Bayesian Linear Estimation of Okun Coefficient for Romania: Sensitivity to Priors

Abdellah KORI YAHIA

Institute for Economic Forecasting, Romanian Academy, Bucharest

7 January 2018

Bayesian Linear Estimation of Okun Coefficient for Romania: Sensitivity to Priors

Petre Caraiani[1]

Abstract:

I use the Bayesian approach in order to derive an estimation of Okun coefficient for Romania. The data used is at quarterly frequency and it consists in the unemployment rate and GDP between 2000 and 2009. I use three different priors, a normal one, a beta prior and a uniform prior for the parameter associated to the Okun coefficient. The results indicate an Okun coefficient around -0.20, with the prior distributions having a mild effect on posterior mean results.

Key words:

dynamic linear models, Bayesian techniques, unemployment, Okun coefficient, simulation techniques;

JEL Classification: C51, E32, E52.

---

[1] - **Petre CARAIANI**, Researcher at the Institute for Economic Forecasting, Romanian Academy, Bucharest, Caraiani@ipe.ro

1- Introduction:

The relation between unemployment and production is at the forefront of macroeconomics ever since the macroeconomics emerged as a discipline due to the contributions of Keynes. With the consolidation of econometrics and mathematical modelling of economic processes, due to the contributions of Okun, Okun (1970), the relationship became known as the Okun relationship.

The last financial and economic crisis reignited the interest in the estimation of the Okun coefficient. Such is the case of Romania where the recession severely affected the labour market.

This paper proposes the Bayesian approach to the estimation of the Okun coefficient. There is a growing interest in the use of the Bayesian approach due to its obvious advantages as compared to the classical approach (more internal coherence, better grounded on probabilistic theory, etc).

This paper is organized as follows. The second section reviews the main results in the literature on the Okun coefficient. The following section introduces the model and explains its building blocks. I estimate the model using Bayesian techniques and I derive an estimation of the Okun coefficient. I draw an assessment of the results and outline some possible future developments in the last section.

2- Literature review

In original form proposed by Okun (1970), the unemployment was related to the change in production through a simple linear regression. By estimating this simple equation for the data from US economy he was able to show that the Okun coefficient is around -0.30.

This study created a line of research into the relationship between unemployment that studies various aspects of this relationship. Most of the research was initially done on data from US economy. Some of the most important studies on this topic were those by Friedman a Wachter (1974), Gordon and Clark (1984), Evans (1989), Prachowny (1993) or Weber (1995).

Several studies approached the issue by estimating the results on several countries, Moosa (1997), Lee (2000), or Dritsaki and Dritsakis (2009).

Moosa (1997) used a model that was also used in Weber (1995) but he innovated by using a cross-perspective. He found Okun coefficients ranging from -0.08 for Japan to -0.41 for the United States which he explained based on the different degree of rigidity of the labour markets.

Lee (2000) also undertook a cross-country study on Okun coefficient, this time for 16 OECD countries and found two new relevant aspects: cross-country heterogeneity for OECD data, and strong evidence in the favour of structural changes of this coefficient.

More recently, some other aspects of the Okun coefficient were deepened, like time varying dynamics while other favoured the Bayesian approach. For example, Sogner and Stiassny (2000) study the structural stability of the Okun coefficient in 15 OECD economies using the Bayesian approach. They found significant variations among the countries studied as well as some evidence for some countries in favour of structural change.

Huang and Lin (2008) study showed using a Bayesian framework based on Gibbs sampler that it is better to model the Okun coefficient depending in a smooth way to time.

3- An Estimation of the Okun Coefficient Using the Bayesian Approach

I use the Bayesian framework in order to estimate the Okun coefficient for Romania. The model used is builds upon the initial contribution by Okun (1962) to which it adds the assumption of a AR(1) process for output. The resulting model is given below:

$$u_t = \beta y_t + \varepsilon u_t$$

$$y_t = \rho y_{t-1} + \varepsilon y_t$$

Here u_t is the quarterly unemployment, while y_t is quarterly GDP in 2000 prices with the sample between 2000 quarter 1 and 2009 quarter

Both series seasonally adjusted, logged and filtered using the Hodrick Prescott filter so as to obtain stationary series.

The Bayesian linear regression model implies the use of the same hypothesis as in the classical linear regression. To this, it adds the well known Bayesian principle, where:

Posterior α prior x likelihood:

In order to determine the sensitive dependence on the prior distributions, one of the most key aspects in the Bayesian approach, I use three different priors for the parameter related to the Okun coefficient. The baseline prior is a normal distribution with mean 0.5 and standard error 0.15, the second model comprises a beta prior distribution for the Okun coefficient with 0.5 mean and a 0.15 standard error. In the last model I use the uniform distribution with the sample between 0.05 and 0.75.

The models were estimated using two chains of 250000 extractions each using again the Monte-Carlo-Markov-Chains method. The parameter related to the Okun coefficient was monitored and statistics regarding its 90% confidence interval and mean were computed, see Table 1. The annexes also present detailed graphs regarding the posterior distributions as well as univariate and multivariate convergence statistics based on Brooks-Gelman contributions. The statistics in annexes A, B and C suggest that convergence was achieved for each of the cases. There is also considerable variability for posterior distributions relative to the prior ones.

Table 1

A Comparison of the Estimations of Okun Coefficient

Estimation	Posterior Mean	Confidence Interval		Log-Likelihood
Baseline model with a normal prior	-0.18	-0.06	-0.30	210.75
Alternative model with a beta prior	-0.20	-0.10	-0.30	210.80
Alternative model with an uniform prior	-0.13	-0.15	-0.20	212.81

Source: Own Computations.

The results here are in line with previous researches, like Caraiani (2006). The first thing that is remarkable is that the three approaches indicate a similar result with a posterior mean of about -0.20. The posterior confidence interval is also similar for the three priors used. In terms of log-likelihood the results indicate, see table 1, that we could not favor any of the models.

4- Conclusion

This paper addressed the estimation of the relationship between unemployment and output for the case of Romania. The study brings as novelty the use of the Bayesian linear regression. In order to assess the sensitivity of results to the prior distributions, three different prior distributions are used. The results indicate an Okun coefficient around -0.20 in line with other researches undertaken for Romania. What is more

remarkable is that there is a consensus among the three approaches used, all indicating a posterior mean between -0.15 and -0.20.

Much more work should be done into refining the estimation of the Okun coefficient not only for Romania but also for emerging economies or new member states. Following studies should deepen the stability aspect as well as using structural approaches.

References

Brooks, S.P. – Gelman, A. (1998). "General Methods for Monitoring Convergence of Iterative Simulations." Journal of Computational and Graphical Statistics, 7 (4): 434–455.

Caraiani, P. (2006). „Alternative Methods of Estimating the Okun Coefficient. Applications for Romania." Romanian Journal of Economic Forecasting, 7(4): 82-89.

Caraiani, P. (2010). „Bayesian Estimation of the Okun Coefficient in Romania," Acta Oeconomica 60(1): 79-92.

Dritsaki, C. and N. Dritsakis. (2009). "Okun's coefficient for four Mediterranean member countries of EU: an empirical study." International Journal of Business and Management 4 (5): 18-26.

Evans, G.W. (1989). "Output and Unemployment Dynamics in the United States: 1950 – 1985. Journal of Applied Econometrics, 4 (3): 213-238.

Friedman, B. – Wachter, M. (1974). "Unemployment: Okun's Law, Labor Force and Productivity." The Review of Economics and Statistics, 56 (2): 167-176.
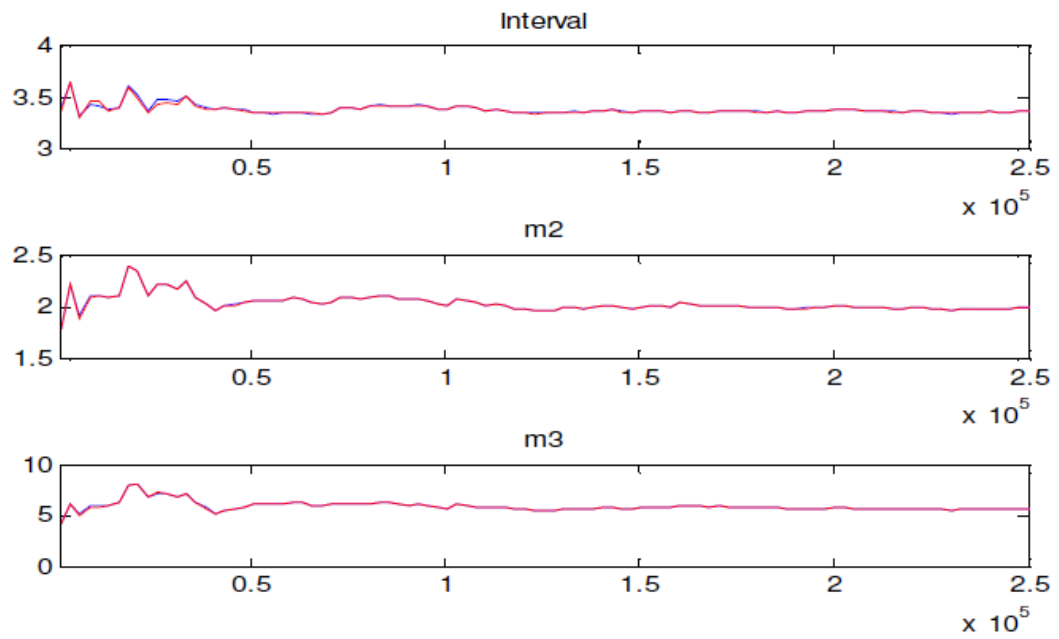
Gordon, R. – Clark, P. (1984). "Unemployment and Potential Output in the 1980's." Brooking Papers on Economic Activity, 15 (2): 537-564.
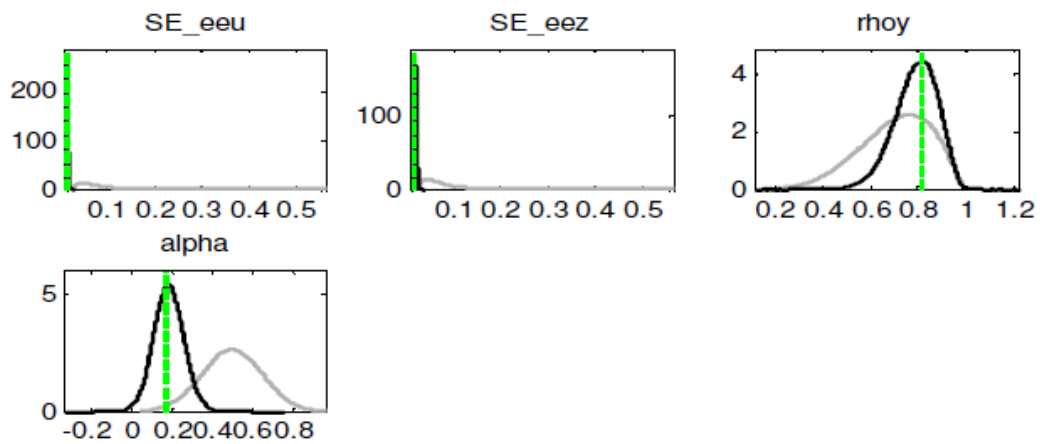
Annex A. Statistics for the baseline model with normal prior

A.1. Univariate convergence statistics
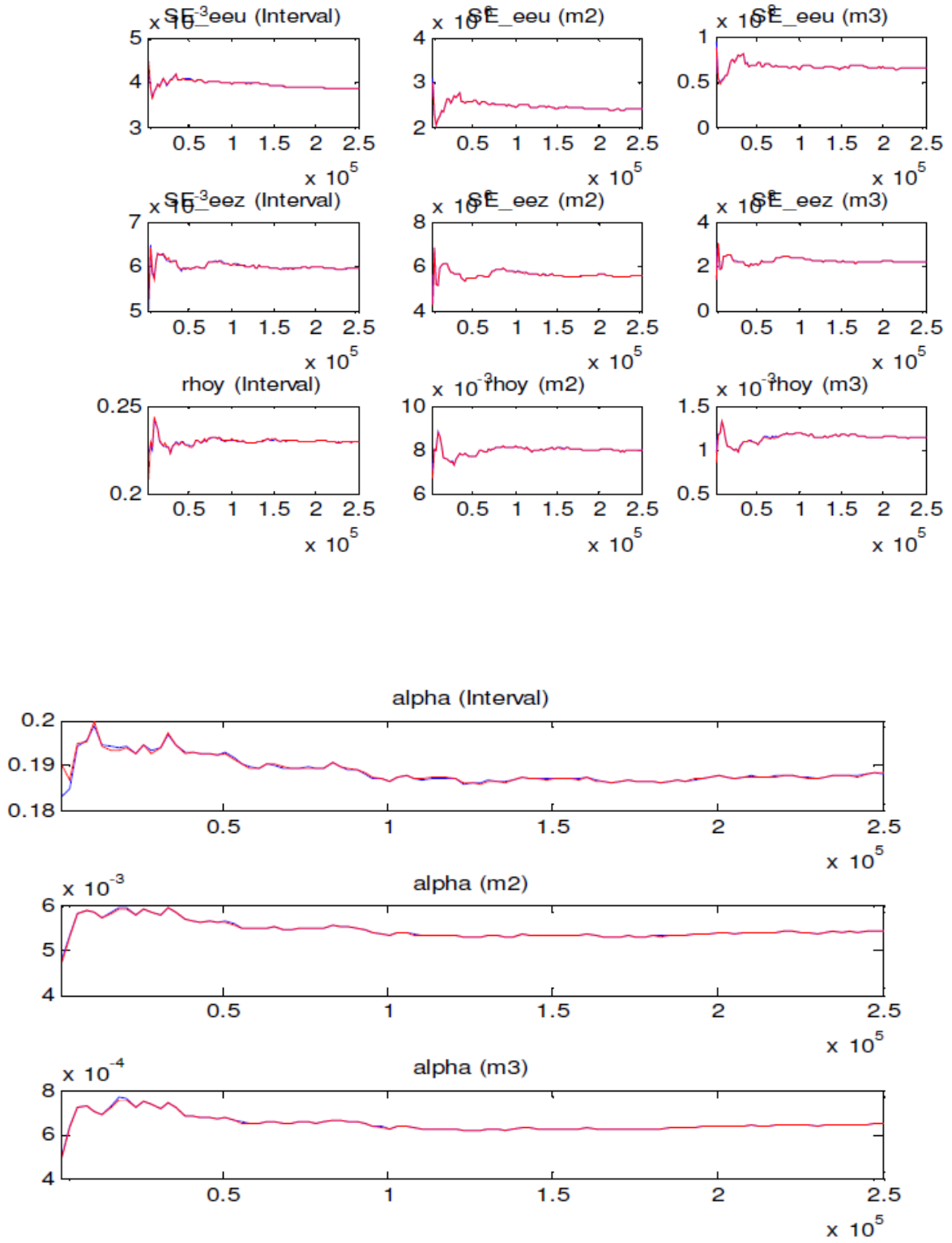
A.2 Multivariate convergence statistics

A.3. Prior and posterior distributions
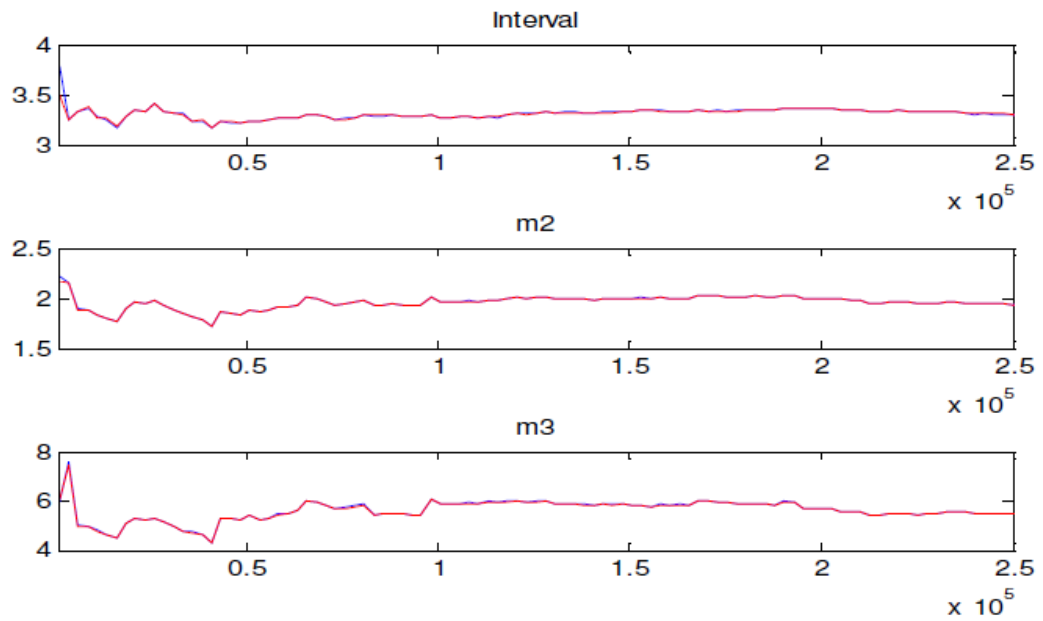
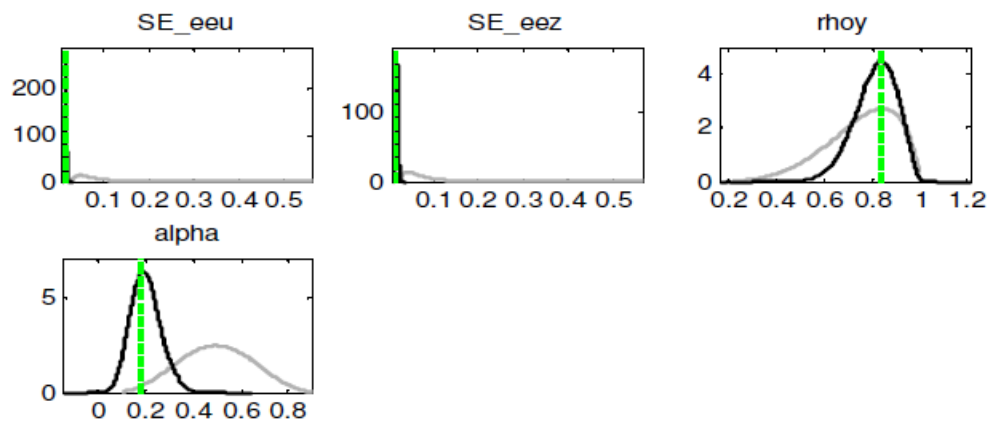# Annex B. Statistics for the alternative model with beta prior

B.1. Univariate convergence statistics
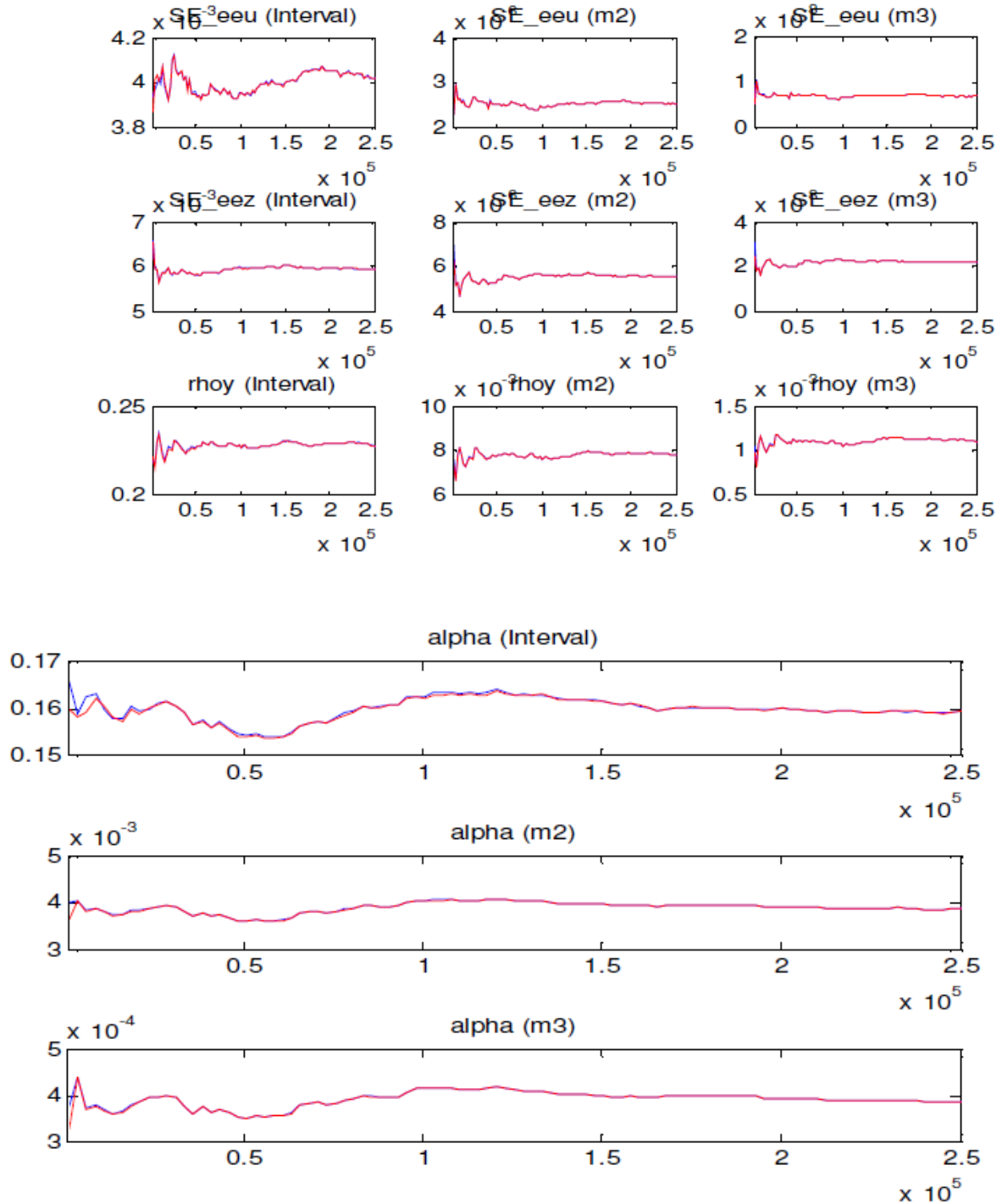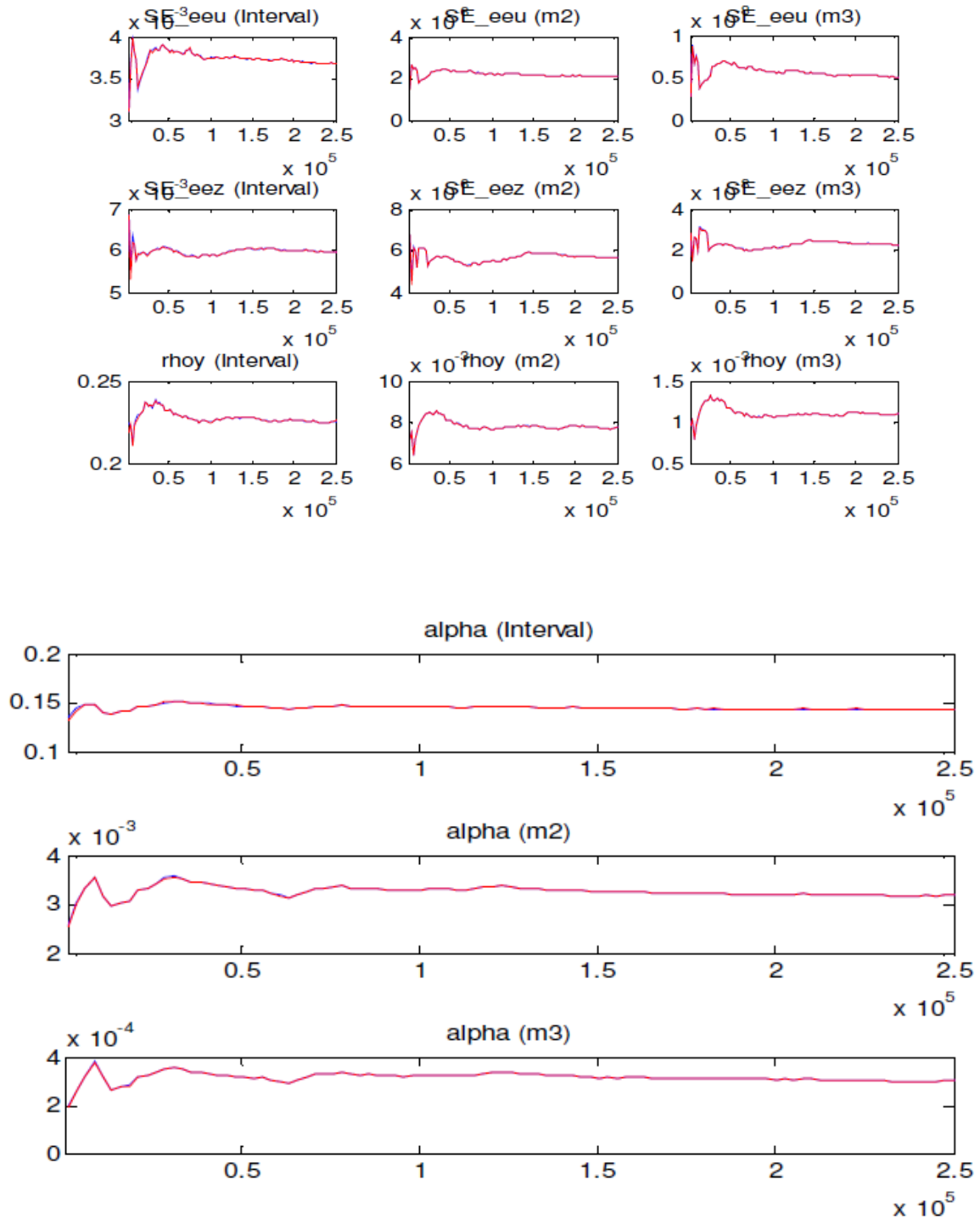
B.2 Multivariate convergence statistics
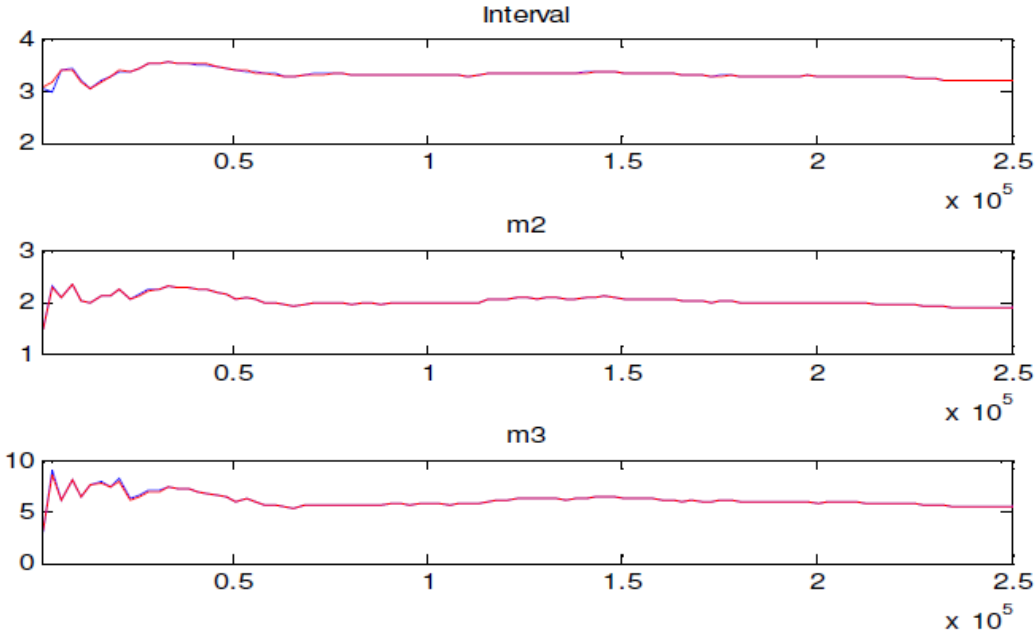

B.3. Prior and posterior distributions

Annex C. Statistics for the alternative model with uniform prior

C.1. Univariate convergence statistics

C.2 Multivariate convergence statistics

C.3. Prior and posterior distributions