The Time-Varying Long-Run Unemployment Rate: The Colombian Case

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Summary

The long-run component of the Colombian unemployment rate is estimated for the last twenty years. According to the results, the main determinants of the permanent component of the unemployment rate are the real hourly wage, the non-wage labor costs and the rate of capital accumulation. Given the statistical properties of the variables, a cointegration approach was adopted.

JEL classification: J32, J23, J60, E24, C32.
Key words: unemployment rate, labor costs, capital accumulation, cointegration.

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1. Introduction

After the failure of the Phillips curve to explain the simultaneous occurrence of rising inflation and unemployment, the classical approach to the theory of unemployment and inflation reemerged [see Friedman (1968) and Phelps (1967, 1968)]. Milton Friedman (1968) defined the natural rate of unemployment "…as the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demand and supplies, the cost of gathering information about job vacancies and labor availabilities, the cost of mobility, and so on." Accordingly, any gap between the observed unemployment rate and the natural rate is the result of optimizing decisions of households and firms and the microeconomic structure of labor markets (Walsh, 1998), including any informational failures. The main policy implication of this hypothesis is that any intervention of the government to reduce the unemployment rate below the natural rate would result in accelerating inflation. In other words, higher inflation cannot reduce unemployment forever, nor does lower inflation cause any permanent costs in terms of higher unemployment rate.

The rise in unemployment in the 1970s and early 1980s, mainly in Europe, generated another view that tried to combine the involuntary unemployment hypothesis with some ideas underlying Friedman's explanation of both rising inflation and unemployment. This strand of the literature analyzes unemployment and inflation under imperfect competition. This view, known as "non-accelerating inflation rate of unemployment", or *NAIRU*, brings into play Keynesian features and the existence of an equilibrium rate of unemployment[1]. A result of the imperfect competition model, which considers non-competitive labor and product markets, is that the equilibrium rate of unemployment will be the rate at which inflation is constant (Carlin and Soskice, 1990). In the view of Mishkin and Estrella (1998), the *NAIRU* might be interpreted as the unemployment rate consistent with steady inflation within the next year[2].

[1] Modigliani and Papademos (1975) first defined the noninflationary rate of unemployment (*NIRU*) "as a rate such that, as long as unemployment is above it, inflation can be expected to decline – except perhaps from an initially low rate".

[2] For Mishkin and Estrella (1998) the natural rate of unemployment is defined "as the level of unemployment to which the economy would converge in the absence of structural changes to the labor market".

Thus, the natural rate notion is different from the *NAIRU* and both can be thought of as derived from different views about the functioning of the economy. Additionally, the former is a long-run concept, while the *NAIRU* can be viewed as a short or medium-run one[3].

The objective of this work is to give a description and estimate of the long-run unemployment rate in Colombia, a country whose labor market has been characterized by, among other things, lack of flexibility. For example, this market accounts for the existence of a minimum wage, a legal prohibition of reducing the nominal wage assigned to a particular job, statements of the Constitutional Court about the annual increase of the minimum wage, the equality of the rural and urban minimum wages, etc. Consequently, our work achieves an estimate of the long-run unemployment rate that condenses characteristics of both the natural rate and the *NAIRU*.

Previous attempts to estimate the permanent component of the unemployment rate have been undertaken in Colombia (among others see Clavijo, 1994; Farné *et al*., 1995; Henao and Rojas, 1997; Núñez and Bernal, 1997; Cárdenas and Gutiérrez, 1998)[4]. In this article, as in some of the earlier, we use the theory related to both supply of and demand for labor to derive an expression for the unemployment rate and then to estimate the long-run component of it.

The behavior of the unemployment rate in Colombia gives some insights on how well the labor market works and the type of institutions that might be governing it. As we can observe in Figure 1, the unemployment rate showed a declining trend between 1984 and mid-1994. Between 1994 and 2000, it exhibited growth; since then, the unemployment rate has had a declining trend. This behavior during the last decade suggested some difficulties in the labor market. In our view, the very prolonged period in which the unemployment rate was rising suggests that a sufficiently sound set of institutions required to support economic growth was not in place in such a labor market.

This work evolves as follows: the next section shows the main facts over the sample period; Section Three outlines a simple neoclassical-type model that provides us the framework for the discussion of the long-run component of unemployment rate; Section Four shows and

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[3] The controversy about the similitude or difference of the concepts is far from being solved. For example, Ball and Mankiw (2002) sustain that there is no difference between the natural rate and *NAIRU*. On the other hand, Estrella and Mishkin (1998) and Walsh (1998), among others, claim that the concepts are different.

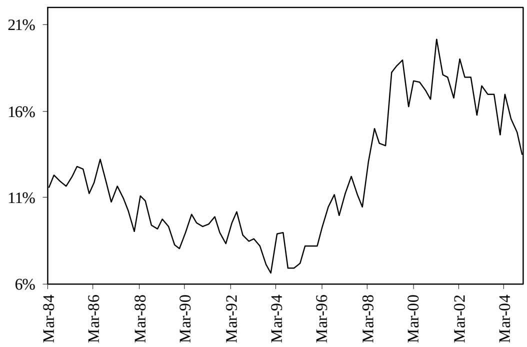
[4] Guataquí (2000), surveys the previous works done in Colombia. Julio (2001) estimates the *NAIRU* by using the approach of Staiger, Stock and Watson (1997).

comments on the results we obtain by using a standard cointegration approach; Section Five draws some conclusions.

2. The Observed Unemployment Rate and some Related Facts

In this work we refer to the unemployment rate estimated for seven cities instead of that for thirteen cities or the nationwide (which includes rural areas and cities of populations less than 100,000). The reason lies in access to the sample; the seven cities unemployment rate is available from 1984:1 up to the present, while thirteen cities and nationwide data are available only from 2000 and 2001, respectively. Furthermore, the National Housing Survey is the source of seven cities unemployment rate (between 1984:1 and 2000:4) while the Continuous Housing Survey – a mechanism that is rather different not only in some concepts and questions, but also in the frequency of data gathering – is the source of the seven and thirteen cities and nationwide unemployment rates (since 2001:1).

Figure 1. Unemployment rate in Colombia 1984-2004

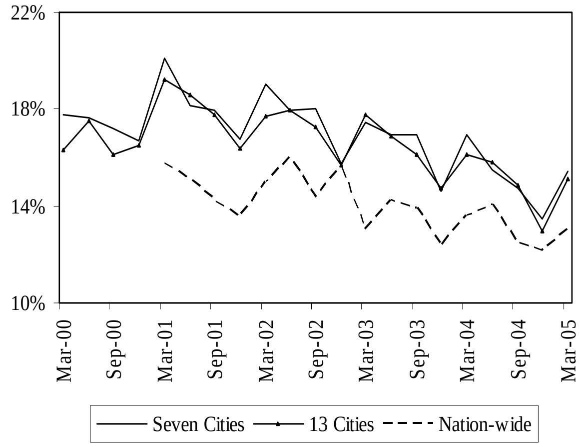


Source: DANE and Lasso (2002).

Given this change of methodology produced by the modification of the surveying process (from the National Housing Survey to the Continuous Housing Survey), we use the series generated by Lasso (2002) which in essence estimates the unemployment rate by extrapolating the current questions to the answers of the previous questionnaire and making adjustments to account for the seasonality and frequency of the information collection. Figure 1 above shows the evolution of the unemployment rate obtained by using Lasso's approach from 2000:1 back to 1984:1 and the current number produced by the official statistics agency (*DANE*).

Figure 2 shows the behavior of unemployment rate for seven cities, thirteen cities and nationwide to give a sense of the differences among them. It should be understood that, because of the inclusion of rural areas and small towns in the sample, the nationwide unemployment rate is lower than those corresponding to seven cities or thirteen cities[5]. Between these two (seven and thirteen cities) the difference seems less important than between them and the nationwide definition.

Figure 2. Some measures of unemployment rates in Colombia 2000-2004



Source: DANE

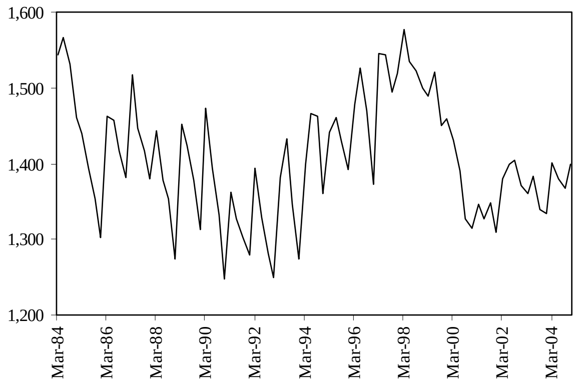
A noteworthy fact was the movement of the real wage during the sample period (see Figure 3). In the meantime, Arango, Posada y Uribe (2005) documented the real wage behavior between 1984 and 2000 by decomposing it between changes in supply of and demand for skilled and non-skilled labor given a skill-biased technological change. These authors show evidence of the increase in the relative wage during the period 1992-1998. Furthermore, they distinguished two sub-periods: 1992:3-1996:3 and 1996:4-1998:4. During the first sub-period the increase in the relative wage is explained by limited growth of supply and the fast growth of demand. During the second sub-period the increase in the relative wage is explained by a teeming increase in the supply but a growth in the demand for skilled labor that exceeded the supply.

Figure 4 shows the joint behavior of the Hodrick-Prescott low frequency component of the unemployment rate and the real hourly wage. It is clear that the latter leads the former. The

[5] The rural unemployment rate is lower than the urban one.

immediate implication of this regularity in Colombia is that the adjustment in the labor market seems to take place via quantities rather than wages.

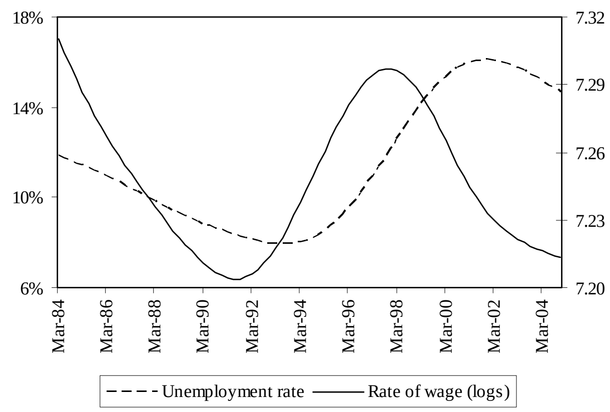
Figure 3. Real hourly wage in Colombia 2000-2004



Source: DANE-ENH-ECH and author's calculations

Figure 4 also suggests a slow reaction of unemployment rate to changes in the Hodrick-Prescott permanent component of the real hourly wage; the latter reached a minimum by June 1991, while the Hodrick-Prescott permanent component of unemployment rate reached a minimum ten quarters later. On the other hand, the real wage achieved the maximum by September 1997, while the unemployment rate achieved the maximum sixteen quarters later. It is also important to observe that the problem was not only the increase of the real wage but also the speed at which such an increase took place.

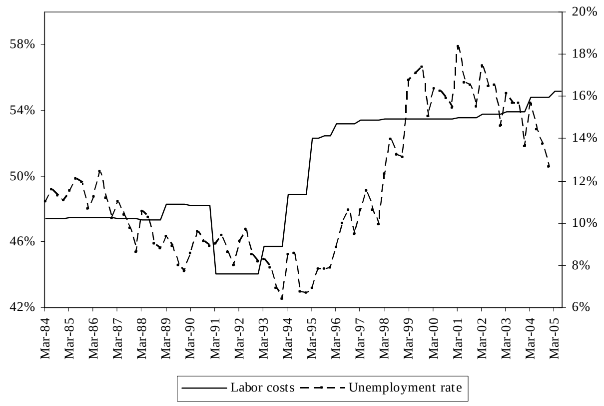
Figure 4. Hodrick-Prescott Permanent components of unemployment rate and real hourly wage (in logs)



Source: author's calculations

Some important institutional reforms undertaken in Colombia during the nineties dealt with social security changes. In the first place, Law 50 of 1990 reduced severance payments for employers. The second Act took place in 1993 and was known as Law 100 which, among many other changes, increased the contributions to health and retirement funds for both employees and employers. In fact, Law 100 introduced deep changes in the legislation which produced an increase in the above items of about ten percentage points. Figure 5 shows the behavior of the total payroll taxes and contributions that formal employers have to make considering the reforms of 1990 and 1993.

Figure 5. Total payroll taxes and contributions of employers (non-wage labor costs)



Source: Banco de la República – Human Resources Division. These costs include, among other elements, contributions for health, pension and severance payments, payroll taxes, etc.

Keeping these reforms in mind, along with the behavior of the real wage, our hypothesis is that the unemployment rate declined when labor became a cheap factor, but when it turned into a costly factor, the unemployment rate started to rise[6].

3. Statistical properties and a stylized model

Under conventional tests (*ADF* and *KPSS*) there is no evidence suggesting that the unemployment rate is a mean reverting process for the sample period at hand (1984:1-2004:4). This result is troublesome in the sense that conventional treatments (e.g. Henao and Rojas, 1997;

[6] This hypothesis is in opposition to the Iregui and Otero´s (2003) who make the point that wages above their long-run equilibrium level do increase unemployment, but wages below this level do not reduce it. This hypothesis implies that those factors that increase unemployment are not the same as those that reduce it.

Ball and Mankiw, 2002) cannot be directly applied. Consequently, an approach to deal with non stationary variables – as we will see below – was needed.

The restriction imposed by such a statistical property to the key variable was taken into account to formulate the theoretical guide. Thus, the model[7] consists of four basic equations (variables in logs):

$$n_t^d = -\alpha\ w_t^e + \lambda\,\theta_t + \gamma\, r_t - \varphi\, c_t + \eta\,\overline{\pi}_t \tag{1}$$

$$n_t^s = \delta\, w_t^e - \phi\,\overline{w}_t + \vartheta\,\tau_t \tag{2}$$

$$u_t = n_t^s - n_t^d \tag{3}$$

$$w_t^e = \mu + \rho\, w_{t-1} - \psi\,(n_{t-1}^s - n_{t-1}^d) \tag{4}$$

where n_t^d represents demand for labor; n_t^s, labor supply; w_t^e, the expected real wage; $\overline{w}_t$, reservation wage; θ_t, technological change; r_t, real interest rate; c_t, other labor costs different from wage (e.g. contributions to health, severance payments and pension plans, and other items showed in Figure 6 above etc.); $\overline{\pi}_t$, the inflation surprise; τ_t, all other things that affect the supply of labor such as demographic processes, "discouraged worker effect", "additional worker effect", etc.; and u_t, unemployment rate. All the parameters in the model are expected to be positive except for γ which might be either positive or negative depending on the degree of gross substitutability or complementarity of inputs in the production function. We assume that θ_t, c_t, and τ_t behave as random walks:

$$\theta_t = \theta_{t-1} + \varepsilon_t^\theta \tag{5}$$

$$c_t = c_{t-1} + \varepsilon_t^c \tag{6}$$

$$\tau_t = \tau_{t-1} + \varepsilon_t^\tau \tag{7}$$

where $\varepsilon_t^j \sim i.i.d.\ (0, \sigma_{\varepsilon^j}^2)$ where j = θ, c, and τ. Accordingly, the change in unemployment rate is given by:

$$\Delta u_t = -[1 + \psi(\alpha + \delta)]\xi_{t-1} - \phi\,\overline{w}_t - \gamma\, r_t - \eta\overline{\pi}_t + \vartheta\varepsilon_t^\tau + \varphi\varepsilon_t^c - \lambda\,\varepsilon_t^\theta \tag{8}$$

where the term ξ_{t-1} includes the long-term relationship:

[7] This model builds on Arango and Posada (2002) and Arango *et al*. (2006).

$$\xi_{t-1} = -\frac{(\alpha+\delta)\mu}{1+\psi(\alpha+\delta)} + u_{t-1} - \frac{(\alpha+\delta)\rho}{1+\psi(\alpha+\delta)} w_{t-1} - \frac{\vartheta}{1+\psi(\alpha+\delta)} \tau_{t-1} + \frac{\lambda}{1+\psi(\alpha+\delta)} \theta_{t-1} - \frac{\varphi}{1+\psi(\alpha+\delta)} c_{t-1} \tag{9}$$

Equations (8) and (9) conform altogether a vector error correction representation where the term $[1+\psi(\alpha+\delta)]$ represents the speed of adjustment and the parameters inside Equation (9) the coefficients of the cointegrating relation after normalizing by the coefficient of u_{t-1}. The unemployment rate generated by this model corresponds neither to the natural rate nor to the *NAIRU*. Rather, it is the result of demand and supply factors, assuming that the real wage is not an endogenous variable.

For empirical purposes, for w_t we used the real monthly wage, the real hourly wage, the minimum wage, the average age of the labor force, the average years of labor force education, and some interactions among these two variables ; for $\overline{w}_t$, besides the set used for w_t, we checked the gender and the participation of young people in the labor force; for τ_t we considered female and young labor force; for θ_t we used the annual rate of capital growth[8] by assuming that most of the technical change has been embodied; for r_t we used the active real interest rate and the fixed term deposit real interest rate. The inflationary surprise $\overline{\pi}_t$ was computed as the difference of observed inflation without food prices and the inflation rate computed from an *ARIMA* model of order four on the annual difference of inflation[9]. At the end, only the real hourly wage (Figure 3), the non-wage labor costs (Figure 5), the capital accumulation and the inflationary surprise (Figure 6) were significant for the *VEC* model as we show next.

4. Econometric approach, results and discussion

The method of Johansen (1991, 1996) provides a suitable approach for dealing with variables for which evidence of stationary behavior is not clear. Tables 1a and 1b show the tests suggesting the existence of one cointegration vector: the unemployment rate happened to share a long-run

[8] This variable has been kindly provided by Jesús Bejarano and first used in Bejarano (2005).

pattern with the real hourly wage, the non-wage labor costs and the capital growth rate; the latter acting as a proxy for the technological change.[10] Also, evidence of some desirable properties of the variables at hand is obtained (see Table 1b).

Figure 6. Capital growth and inflationary surprise

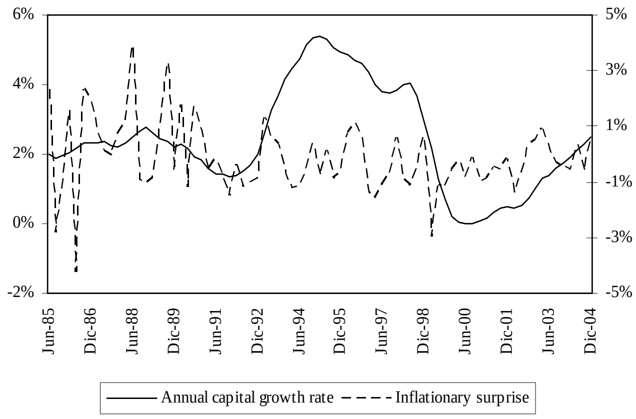


Table 1a. Cointegration tests

Eigenvalue	L-max	Trace	$H_0 : r$	Critical values	
				L-max	Trace
0.3137	28.60	33.78	0	10.29	17.79
0.0658	5.17	5.17	1	7.50	7.50

Table 1b. Cointegrating statistical property tests

r	dgf	χ^2	*u*	*Real hourly wage*	*Non-wage labor costs*	ΔK	Constant
Exclusion							
1	1	3.84	17.02	23.43	9.58	22.13	23.34
Stationarity							
1	4	9.49	28.26	28.49			
Weak-exogeneity							
1	1	3.84	13.66	15.31			

Given these results, Table 2 presents the cointegrating vector. Accordingly, the higher the real hourly wage and the non-wage labor costs, the higher the long-run unemployment rate, whereas the higher the capital accumulation, the lower the unemployment rate. These results do match with the theoretical model.

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[9] Other variables not strictly connected to the model were also considered. This is the case of real exchange rate, terms of trade, consumption taxes, the establishment of the health subsidized system to the poor population (*SISBEN*), etc.

[10] The hypothesis of exogeneity of non-wage labor costs and capital growth was not rejected by the data (see *LR* for binding restrictions in Table 2).

With regard to the short run, the inflationary surprise was the only significant variable and its coefficient has the expected sign. As long as the expectations are backward-formed, there will be room for inflationary surprises which will have a transitory effect on the unemployment rate.

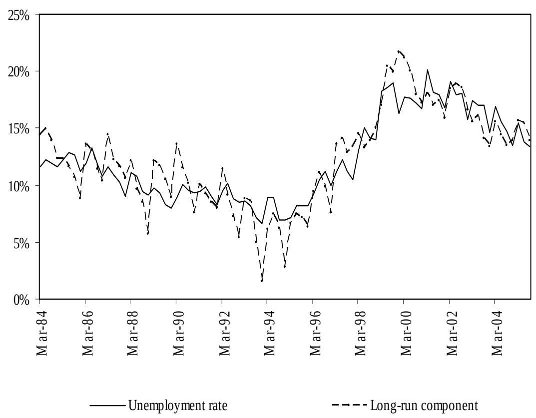
Table 2. System of equations

Long- run equation	u = -2.8960 + 0.3872 × ***real hourly wage*** +0.6447 × ***non-wage labor costs*** – 2.4242 × ΔK (-5.7545) (5.3397) (6.5280) (-11.5584)				
Exogenous stationary variables: inflationary surprise: -0.207 (-3.951)					
Seasonal variables					
Seasonal 1	0.0213 (5.5510)	**Seasonal 2**	0.0045 (0.7959)	**Seasonal 3**	0.0016 (0.3302)
Impulse dummies					
1996:2	0.0153 (2.2753)		**1999:4**	-0.0147 (-1.8971)	
	Δu	$\Delta wage$	**Number of lags = 4**; **Sample: 1986:1 – 2004:4**; **autocorrelation (*p*-val)**: 0.06; ***LM*(1) (*p*-val)**: 0.02; ***LM*(4) (*p*-val)**: .94 **Normality-test (*p*-val)**: 0.73; ***LR* for binding restrictions**: 0.9265.		
Speed of adjustment	-0.3078 (-3.6356)	1.4365 (3.9047)			
R-squared	0.7958	0.7860			
SSR	0.0020	0.0392			

Note: *t*-statistics in parenthesis.

Figure 7 shows the long-run component of the unemployment rate for seven cities estimated by using the cointegrating relationship given by the model. The long-run component of the unemployment rate has exhibited a declining trend from 1999 up to the present. The numbers corresponding to the third quarter of 2005 are 13.4% for the observed unemployment rate and 13.9% for the long-run component.

Figure 7. Observed unemployment rate and estimated long-run component (cointegration component)



Based on the *VEC* model we have estimated the long-run elasticity of the unemployment rate to each variable in the cointegrating relationships. Such values are shown in Table 3. The results suggest that an increase in the real hourly wage of 1% increases the unemployment rate in 0.38%; an increase of 1% in the non-wage labor costs increases the unemployment rate in 0.60%; and, finally, an increase in the rate of capital growth of 1% reduces the unemployment rate in 0.78%.

Table 3. Long-run elasticities of unemployment rate

Variable	**Hourly real wage**	**Non-wage costs**	ΔK
Value	0.38	0.60	-0.78

What we have obtained so far corresponds to the long-run component of the unemployment rate which has been dug out from an equilibrium relationship among the unemployment rate, the real hourly wage, the non-wage labor costs and the technological change proxied by capital accumulation. But a question about the equilibrium level of the real wage and the capital accumulation during the sample period immediately arises. Our interpretation is that, in spite of the fact that we have obtained the long-run component of unemployment rate, the level of those variables observed each time during the sample period might not correspond to the equilibrium levels of each.

5. Conclusions

In this work we have estimated the long-run component of the Colombian unemployment rate for the last twenty years. To carry out the estimate we have constructed a stylized model accounting for some particular traits of the Colombian labor market, which has been characterized by its lack of flexibility.

Given the statistical properties of the variables and the empirical evidence provided by some previous works on the supply of and demand for labor in Colombia, we end up with a cointegration relationship between the unemployment rate, real hourly wage, non-wage labor costs (i.e. payroll taxes and other compulsory fringe benefits) and capital accumulation, the latter as a proxy for technological change. In an economy where the real wage movements are somehow sluggish, the non-wage labor costs and the capital accumulation pace help to explain the long-run behavior of unemployment. The higher the real wage and the non-wage labor costs or the lower the capital accumulation, the higher the long-run unemployment rate.

From these results we underline two facts. Firstly, long-run unemployment rate I Colombia is time-varying. Second, monetary policy does not have possibilities of reducing the long-run unemployment.

In the short run the unemployment rate also reacts to inflationary surprises, which is evidence in favor of a short-run Phillips curve. By contrast, some variables connected to the labor supply (proxies of the reservation wage and composition of the labor force) and labor demand (real exchange rate, terms of trade, etc.) turned out to be not significant within our model.

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