Economics Bulletin

Volume 41, Issue 2

How persistent is unemployment in major Latin American economies?

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Abstract

This document investigates the degree of unemployment persistence in four major Latin American economies by using Bayesian methods to estimate a generalized stochastic unit root. Among the main results, it is found that the four countries in the sample exhibit a high degree of unemployment persistence. Colombia and Mexico show some periods of explosiveness associated with periods of crisis. Chile and Bazil display the most moderate cases. The study exploits two different channels to explain the unemployment persistence connected with institutional changes and the duality that characterizes developing countries.

With the usual disclaimer, I want to thank Ellis Scharfenaker for his valuable comments on a previous draft of this document.
Citation: Pedro Clavijo-Cortes, (2021) "How persistent is unemployment in major Latin American economies?", *Economics Bulletin*, Vol. 41 No. 2 pp. 342-360.
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Submitted: May 07, 2020. **Published:** April 09, 2021.

1 Introduction

Studies on unemployment occupy a privileged position in both academic and policy agendas. For developing countries, in particular, where economic policy focuses on reducing the high levels of unemployment that prevail in these countries, understanding the forces that govern this phenomenon becomes a significant policy concern. Economic theory suggests that unemployment is governed by a natural rate of unemployment, around which the unemployment rate gravitates in the long run.

A considerable number of man-hours have been devoted to finding statistical evidence of the presence of a natural rate of unemployment. The literature on hysteresis has employed different unit root statistics to test the stationarity of the unemployment series. The intuition is that if the series is stationary, then the unemployment rate has a long-term attractor toward which it tends to evolve. Stationarity implies that unemployment can depart from the natural rate after exogenously shocked but eventually returns to it as shocks are transitory. Conversely, if the unemployment series features a unit root, shocks have permanent effects since there is a lack of a long-term attractor.

There are at least two inconveniences with the bulk of the literature on hysteresis. First, the literature based on traditional unit root tests delivers binary outcomes exclusively: the series is either I(0) or I(1). Thus, the likelihood of intermediate cases is neglected—cases where shocks have protracted but not permanent effects on unemployment. Second, closely linked to the first issue raised, is the power of the unit root tests to distinguish between stationary and difference stationary processes when persistence is pervasive (see Newbold et al., 2001). It is well documented that typical unit root tests are powerless when the root is close to unity. For instance, a unit root test is incapable of distinguishing between a unitary root and a root equals 0.976 (see Mills, 2019 Chapter 5). Hence, protracted persistence is easily confused with an I(1) process by standard unit root tests.

In this document, I estimate a generalized stochastic unit root (GSUR) test, which addresses the literature's main problems on hysteresis raised above. This approach allows estimating potential changes in the degree of persistence over time that can leave the unemployment series to be I(0) at some periods and explosive at others (with the random walk in between). I follow Jones and Marriott (1999) and use Bayesian methods to estimate the GSUR test to overcome typical imprecision issues in parameters estimation using approximate maximum likelihood. Moreover, the GSUR test has some properties that give a statistical motivation for testing persistence in unemployment, such as strict stationarity and weak stationarity to any order of differencing (Yoon, 2006).

In their influential contribution, Blanchard and Summers (1986) suggest that protracted persistence can be associated with exceptionally high dependence of current unemployment on past unemployment. In that case, the root is close but not necessarily equal to unity. Hence, persistence defined as a root close, but less than unity does not rule out the hypothesis of a natural rate of unemployment. It merely implies quite slow convergence toward the long-run equilibrium. Following Blanchard and Summers (1986), this document investigates the degree of persistence in the quarterly unemployment rate in the medium industrialized Mexico and Brazil, and the more commodity-exporting Chile and Colombia.

The aim thus is about size and persistence of the effects of shocks on unemployment, not the existence of a natural rate (which is assumed by using the GSUR) nor the permanence of those shocks. Some literature (see, e.g., Roed, 1997; Blanchard, 2018) argues that the natural rate hypothesis should not be rejected a priori since unemployment does not wander around randomly but reverts to its past levels sooner or later. Indeed, the bounded nature of the unemployment rate series prevents it from taking values outside the 0–1 range. In other words, this literature argues that the unemployment rate cannot be a random walk.

The empirical literature on hysteresis is abundant but focused almost exclusively on developed countries. These works apply univariate tests and typically cannot reject the unit root null hypothesis; see Mitchell (1993), Roed (1996), Hassler and Wolters (2009) also Hoarau et al. (2010). For the U.S., the results mostly suggest a mean reversion and, therefore, no evidence of hysteresis in the unemployment rate; see Nelson and Plosser (1982), Blanchard et al. (1992) also Roed (1996).

The high levels of unemployment witnessed in Latin America would indicate that persistence could also be an underlying macroeconomic phenomenon in developing countries. Nonetheless, the empirical works on persistence for the region are rare. For example, Ball et al. (2013) find evidence of hysteresis in the unemployment rates for the countries under study. Their study concludes that unemployment is caused mainly by contractions in aggregate demand. My results, however, conflict with those of Ball et al. (2013) because I underlie the hypothesis of a natural rate, although immersed in high persistence.

As a preview of my findings, I conclude that persistence is steady, though with high variability among the countries in the sample. I identify that the estimated time-varying roots lie in the vicinity of a unit root. Some countries indeed have experienced changes in the data generating process of their unemployment rates by moving between I(0) and I(1) processes over time. I argue that this is why it is hard to reject the unit root null hypothesis using standard unit root statistics. In general, for the countries considered in this study, a GSUR seems to be a reliable option to explain the underlying unemployment dynamic.

The rest of the document is organized as follows: Section 2 presents the GSUR process I use to estimate time-varying persistence; Section 3 shows data and results from selected GSUR tests for the countries in my sample; Section 4 concludes.

2 The GSUR Test

This section borrows heavily on the work of Yang and Leon-Gonzalez (2010), who consider an extension of the stochastic unit root proposed by Granger and Swanson (1997) given by:

$$u_t^k = \gamma + \delta t + \nu_t \tag{1}$$

$$\nu_t = \rho_t \nu_{t-1} + \sum_{i=1}^{l} \lambda_i \Delta \nu_{t-i} + \varepsilon_t \tag{2}$$

$$\alpha_t = \phi_0 + \phi_1\alpha_{t-1} + \cdots + \phi_p\alpha_{t-p} + \eta_t \tag{3}$$

where u_t stands for unemployment rate in k = Brazil, Chile, Colombia, and Mexico; ε_t is $i.i.d.N(0, \sigma_\varepsilon^2)$; η_t is $i.i.d.N(0, \sigma_\eta^2)$; and $\rho_t = \exp(\alpha_t)$. Equation "(1)" stablishes that unemployment is a process determined, as usual in unit root tests, by a deterministic trend and an error term. The latter represented by equation "(2)" adopts a general autoregressive specification in which the root is stochastic rather than constant, as typical unit root tests assume. This property of a stochastic root is captured by equation "(3)" that defines the time-varying persistence parameter α_t as an $AR(p)$ process, which is assumed to be stationary. Thus, the unconditional mean μ_α of the stationary process α_t is:

$$\mu_\alpha = \frac{\phi_0}{1 - \sum_{j=1}^{p} \phi_j}. \tag{4}$$

Note that the process is stationary if $\rho_t < 1$ and not stationary if $\rho_t \geq 1$. Hence, ρ_t determines the degree of persistence and varies stochastically in the GSUR process. The intuition of the system of equations "(1)-(3)" is that unemployment persistence varies with time in a way that the process is stationary for some periods and mildly explosive for others. The economic intuition is that a changing history materialized in the trajectory of ρ_t, allows to capture changes in the unemployment equilibrium. For instance, following Blanchard and Summers (1986), Ball (2009) describes the degree of persistence as depending on the history of the natural rate and the length of time unemployment is strayed from it. Hence, the time-varying behavior of ρ_t captures Ball's insights on how history can affect the macroeconomic unemployment equilibrium. This gives an economic motivation to use a GSUR process to test persistence. Regarding the econometric motivation to use the GSUR, it can be argued that we could investigate the persistence of the unemployment rate series at various moments in time by performing the traditional unit root tests on subsamples of the series. The drawback, however, is that this procedure deteriorates unit root tests' power since typical tests (e.g. the Augmented Dickey-Fuller) exhibit low power in small samples. Another advantage of the GSUR against the typical unit root test is that the GSUR is time-varying and therefore delivers the exact moments in which persistence changes.

Regarding the priors specifications I opt for $\mu_\alpha \sim N(\bar{\mu}_\alpha, V_\alpha)$, $\{\gamma, \delta\} \sim N(\mu_\Omega, V_\Omega)$, and $\lambda \sim N(\mu_\lambda, V_\lambda)$. The prior density of ϕ is $p(\phi) = C^{-1} f_N\left(\mu_{\phi_i}, V_{\phi_i}\right) \mathbf{1}\,(||z^*|| > 1)$, where $f_N(\cdot)$ is a multivariate normal density with C as the normalizing constant, and $\mathbf{1}(\cdot)$ is an indicator function for the event that $\phi_i, \forall i$, jointly satisfy the stationarity condition given by $||z^*|| > 1$ where z^* represents the inverse characteristic roots of the polynomial associated with equation "(3)". The prior densities for error precisions are chosen as $p(h_\varepsilon) = f_{\Gamma_\varepsilon}(a_\varepsilon, b_\varepsilon)$, and $p(h_\eta) = f_{\Gamma_\eta}\left(a_\eta, b_\eta\right)$, where $f_\Gamma(\cdot)$ denotes the density of the Gamma distribution. For further details on initial values see Table IV in Appendix.

Let $\theta = (\gamma, \delta, \lambda, \phi, \mu_\alpha, \sigma_\varepsilon^2, \sigma_\eta^2)$ be a vector containing all the parameters of interest; $\alpha = (\alpha_{1-p}, \ldots, \alpha_0, \alpha_1, \ldots, \alpha_{T-1}, \alpha_T)'$ be the vector containing all unobserved stochastic roots over the time T period; and $u = (u_1, \ldots, u_n)$ be the whole sample of observations with a sample size of N. The conditional posterior distributions that can be used in the MCMC algorithm, given the priors, will be computed by using the augmented likelihood, such that the posterior for θ can be written as:

$$p(\theta, \alpha|u) \propto p(\theta, \alpha) \prod_{t=2}^{N} p(u_t|\theta, \alpha, F_{t-1}), \tag{5}$$

where F_t denotes the history of u_t up to time t.

All conditional posterior densities have standard forms and can be sampled directly, except for that corresponding to α_t, which is non-standard. I follow Yang and Leon-Gonzalez (2010) in using the Metropolis-Hastings algorithm to draw values of α_t.

The GSUR is highly parameterized, considering I have to decide whether to include an intercept, a deterministic time trend, or both. Also, the lag length in the measurement equation (l) as well as the degree of persistence of history (p). I rely upon the log marginal likelihood approach introduced by Chib (1995) to reduce my uncertainty regarding the best specification of the test in the space of candidate tests, as Yang and Leon-Gonzalez (2010) suggest.

Chib (1995) computes the marginal likelihood, $m(u|M_k)$, given parameters draws from the posterior distribution of specification M_k according to:

$$m(u) = \frac{p(u|\theta)p(\theta)}{p(\theta|u)}, \tag{6}$$

where the numerator is the product of the sampling density and the prior, with all integrating constants included, and the denominator is the posterior density of θ (see Chib, 1995, and Yang and Leon-Gonzalez, 2010 for further details). The proposed estimate of the marginal density, on the computationally convenient logarithm scale, is

$$\ln m(u) = \ln p(u|\theta) + \ln p(\theta) - \ln p(\theta|u). \tag{7}$$

It is worth noting that the random walk (RW) process is nested within the GSUR specification at the point where $\mu_\alpha = 0 = \sigma_\eta^2$, such that ρ_t will always be equal to 1. I use the Bayes factor as my model comparison criterion. Specifically, to compare two models, M_{RW} and M_{GSUR}, the Bayes factor in favor of GSUR against RW is defined as

$$BF = \frac{p(u|M_{GSUR})}{p(u|M_{RW})}, \tag{8}$$

where $p(u|M_i)$ is the marginal likelihood for M_i, $i = GSUR, RW$, which is simply the marginal data density under model M_i evaluated at the observed data u. If the observed data are likely under the model, the associated marginal likelihood would be "large" and vice versa. Kass and Raftery (1995) suggest values against which to contrast the BF. In general, if the BF is greater than three, the observed data are likely under the model.

3 Data and Results

I estimate the GSUR test for four major Latin American economies (Brazil, Chile, Colombia, and Mexico) for the longest possible periods, selected according to data availability. I use quarterly data for the unemployment rate collected from OECD for Brazil, Chile, and Mexico. Data for Colombia come from BanRep (Central Bank of Colombia) and are seasonally adjusted using X-13ARIMA to make them comparable to data of the rest of the countries in the sample. These particular countries were selected for data availability only, so they cannot be considered a representative sample of Latin America. Nonetheless, these countries are four of the top five economies in the region by GDP size. Figure 1 shows the unemployment trajectory in these countries.

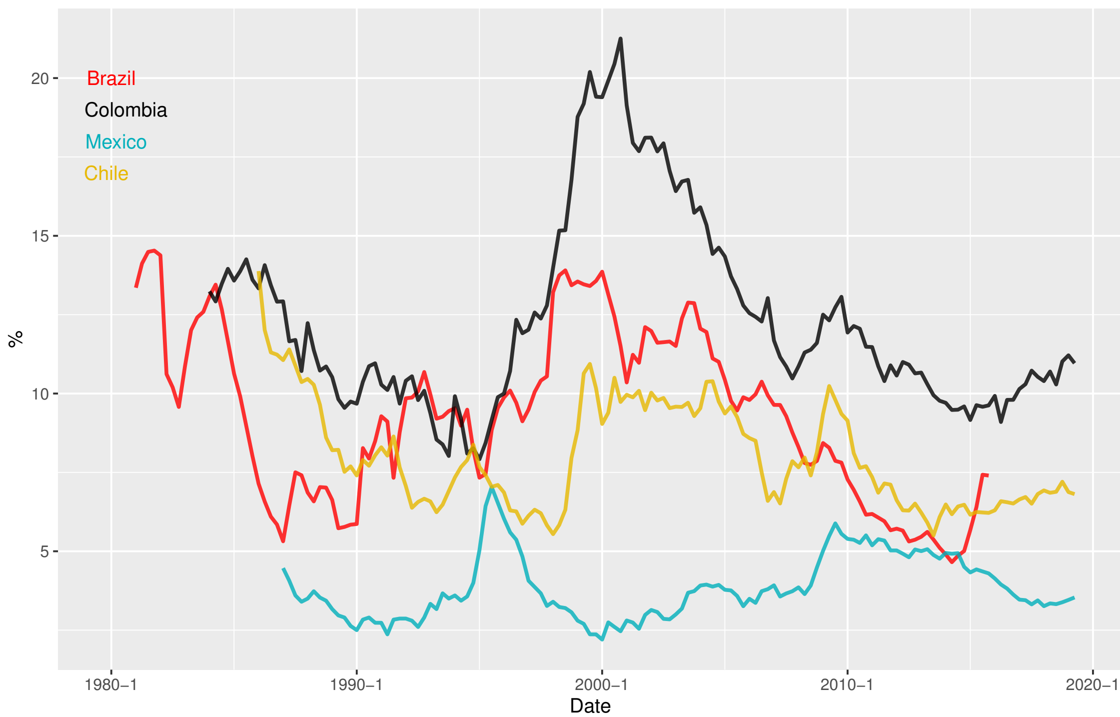


Figure 1. Percentage unemployment rate in Brazil (1981Q1-2015Q3), Chile (1986Q1-2019Q2), Colombia (1984Q1-2019Q2) and Mexico (1987Q1-2019Q2)

It can be seen from the data in Figure 1 that these countries have endured protracted periods of high unemployment. Figure 1 also shows that Colombia exhibits the worst panorama, while Mexico presents the less bleak scenario. However, it is essential to realize that Mexico's low unemployment rate, to a significant extent, hinges upon immigration to the United States. Between 2013 and 2017, more than eight million Mexicans migrated northward, motivated mostly by unemployment (Gutiérrez, 2019). It can be easily discerned that migration is not an exclusive phenomenon of Mexico but that most countries in the region export a considerable fraction of their unemployed labor force to developed countries.

Table I. Log Marginal Likelihood of GSUR tests

	$\gamma = 0 = \delta$	$\gamma = 0, \delta \neq 0$	$\gamma \neq 0, \delta = 0$	$\gamma \neq 0, \delta \neq 0$
		Colombia		
$p = 3$				
$l = 1$	-242.5369	-182.606	-160.2946*	-179.773
$l = 2$	-249.7764	-190.3189	-168.6247	-188.0582
$l = 3$	-257.699	-198.1233	-172.8865	-191.7385
$p = 2$				
$l = 1$	-243.2466	-184.4594	-162.8922	-181.9197
$l = 2$	-250.7704	-192.5472	-170.7054	-190.0041
$l = 3$	-257.9145	-197.9372	-174.1403	-192.6595
$p = 1$				
$l = 1$	-242.6448	-185.2702	-164.0653	-182.7767
$l = 2$	-250.3362	-192.9093	-172.1934	-190.5732
$l = 3$	-257.2643	-197.9058	-174.3278	-192.6734
		Mexico		
$p = 3$				
$l = 1$	-107.1695	-62.3160*	-66.5058	-83.0604
$l = 2$	-115.2454	-69.2472	-71.2345	-87.878
$l = 3$	-122.7703	-77.1579	-79.1085	-96.7565
$p = 2$				
$l = 1$	-106.372	-63.6011	-68.1502	-85.504
$l = 2$	-114.2916	-69.2405	-73.5461	-89.8961
$l = 3$	-122.9912	-77.7267	-80.5458	-97.8211
$p = 1$				
$l = 1$	-106.1968	-64.5338	-70.173	-87.899
$l = 2$	-113.6541	-70.5654	-73.8429	-89.5143
$l = 3$	-121.9991	-78.9014	-82.3251	-100.0838
		Brazil		
$p = 3$				
$l = 1$	-188.5427	-123.6541	-114.6678	-103.0451
$l = 2$	-187.2996	-125.4946	-117.1009	-105.9464
$l = 3$	-193.0141	-124.188	-109.5472	-132.6702
$p = 2$				
$l = 1$	-85.3016	-83.0851	-59.2744	-84.4317
$l = 2$	-61.4213	-122.2344	-57.3709*	-80.1616
$l = 3$	-90.3715	-102.6363	-71.6485	-99.6193
$p = 1$				
$l = 1$	-125.8485	-173.0621	-182.6627	-136.5663
$l = 2$	-176.6985	-185.5881	-175.0885	-159.7223
$l = 3$	-159.9771	-188.6984	-177.9488	-135.3031
		Chile		
$p = 3$				
$l = 1$	-153.2169	-132.4307	-100.6077	-143.2627
$l = 2$	-158.1042	-131.1463	-95.8071	-148.418
$l = 3$	-152.7286	-132.5008	-94.9413	-141.4807
$p = 2$				
$l = 1$	-126.6111	-98.0146	-111.9387	-126.1421
$l = 2$	-121.0605	-96.7498	-115.0315	-114.7682
$l = 3$	-128.9126	-108.9538	-118.5035	-109.0872
$p = 1$				
$l = 1$	-153.9894	-139.4507	-91.8082	-169.1067
$l = 2$	-168.2656	-155.3448	-93.2416	-166.2961
$l = 3$	-169.6586	-153.9294	-90.8336*	-146.3166

* Indicates the GSUR specification favored by the maximum log marginal likelihood.

Furthermore, a distinctive feature of the labor market in these countries is its duality, where a substantial share of the labor force remains in a state of disguised unemployment in informal labor markets. This phenomenon of dualization distorts the unemployment series, which would move toward higher levels if those disguised unemployed were correctly counted. In general, unemployment in Latin America is a complex phenomenon governed by several forces hard to disentangle. Unfortunately, the unemployment series ignores valuable information that cannot be put into so convenient a time series form and takes substantial dynamics for granted.

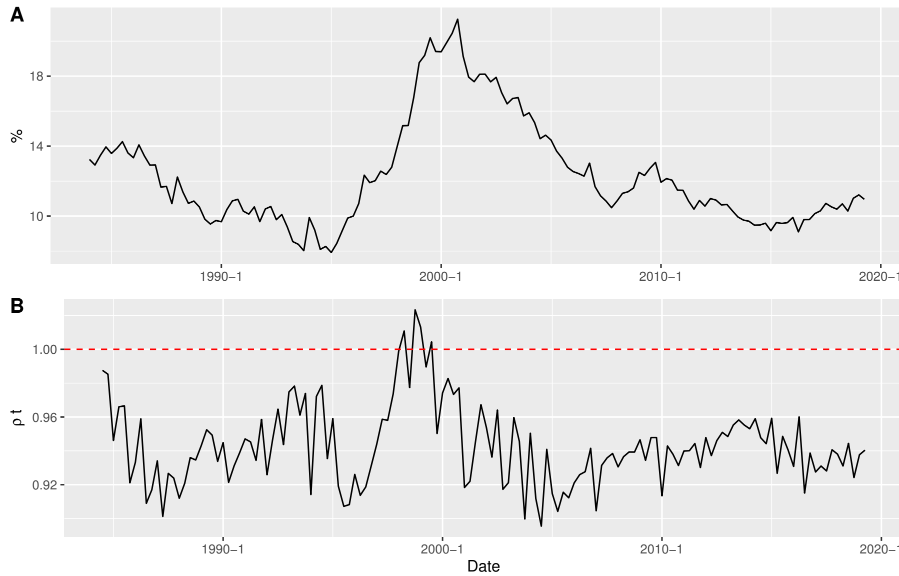
I start my analysis on unemployment persistence by computing the log marginal likelihood for alternative GSUR specifications with different parameter combinations. The results are summarized in Table I, where for each of the thirty-six specifications considered, the maximized likelihood is reported. The log marginal likelihood favors a test with intercept and no deterministic time trend for Brazil, Chile, and Colombia, while for Mexico, it favors exactly the opposite specification. The BF, for its part, favors the GSUR process against the RW for all countries. For instance, in the case of Colombia, a $BF = \frac{p(u|M_{GSUR})}{p(u|M_{RW})} = \frac{\exp(-160.2946)}{\exp(-162.7965)} \approx 12$ indicates the GSUR proposed is 12 times more likely than RW process given the data. Table II summarizes some basic posterior statistics for parameters of interest and convergence diagnostics. The MCMC algorithm is run for 30,000 iterations omitting the first 5,000 random draws due to burn-in.

Table II. Diagnostics of the MCMC Algorithm for the GSUR Selected

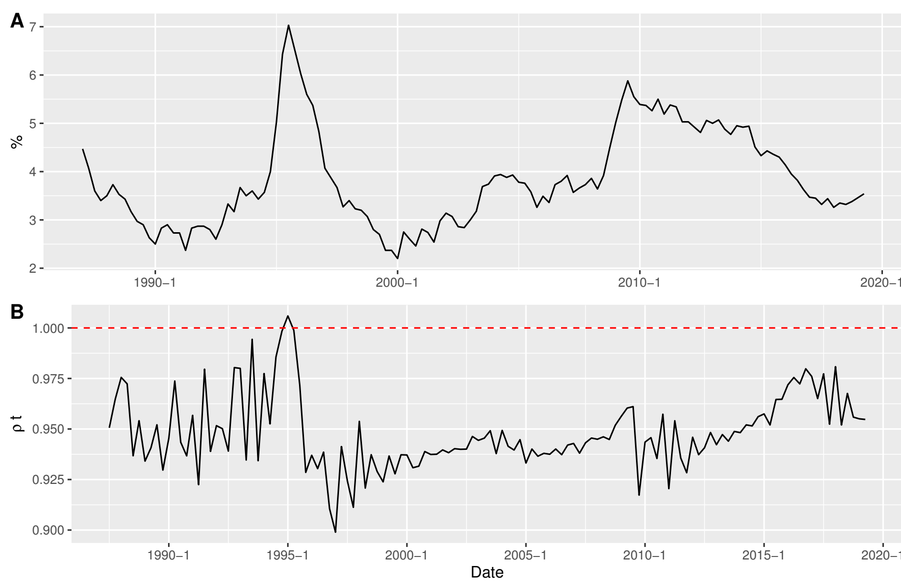
Variable	**Mean**	**Std**	**Gs**	NSE_{15}	**Mean**	**Std**	**Gs**	NSE_{15}
		Colombia				**Mexico**		
μ_α	-0.07380	0.04540	-0.74290	0.00110	-0.06770	0.04504	-1.45981	0.00113
σ_η^2	0.02350	0.00590	1.99820	0.00010	0.02375	0.00585	1.04234	0.00005
σ_ε^2	0.50130	0.07270	0.96910	0.00070	0.17176	0.02461	1.37192	0.00023
ϕ	0.15410	0.12730	-0.66440	0.00140	0.15800	0.13275	-0.78354	0.00160
γ	0.15540	0.13000	-0.14390	0.00100	0.16276	0.13596	-1.95058	0.00117
λ_1	0.13590	0.12690	0.08570	0.00090	0.13738	0.13112	0.02906	0.00143
		Brazil				**Chile**		
μ_α	0.07432	0.03862	-1.62696	0.00139	0.10504	0.04763	0.37359	0.00160
σ_η^2	0.02189	0.00518	0.82094	0.00010	0.02402	0.00594	-0.35792	0.00008
σ_ε^2	0.59364	0.08065	-1.02071	0.00059	0.31830	0.04341	-0.03647	0.00024
ϕ	0.13313	0.12713	-0.31935	0.00087	0.10867	0.12916	-0.28190	0.00061
γ	0.13202	0.12844	-1.06811	0.00083	7.59082	0.44409	-1.00732	0.00468
λ_1	8.95176	0.73542	-1.02283	0.00633	0.26015	0.10817	0.89666	0.00086

The convergence diagnostics refers to Geweke's statistic (**Gs**) and numerical standard error (NSE_{15}) calculated, taking the correlation up to lags of 15% of the size of the retained MCMC samples. The convergence diagnostics, as well as the plots in the appendix, underpin convergence of the MCMC algorithm for all countries. Interestingly, the negative mean and the low standard deviation of μ_α suggest that Colombia and Mexico's unemployment rate has been alternating between a stationary and a non-stationary process. This motivates to split the countries sample into two groups: Colombia and Mexico in one and Brazil and Chile in the other.

The drastic change in persistence over the sample period for the estimated GSUR test for Colombia and Mexico are plotted below the unemployment rates series in Figure 2.



(a) Colombia



(b) Mexico

Figure 2. **A:** Unemployment Rate. **B:** Unemployment Persistence

Overall, the estimated time-varying roots ρ_t underlie the view that the persistence of unemployment in the first group of countries is strong. As for Colombia, the degree of persistence is such that toward the end of the 1990s, the root is greater than unity leading to changes in stationarity; changes that are neglected by standard unit root tests. For instance, Table III shows that the Augmented Dickey-Fuller (ADF) and the Phillips-Perron

(PP)[1] statistics for Colombia lead us to accept the unit-root null. These abrupt changes in persistence may explain why typical unit root approaches find significant evidence in favor of hysteresis. Another observation stands out in Figure 2. The change from strong persistence to an explosive behavior **($\rho_t > 1$)** occurs precisely at the end of the nineties when the financial crisis in Colombia triggers. These findings support the thesis that empirical evidence in favor of a unit root may be due to large shocks to the series, as Perron (1989) suggested.

Like Colombia, Mexico exhibits a moment in history in which the unemployment rate becomes explosive. As shown in Table III, the ADF and the PP statistics are highly insignificant for Mexico, suggesting Mexico's unemployment rate is non-stationary. As happen with Colombia, the explosive behavior of Mexican unemployment occurs during an episode of crisis. In 1994 the tequila crisis hit the Mexican economy, causing a considerable contraction of the general economic activity. These results for Colombia and Mexico are impressive since they correlate episodes of profound crisis with unemployment explosiveness.

Table III. Unit root tests

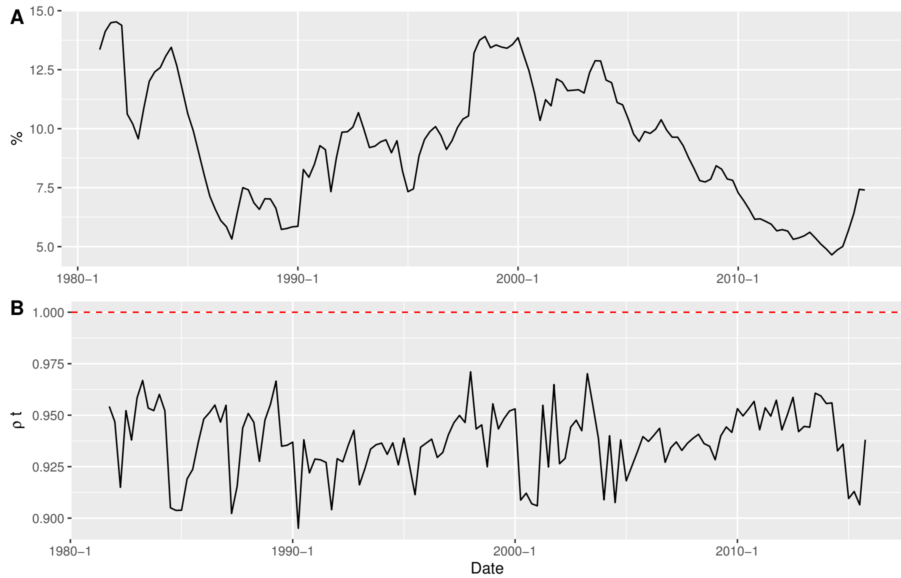
		Unit Root Test*	
Country		ADF	PP
	Stat.	**-2.48**	**-2.05**
Brazil	5% c.v.	-2.88	-2.88
	10% c.v.	-2.58	-2.58
	Stat.	**-2.81**	**-3.63**
Chile	5% c.v.	-2.88	-2.88
	10% c.v.	-2.58	-2.58
	Stat.	**-1.24**	**-1.50**
Colombia	5% c.v.	-2.88	-2.88
	10% c.v.	-2.58	-2.58
	Stat.	**-2.69**	**-2.53**
Mexico	5% c.v.	-3.45	-3.45
	10% c.v.	-3.15	-3.15

* The ADF and PP tests for Brazil, Chile, and Colombia include an intercept, while the tests for Mexico include both trend and intercept. The components of the deterministic trend are chosen to make the tests specification comparable to that of the GSUR. Mexico's tests include intercept since there is no specification of those tests with a time trend alone.

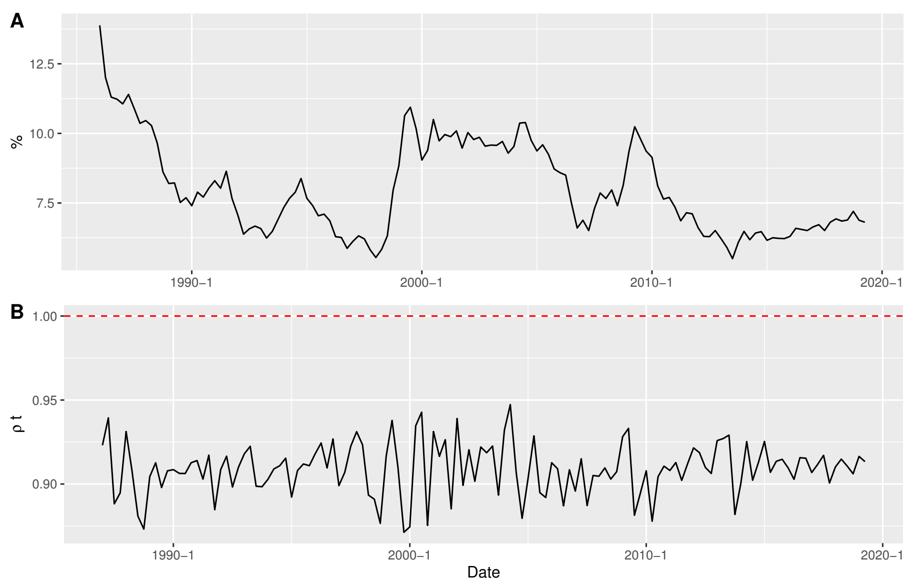
I now turn to analyze the case of the second group of countries. Figure 3 illustrates the estimated time-varying roots for Brazil and Chile. In the case of Brazil, this country shows a high persistence, though the unemployment series remains stationary across the sample. The corresponding ADF and PP statistics do not permit us to reject the null of unit root at 5% level of significance, which confirms the idea that a unit root test is

[1] Those tests were selected to exemplify the idea of the low power of typical tests to discriminate between unit root and persistence.

incapable of distinguishing between a unitary root and high unemployment persistence.



(a) Brazil



(b) Chile

Figure 3. **A:** Unemployment Rate. **B:** Unemployment Persistence

Chile is the country with the lower degree of persistence. If we use the looser 10% level of significance, it turns out that the ADF test allows us to reject the unit-root null. Indeed, the PP test ratifies Chile's unemployment stationarity at all levels of significance. Hence, Chile is more likely to converge quicker to its natural rate of unemployment than the rest of the countries after an exogenous shock hits the unemployment rate. Note that Chile and Brazil also underwent crises during the nineties, but those were not strong enough to provoke changes in series stationarity. On the other hand, Colombia and Mexico's crises drove the unemployment rate to reach their peaks during the sample, as shown above.

The literature on hysteresis proposes some explanations regarding why persistence unemployment can be a ubiquitous macroeconomic phenomenon. Since Blanchard and Summers (1986), the insider-outsider hypothesis is a potential suspect. According to the mechanism emphasized by Blanchard and Summers, insiders have relatively high bargaining power in the wage formation process. A process in which wages are set by bargaining between firms and workers, where the unemployment rate is a crucial variable. The balance of forces will determine how rapidly the unemployment rate will converge toward its natural rate; the higher workers' bargaining power, the stronger the unemployment persistence. This mechanism hinges heavily upon workers with power in the bargaining process. Bargaining power, however, is something workers lack in Latin America. As well known, pro-market reforms undertaken in the region since the nineties, which include more flexible labor markets, have weakened workers' leverage; therefore, I think the explanation for persistence is to be sought elsewhere.

I suggest that two fruitful conjectures that might explain unemployment persistence rest, on the one hand, upon institutional changes that affect labor market functioning and, on the other hand, upon the interplay between formal and informal labor markets that characterize developing economies. Those conjectures connect with various strands of the literature on unemployment persistence. One of those strands is the literature on unemployment dynamics that states that unemployment deviations from its steady-state flow contribute substantially to unemployment persistence (Elsby et al., 2013). I also connect the conjectures with the theory on skill loss during unemployment as a source of persistence (Pissarides, 1992) and with the literature on the role of institutions in unemployment duration (Blanchard and Wolfers, 2000).

The first conjecture emphasizes the nonlinear effects of the political and economic institutions that define those phases verging on a unit root, and the periods of punctuated equilibrium between them. We might interpret these out-of-equilibrium periods of explosiveness as moments of a confluence of economic, political, and social crisis that compel an institutional change, while those punctuated equilibria are interpreted as moments of relative calm. It is reasonable to speculate that unemployment might start to exhibit unit-root behavior in these transitionary periods, probably trending upwards significantly. At some point, however, nonlinear effects take effect, and new institutions are established that stabilize the system around another punctuated equilibrium. There is no reason to believe that the new equilibrium level will be the same as the prior one, which is confirmed by the changing behavior over time of ρ_t.

An example of those institutional changes can be appreciated in the cases of Colombia and Mexico. As for Colombia, the financial crisis of 1999 meant a radical change in how the macroeconomic policy was driven. The crisis concluded the exchange rate band in 1999 and brought the inflation targeting strategy as the new monetary policy framework to stabilize the economy. Similarly, the tequila crisis paved the way for Mexico to become an OECD member, which also meant a drastic institutional change. Hence, the interaction between a crisis period, the interregnum before a new one, and the institutional change that this yields might explain the high persistence of unemployment.

The literature on labor market institutions highlights the role of trade unions in shaping macroeconomic shocks for labor market dynamics. In particular, higher union density is associated with more moderate labor market reactions in recessions as well as in economic upturns (Bachmann and Felder, 2020). Although, as mentioned before, this theory would be relevant in countries with powerful trade unions. Minford and Naraidoo (2010) emphasize the interaction of shocks and the economy's institutional structure in determining unemployment's equilibrium path. In their model, unemployment moves between high and low equilibria in response to shocks such that some economies can fall into a high unemployment trap depending on the interaction between shock and their institutions.

The second conjecture accentuates the duality à la Lewis (1954) present in developing economies. A dual economy is composed of a modern sector and a subsistence sector in which the former produces using relatively advanced technologies, while the latter employs more primitive modes of production. An informal sector's presence affects the rate at which workers flow into the unemployment pool and the rate at which unemployed workers exit the unemployment pool. Once unemployed, workers can decide whether to join the ranks of the unemployed or to work in informal markets depending on, for example, their reservation wage. In this sense, workers can flow from informal sectors toward formal activities and vice versa without going through unemployment, causing unemployment to be even more persistent than it might be in countries with a small proportion of informal workers. Thus, the informal sector enhances the analysis of unemployment flows (see, Elsby et al., 2013), in which workers inflow to and outflow from unemployment in the absence of informality. Hence, any attempt to estimate the rates of inflow to and outflow from unemployment in developing countries is biased if the informal sector is ignored.

Another reason to expect the informal sector affects unemployment persistence is the well-documented depreciation of workers' human capital due to not using skills for being unemployed or employed in the informal sector since such jobs are mainly low-end jobs performed by unskilled workers. As mentioned before, the subsistence sector uses rudimentary technologies compared with the modern sector. The subsistence sector uses negligible or no physical capital and, as a result, workers' skills deteriorate since capital cannot fructify labor as it does in the modern activity. Therefore, we might expect the more prominent the informal sector's size, the longer is the duration of informal employment spells and the lower is the level of skills in the whole economy (Dutt and Ros, 2007), exacerbating unemployment persistence.

4 Conclusion

Motivated by the likelihood that a low-power-of-attraction natural rate can govern unemployment rates in some major economies in Latin America, this document estimates a generalized stochastic unit root to test for persistence. My findings underpin the hypothesis of a natural rate of unemployment for the four countries in the sample. However, it confirms the idea of low power of attraction since the unemployment series lies at the frontier between a stationary and a difference-stationary process. Unemployment persistence is steady among the four countries, with Colombia and Mexico experiencing explosiveness periods and Chile with the most moderate degree of persistence. I underpin the idea that persistence remains latched to institutional changes and crises that modify the labor market functioning and to the duality that dominates Latin American labor markets.

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Appendix

Table IV. Initial Values in GSUR Tests

Parameter	Value in the Prior	Parameter	Value in the Prior
$\bar{\mu}_\alpha$	$\ln 0.9$	V_α	0.1^2
μ_{ϕ_i}	1	V_{ϕ_i}	0.1
a_ε	1.1	b_ε	0.2
a_η	1.5	b_η	2.5
$\mu_\blacksquare$	$(0,0)'$	$V_\blacksquare$	$10^4 I_2$
μ_λ	$(0,\ldots,0)'$	V_λ	$10^4 I_i$

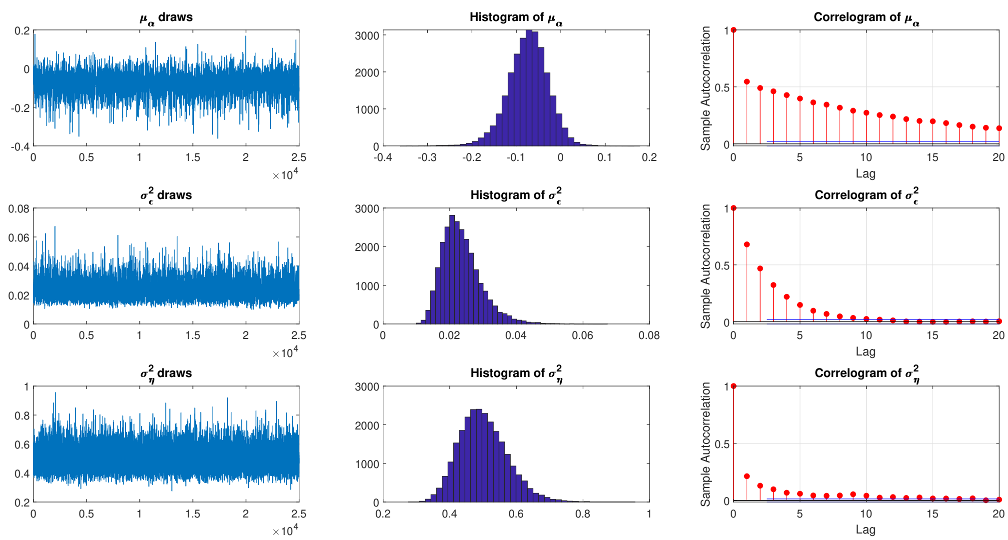

Figure 4. GSUR for Colombia: posterior draws, histograms, and correlograms for some variables of interest

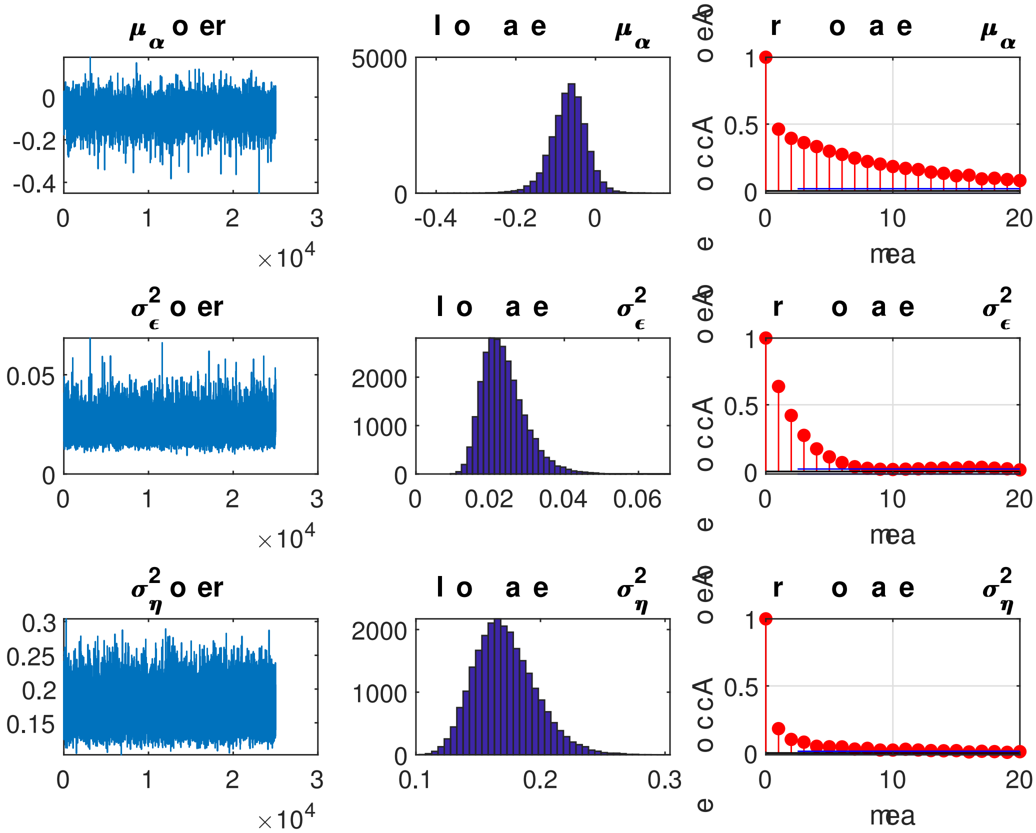

Figure 5. GSUR for Mexico: posterior draws, histograms, and correlograms for some variables of interest

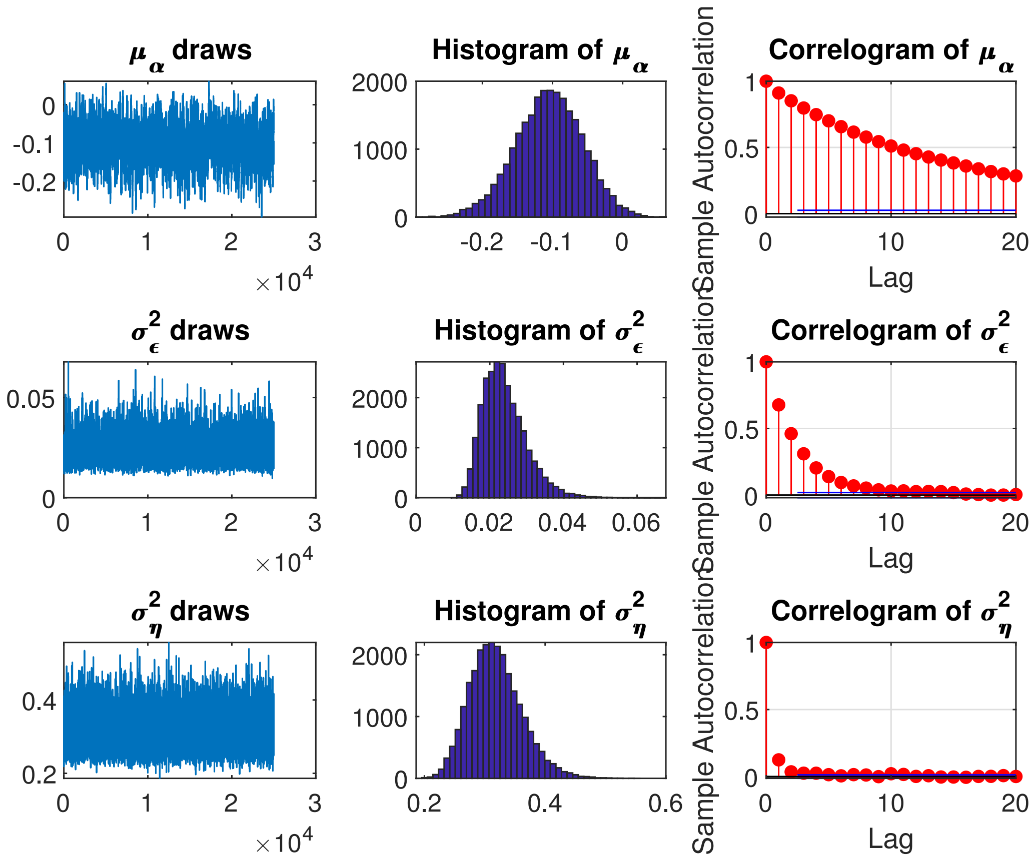

Figure 6. GSUR for Chile: posterior draws, histograms, and correlograms for some variables of interest

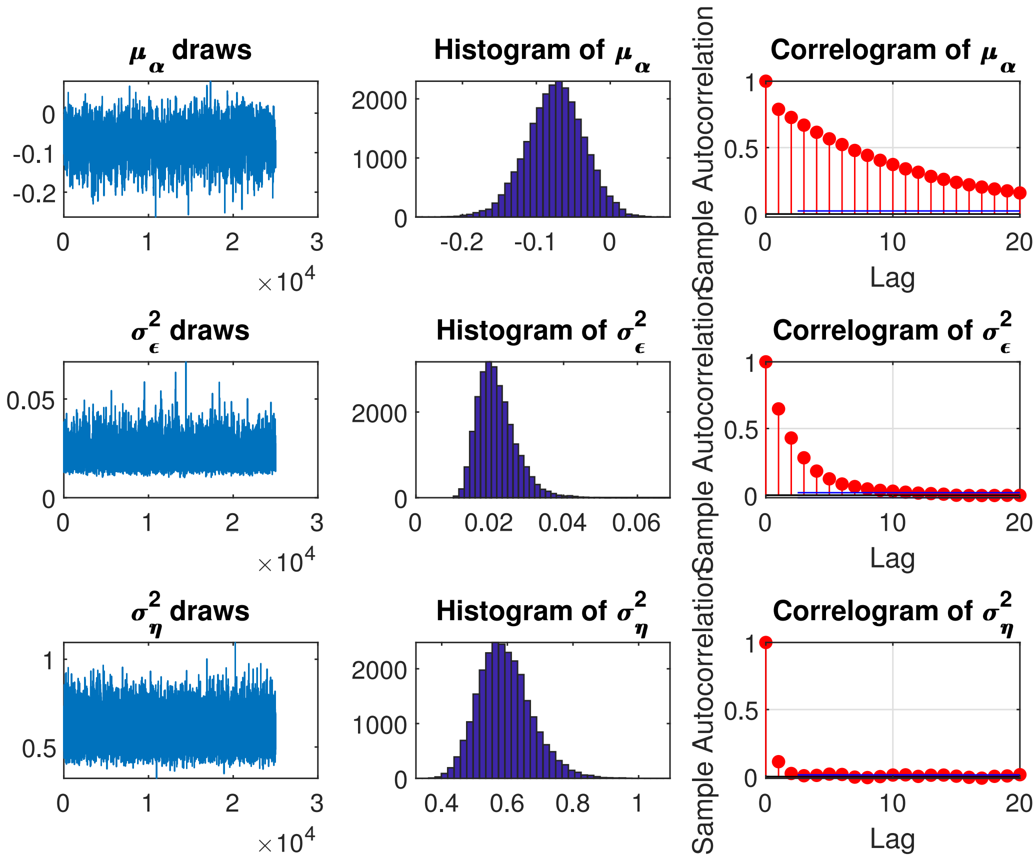

Figure 7. GSUR for Brazil: posterior draws, histograms, and correlograms for some variables of interest