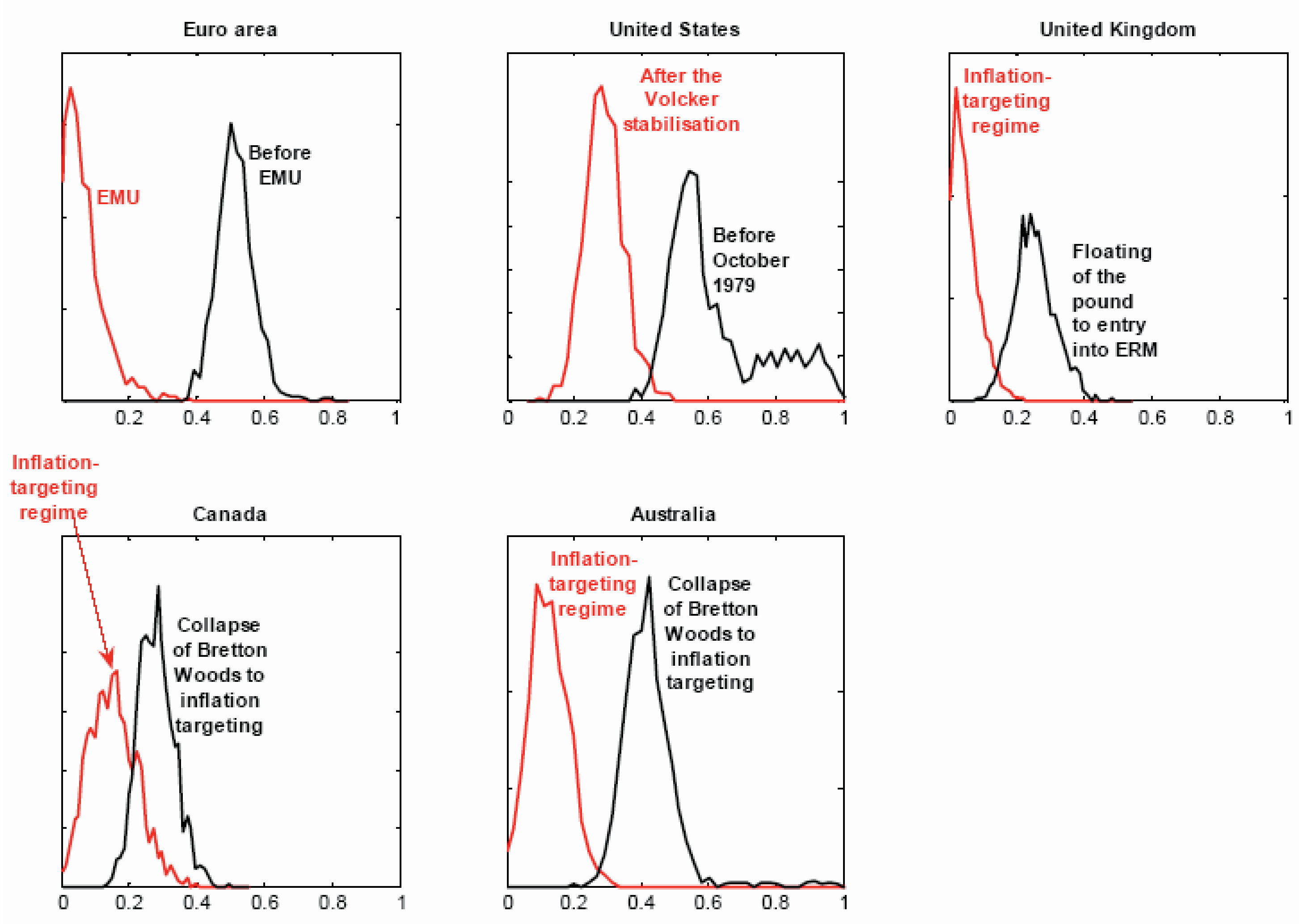

Figure 2 Posterior distribution of ω in the model of Gali and Gertler (1999)

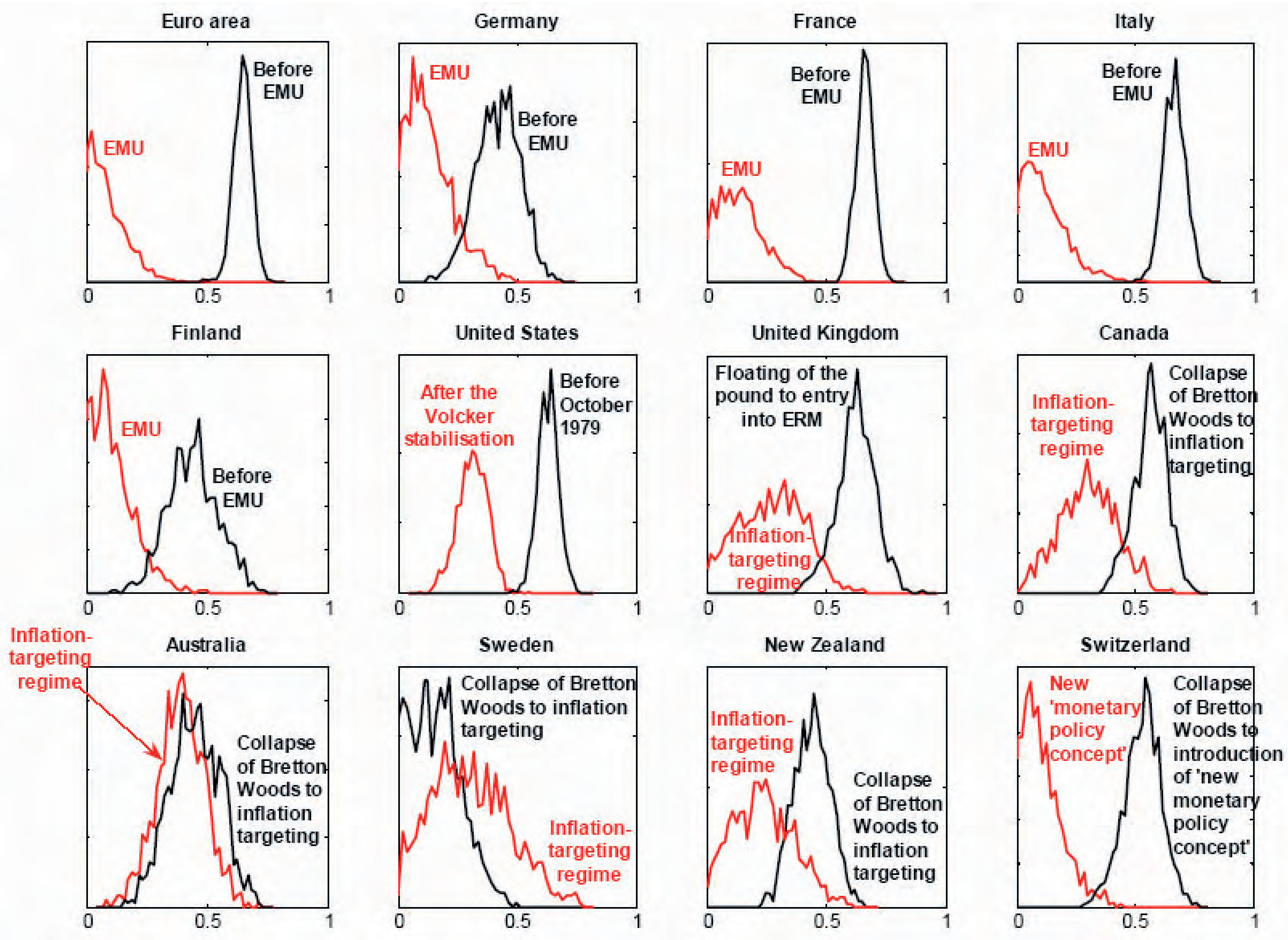

Figure 3 Posterior distribution of γ in the model of Blanchard and Gali (2007)

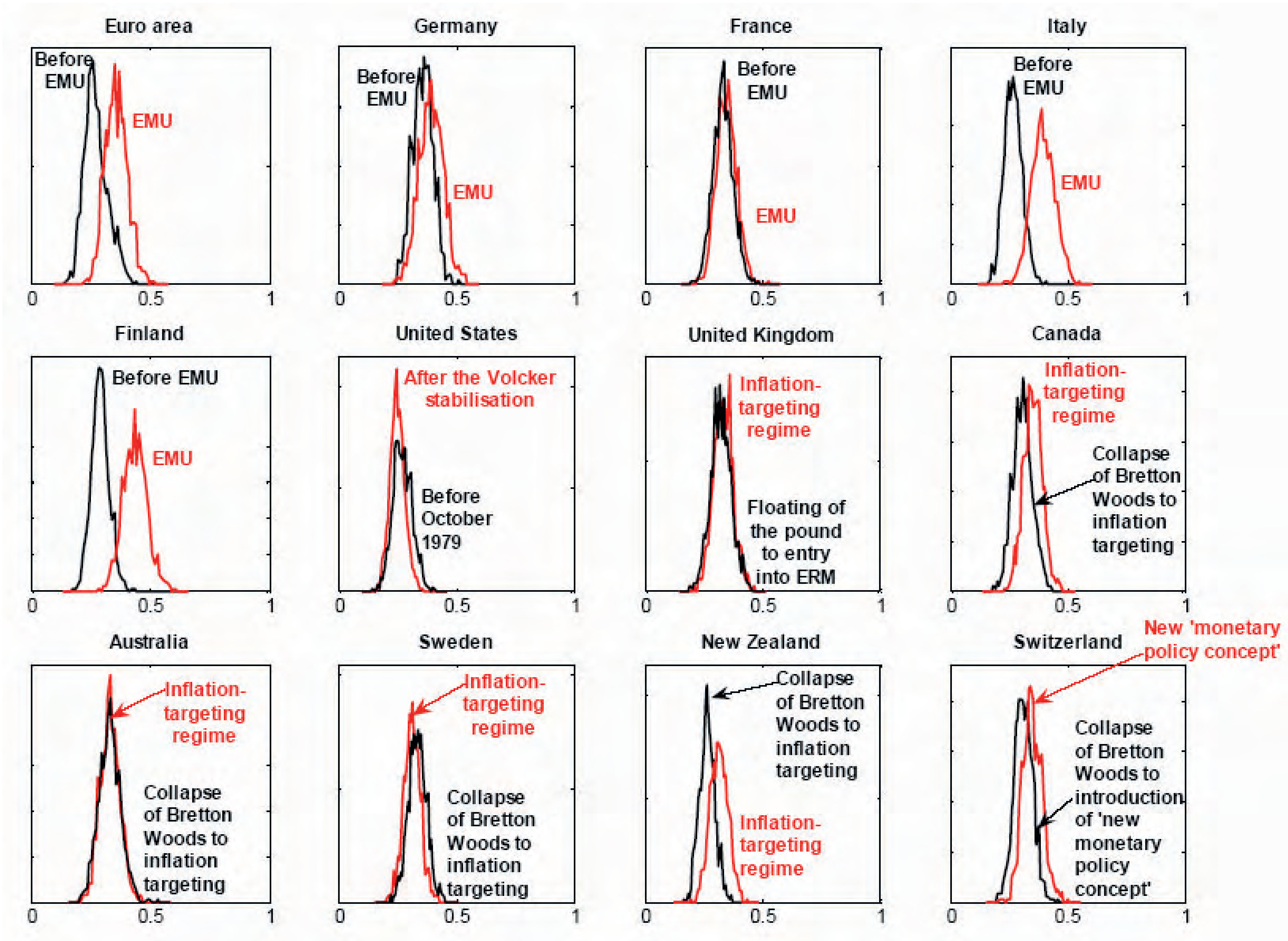

Figure 4 Posterior distributions of α in the model of Sheedy (2007)

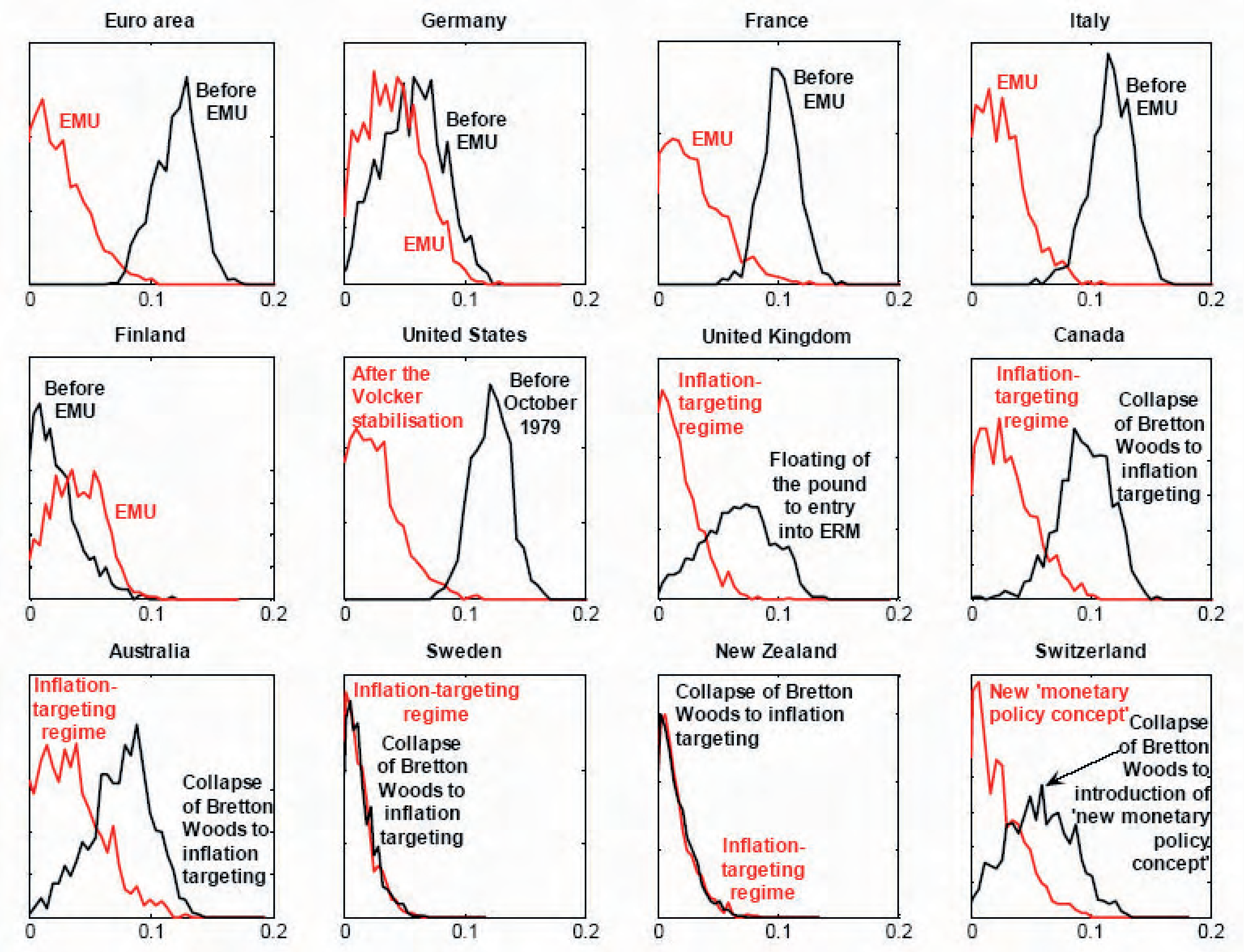

Figure 5 Posterior distributions of ψ_1 in the model of Sheedy (2007)

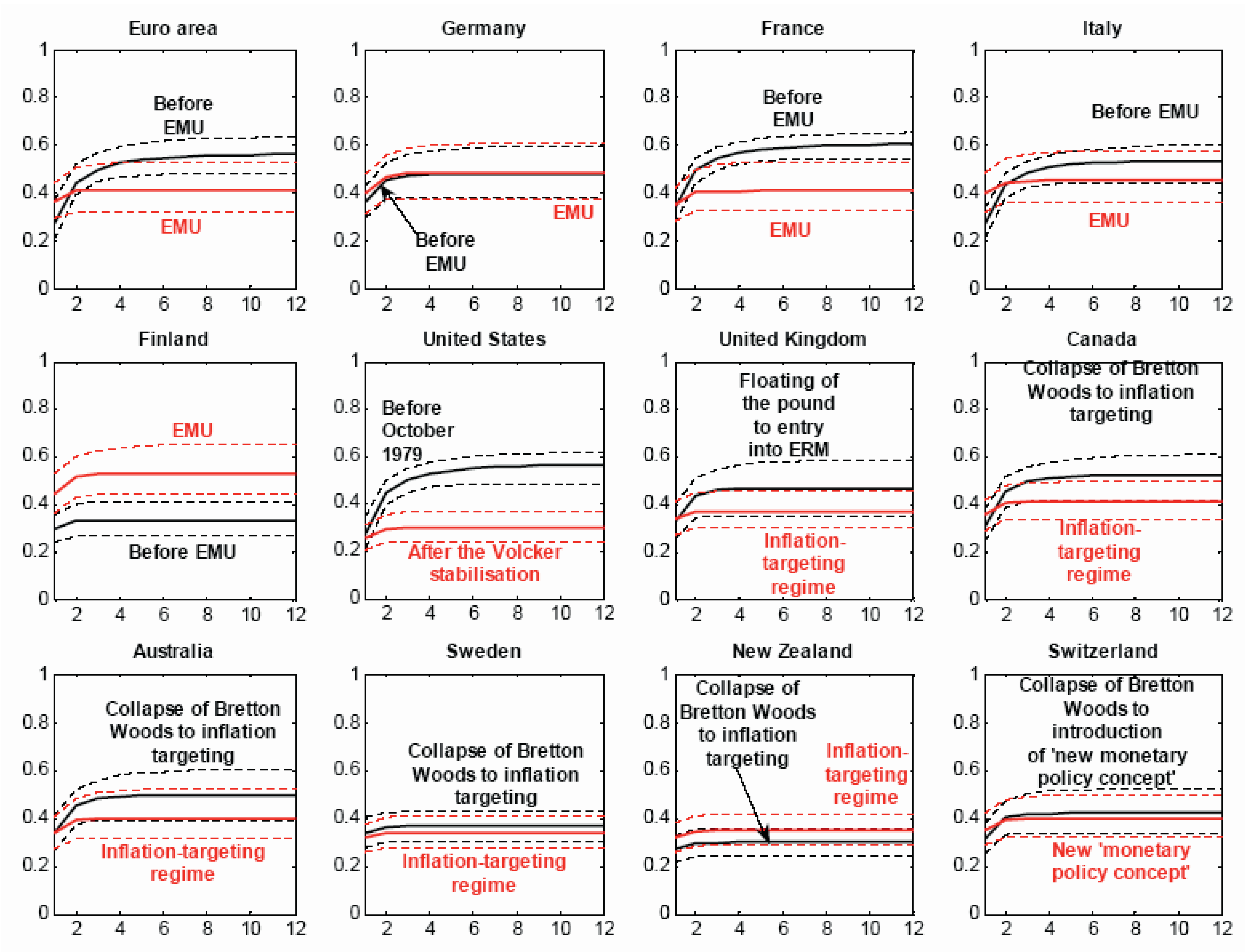

Figure 6 Posterior distributions of the estimated hazard functions for the model of Sheedy (2007)

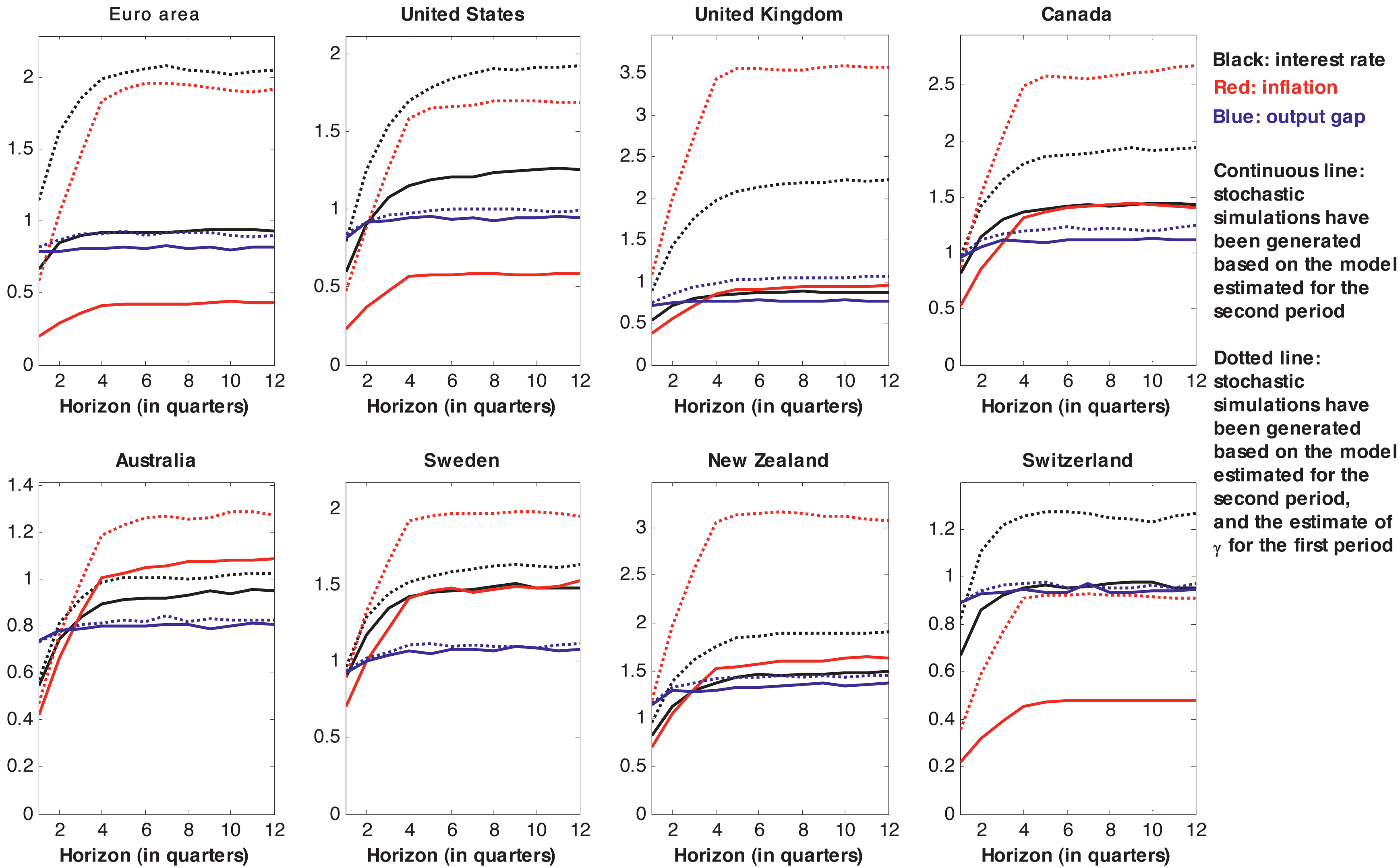

Figure 7 Standard deviations at horizon k of the model-generated distributions of the interest rate, annual inflation, and the output gap, based on 5,000 stochastic simulations of the estimated Blanchard and Gali (2007) model

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