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Recent macroeconomic performance in Colombia: what went wrong?

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Abstract. At the end of the last decade, real activity in Colombia underwent the sharpest recession it had suffered in the last fifty years. With the aim to explain this phenomenon, we are postulating a non-triangular structural VAR model to describe the dynamics of output, prices, unemployment and wages during the last two decades. Evidence suggests that, in the long run, monetary policy has been neutral in regard to both output and unemployment while the main reasons for the increase in the latter have been the way in which wages have been determined (because of backward-formed expectations) and the increase in non-wage labour costs.

Key words: structural VAR, unemployment, monetary policy, wages, non-wage labour costs, expectations.

JEL classification: E24, C40.

Resumen. Al finalizar la década anterior la actividad real en Colombia experimentó la más aguda recesión de los últimos 50 años. Para explicar este fenómeno, postulamos un modelo VAR estructural no-triangular que describe la dinámica de la producción, los precios, el desempleo y los salarios durante las últimas dos décadas. La evidencia sugiere que, en el largo plazo, la política monetaria ha sido neutral con respecto al producto y al desempleo, mientras que la principal razón para el incremento de este último se explica por la forma en que se han determinado los salarios (formación de expectativas hacía atrás) y el incremento de los costos no salariales.

Palabras clave: VAR estructural, desempleo, política monetaria, salarios, costos no-salariales del trabajo, expectativas.

Clasificación JEL: E24, C40.

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1. Introduction

At the end of the 1990's, Colombian economy suffered the most serious recession in its last fifty years. It was so deep that output decreased about 5% in 1999. In addition, the unemployment rate started to rise consistently and reached 20% in 2000. This increase in unemployment was accompanied by a gradual reduction in inflation and an increase in real wages.

Several reasons have been put forward to explain the slowdown of the economic activity. First, the tight monetary policy set by an authority committed to an inflation reduction program. Second, the increase in the cost of labour input due to three elements: (1) the type of expectations formed by agents when setting nominal wages, which pushed wages above their long run equilibrium level, (2) the minimum wage policy, and (3) the increase in non-wage labour costs (Arango and Posada, 2001, 2002). Urrutia (2002) offers another explanation for the recession of 1999 which is linked to the deficit of the current account and the sudden stop of capital flows associated with the international capital markets crisis which occurred in 1997 (see also Izquierdo and Galindo, 2003). However, this view is not emphasized in our work since we will first intend to understand the internal causes of the crisis. A natural step to take towards that goal is to consider external aspects of that crisis.

Accordingly, we postulate a structural VAR model for a closed economy to describe the dynamics of output, unemployment, wages and prices during the last two decades. This type of approach has been previously used to study several macroeconomic aspects in different economies. For example, Dolado and Jimeno (1997) associate the causes of unemployment in Spain with different types of shocks which have long lasting effects due to a full hysteresis phenomenon. They find that the "dismal performance of Spanish unemployment can be explained as the result of a series of adverse shocks, which were difficult to absorb in a context of a rigid system of labour market institutions and disinflationary policies. This finding has relevant policy implications suggesting that, unless supply side reforms are implemented, deflationary policies will continue to be very costly in unemployment terms" (p. 1285).

Balmaseda et al. (2000) focus on the role played by aggregate demand, productivity, and labour supply shocks in explaining the joint dynamic behavior of real output, real wages and the unemployment rate in a model for the labour markets of sixteen OECD economies over the period 1950-1996. They find that "in most countries the identification scheme based on unemployment being persistent but stationary yields more reasonable results than those based on full-hysteresis whereby unemployment is considered to be an I(1) variable" (p. 22). In addition, the authors find that unemployment fluctuations are dominated by aggregate demand shocks in the short run and by labour supply and productivity shocks at lower frequencies. (See also Algan, 2001 and Fabiani et al., 2001.)

In the case of Colombia, Misas and López (1998, 2001) use a $SVAR$ model along the lines of Blanchard and Quah (1989) to estimate output and unem-

ployment gaps. Misas and Posada (2000) examine the sources of variation in the unexpected component of output growth. Arango (1998), also with a *SVAR* approach, provides some evidence on the nature (either nominal or real) of the temporary and permanent components of Colombian output and prices. Finally, Restrepo (1997) uses a *VAR* approach to explain the response of some macroeconomic variables (GDP, real exchange rate index, real money balances, money, inflation, and interest rate) to demand and supply shocks in the markets for goods and money.

Unlike existing literature on Colombian economy, in this paper we present and solve a stylized model to study the economy activity's recent macroeconomic behavior. An appealing of this work is that the empirical approach introduces the long-run restrictions provided by the theoretical framework. The evidence we provide suggests that, in the long run, monetary policy has been neutral as far as both output and unemployment are concerned. The main reasons for the increase in the latter have been the way in which wages are determined (which increased the real wage), and the rise in non-wage labour costs, such as those introduced by pension reforms.[1]

The outline of this paper goes as follows. Some facts related to the macroeconomic performance of the Colombian economy during the last few years are presented in Section 2. The model is introduced in Section 3. The methodology and the empirical application are presented in Section 4. A discussion of our findings is reported in Section 5 and some concluding remarks are provided in Section 6.

2. The facts

Since 1991, Colombia's central bank has been conducting a program that is intended to reduce inflation. This program has been characterized by targets that decrease gradually, accompanied by, among other things, consistent stances of monetary policy.[2] On one hand, the policy was effective in the sense that, since that year, inflation has shown a negative-sloped long-run component (see Figure 1). On the other hand, the program for inflation reduction was not as successful as expected since no inflation target was reached until 1997 (see Figure 1). In 1997 the inflation target was 18 percent while the observed inflation was 17.7 percent. In 1998, the authorities missed the target again. In 1999 and 2000, the observed inflation levels were 9.2 percent and 8.8 percent while targets were 15 and 10 percent, respectively. These results may have undermined the credibility of the monetary authority and, ex post, might

[1] By using a different approach, Cárdenas and Gutiérrez (1998) also underline the increase in non-wage labour costs as one of the determinants for the rise in the unemployment rate. However, in their view, other aspects such as the appreciation of the Colombian peso and the increase in the value added tax have also played a role.

[2] See Urrutia (2002) for an interpretation of the monetary policy during the last decade. See also Hernández and Tolosa (2001).

suggest that the monetary policy stance was tighter than necessary.[3]

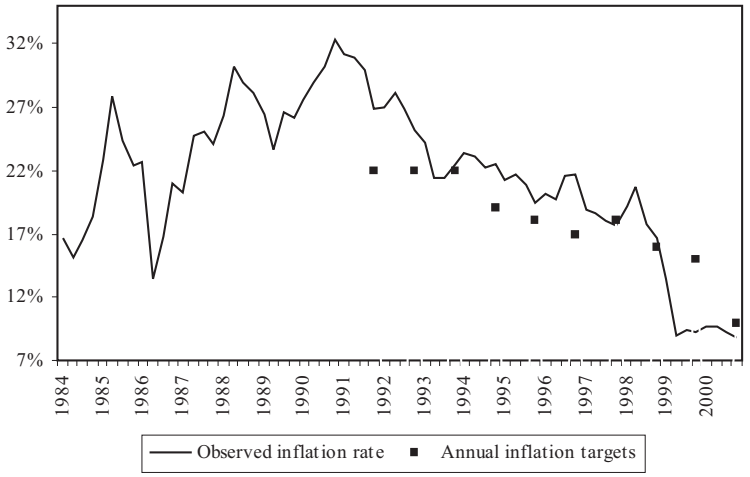


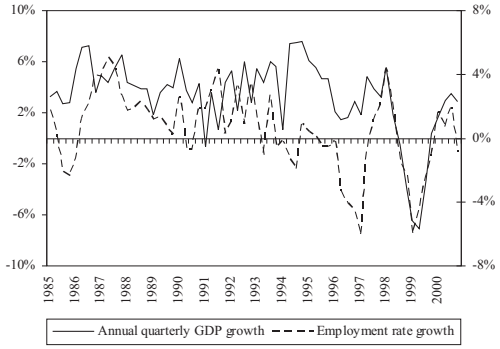
Figure 1. Annual inflation rate.
Source: DANE and Banco de la República-SGEE.

To complete the picture, in the late 1990's, Colombia experienced a deep recession as shown in panels A, B, and C of Figure 2. The growth of real output and the employment rate underwent an abrupt reduction (Panel A) while the unemployment rate for the seven major cities in the country[4] soared between 1994 and 1999 (Panel B). Two measures for the unemployment rate were used. The first one, henceforth u_1, defined as "one minus the employment rate,"[5] rose from 44 percent to about 50 percent between 1994 and 2000. The second measure, henceforth u_2, is defined as "one minus the ratio of the employment rate to the participation rate." This one increased to about 20 percent during the same period. We distinguish between two unemployment measures because u_1 is the measure of unemployment that results from our model, and therefore, it is used in our empirical exercise, while u_2 is the figure published by the government. Finally, Panel C shows the urban employment rate, which exhibits a strong reduction during the same period. However, in contrast to what some believe, the period of inflation reduction and increase in u_2 do not coincide (Figure 3): whereas inflation started to fall in 1991, unemployment started to rise in 1994.

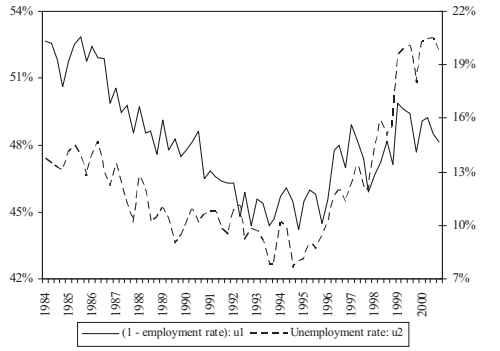
[3]By that time, an international environment that was difficult for emerging markets together with internal fiscal difficulties and a current account imbalance were also part of the picture (see Urrutia, 2002). However, our analysis focuses on neither these aspects nor those related to civil strife and illegal activities.

[4]These cities account for about 75 percent of the country's total population.

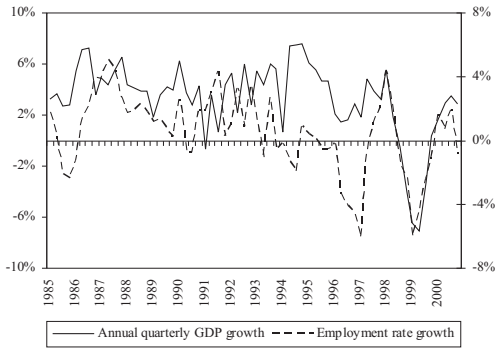
[5]The "employment rate" is defined as the number of (persons employed / persons of working age).



A. Annual growth rate of output and occupation rate.



B. Unemployment rates (seven cities).



C. Employment rate (seven cities).

Figure 2. Evidence of the slump in late 1990's in Colombia. Source: DANE-DNP, Banco de la República-SGEE and authors' calculations.

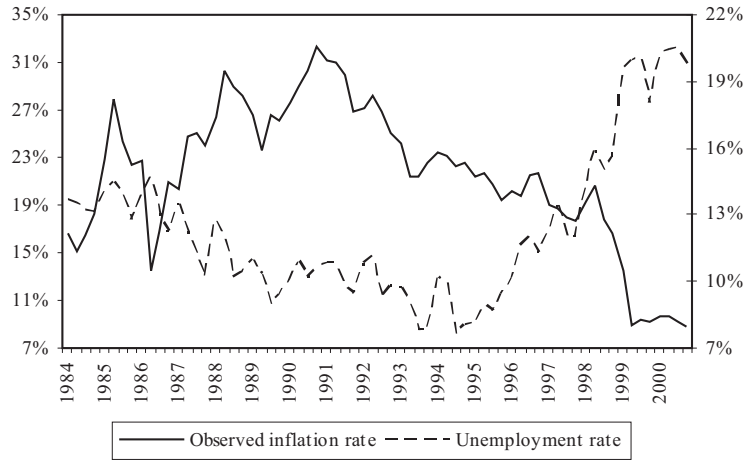


Figure 3. Inflation and unemployment rate (u_2).
Source: DANE-DNP, Banco de la República-SGEE and authors' calculations.

Figure 4 shows u_1 and (the log of) the real labour income index, based on labour income data taken from the *Encuesta Nacional de Hogares* (National Housing Survey) deflated by the Consumer Price Index (*CPI*), which is the proxy we used for the real wage index. According to the graph, this period was characterized, first, by a sharp increase in u_1 during 1994-1999, and, second, by a strong wage growth starting in mid-1992.

The hypothesis we support is that the increase in the unemployment rate was a reaction to a real wage growth that did not conform to the equilibrium path (Arango and Posada, 2002) that converted labour into a very costly factor.[6] The behavior of the real wage might be the result, on one hand, of an unexpected reduction in the inflation rate, perhaps due to a phenomenon of backward-formed expectations. On the other hand, the behavior of the real wage might also be the result of a minimum wage policy that sometimes influences the determination of other nominal wages in the country. The level of this minimum wage is established on political and institutional rather than factual (economic) grounds. However, this phenomenon is not explicitly modeled.

Just before the unemployment rate started to rise in 1994, new labour market and social security legislation was enacted through the Law 100 of 1993. Under this new scheme, some of the labour costs related to health and pension plans were augmented (see Arango and Posada, 2001). As a result,

[6] Iregui and Otero (2003), through nonlinear techniques, make the point that wages above their long-run equilibrium level do increase unemployment, but wages below this level do not reduce it. This result supports their view that those factors which increase unemployment are not the same as those that reduce it.

Figure 4. Unemployment rate (u_1) and real wage index.
Source: DANE-DNP, authors' calculations.

labour became rather costly at the beginning of the second half of the nineties. Figure 5 shows the behavior of non-wage labour costs and the unemployment rate (u_1). Accordingly, the above hypothesis related to the expectations (and effects of the minimum wage policy) could be amended to encompass the impact of the increase in labour costs introduced by such legislation.

3. A stylized model

To account for the above facts, we used a model consisting of a set of structural equations (all variables are in logs):

$$y_t^d = m_t - p_t \tag{1}$$

$$y_t^s = \gamma(p_t - E_{t-1}p_t) + \theta_t \tag{2}$$

$$n_t^d = -\alpha(w_t - p_t) + \beta\, y_t - \varphi\, c_t \tag{3}$$

$$n_t^s = \delta(w_t - p_t) + \tau_t \tag{4}$$

$$w_t = E_{t-1}p_t - \rho\, \tau_t + \lambda\, \theta_t \tag{5}$$

where y_t^d stands for aggregate demand in period t; y_t^s, for aggregate supply; p_t, for the price level; θ_t, for the technology process; n_t^d, for the demand for labour; n_t^s, for labour supply; w_t, for nominal wage; c_t, for the non-wage labour costs,

Figure 5. Unemployment rate (u_1) and non-wage labour costs. Source: DANE, Arango and Posada (2001).

and τ_t, for a labour-supply shift factor (Balmaseda et al, 2000), while E_t is the expectations operator.

Equation (1) suggests that aggregate demand responds to real balances the same way as the quantity theory setting. Equation (2) assumes that aggregate supply is moved by two factors: technology and surprises in the price level or, in other words, deviations of observed prices from expected prices (Sargent and Wallace, 1975). Equation (3) establishes the fact that labour demand depends on real wages, economic activity and non-wage labour costs. Variable reflects costs such as social security contributions (health and pension plans) and other payroll taxes, e.g., contributions to Instituto Colombiano de Bienestar Familiar (ICBF), Servicio Nacional de Aprendizaje (SENA) and Cajas de Compensación Familiar[7] (see Figure 5).

In addition, the model contains the following definition:

$$u_t = n_t^s - n_t^d \tag{6}$$

where u_t is the unemployment rate.

Finally, it is assumed that m_t, θ_t, c_t and τ_t follow independent random

[7]The *ICBF* deals with issues related to the welfare of children. *SENA* is an official agency devoted to the training of labour force. The contributions that *Worker's Families Compensation Funds* (*Cajas de Compensación*) receive are used to provide leisure, training and some health services to workers and their families.

walks:[8]

$$m_t = m_{t-1} + \varepsilon_t^m \tag{7}$$

$$\theta_t = \theta_{t-1} + \varepsilon_t^\theta \tag{8}$$

$$\tau_t = \tau_{t-1} + \varepsilon_t^\tau \tag{9}$$

$$c_t = c_{t-1} + \varepsilon_t^c \tag{10}$$

Equation (7) is used to represent the money supply behavior since the monetary authority focused mainly on monetary aggregates to conduct policy throughout most of the sample period.[9] Given this, the solution to the model is given by:

$$\Delta y_t = \frac{\gamma}{1+\gamma}\left(\varepsilon_t^m - \varepsilon_{t-1}^m\right) + \frac{1}{1+\gamma}\,\varepsilon_t^\theta + \frac{\gamma}{1+\gamma}\,\varepsilon_{t-1}^\theta \tag{11}$$

$$\begin{aligned}\Delta u_t = {} & -A\left(\varepsilon_t^m - \varepsilon_{t-1}^m\right) + A\left(\varepsilon_t^\theta - \varepsilon_{t-1}^\theta\right) \\ & + (\alpha\lambda + \delta\lambda - \beta)\,\varepsilon_t^\theta + (1 - \delta\rho - \alpha\rho)\,\varepsilon_t^\tau + \varphi\,\varepsilon_t^c\end{aligned} \tag{12}$$

$$\Delta w_t = \varepsilon_{t-1}^m + \lambda\,\varepsilon_t^\theta - \varepsilon_{t-1}^\theta - \rho\,\varepsilon_t^\tau \tag{13}$$

$$\Delta p_t = \frac{1}{1+\gamma}\,\varepsilon_t^m + \frac{\gamma}{1+\gamma}\,\varepsilon_{t-1}^m - \frac{1}{1+\gamma}\,\varepsilon_t^\theta - \frac{\gamma}{1+\gamma}\,\varepsilon_{t-1}^\theta \tag{14}$$

where $A = [\alpha + \beta\gamma + \delta/1 + \gamma]$, and $[1/(1+\gamma)]\left[\varepsilon_t^m - \varepsilon_t^\theta\right]$ correspond to the contemporary inflationary surprise.

Accordingly, in this economy only technology shocks have permanent effects on y.[10]

Productivity, labour supply, and non-wage labour cost shocks all have permanent effects on u. Technology, nominal and labour supply shocks have permanent effects on w and both technology and nominal shocks have permanent effects on p. When one looks at the restrictions that emerge from the model, it is obvious that no triangular matrix is useful for identifying those shocks.

[8] We also included a drift in Equation (8). However, the long-run restrictions of the system did not change.

[9] During the last three years of the period under study, other instruments such as the movements of the interest rate of REPO operations were also employed to carry out the inflation targeting strategy.

[10] The long-run restriction of the nominal shock stems from the fact that the polynomial of lags that relates this shock to the first difference of y is zero when it is evaluated with the lag operator equal to one. This type of restriction is used by Blanchard and Quah (1989), along with others.

4. Modeling approach

We use a non-triangular decomposition to identify a *SVAR* model of output (y), unemployment rate (u), nominal wages (w) and prices (p) for the 1984:1-2000:4 period by using quarterly seasonally adjusted data. All variables are in logarithms, with the exception of the unemployment rate, which is a fraction. Real output corresponds to Gross Domestic Product in 1994 prices; the unemployment rate corresponds to , as defined above; nominal wages were computed as labour income (taken from the *National Housing Survey*); and, finally, prices correspond to the *CPI*.[11]

The statistical tests indicate that the series are integrated of order one[12] and that no cointegrating relationship arises from them. Taking into account these stochastic properties we estimate a *VAR* model of order two for the first difference of the selected series.[13] The selected reduced-form *VAR* model may be expressed as:

$$A(L)\,\Delta X_t = e_t, \qquad t = 1, 2, \ldots, T \tag{15}$$

where ${X_t}' = (y_t, u_t, w_t, p_t)$, $A(L) = I - A_1 L - \cdots - A_p L^p$, with L as the lag operator, $p = 2$ and $\{e_t\}$ is a Gaussian white noise process with a covariance matrix Σ. The model (15) can also be written in terms of structural shocks as:

$$B(L)\,\Delta X_t = \varepsilon_t \tag{16}$$

where $B(L) = B_0 - B_1 L - \cdots - B_p L^p$ and $\{\varepsilon_t\}$ is a Gaussian white noise process with covariance matrix I. In our case the structural shocks correspond to ${\varepsilon_t}' = \left(\varepsilon_t^{\theta}, \varepsilon_t^{m}, \varepsilon_t^{\tau}, \varepsilon_t^{c}\right)$. By using the Wold theorem, expression (15) can be written in terms of reduced form shocks as:

$$\Delta X_t = C(L)\,e_t \tag{17}$$

or in terms of structural shocks as:

$$\Delta X_t = \Phi(L)\,\varepsilon_t \tag{18}$$

where $C(L) = I + C_1 L + C_2 L^2 + \cdots$ and $\Phi(L) = \Phi_0 + \Phi_1 L + \Phi_2 L^2 + \cdots$

Based on expressions (17) and (18) it can be shown that structural and reduced form shocks are related to each other as follows:

$$e_t = \Phi_0\,\varepsilon_t \tag{19}$$

[11] The data set is available from the authors on request.

[12] The persistence of the unemployment rate is related to the so-called hysteresis phenomenon (Blanchard and Summers, 1986). However, the persistence of the unemployment rate in Colombia seems to arise because of its behavior during the second half of 1990's (Arango and Posada, 2001).

[13] The number of lags was chosen as the minimum for which we obtain Gaussian white noise residuals. The diagnostic statistics for the residuals of the model are not presented but are available from the authors upon request.

The equations (11) to (14) imply the following restrictions:

$$\Phi(1) = \begin{bmatrix} \phi_{11}(1) & 0 & 0 & 0 \\ \phi_{21}(1) & 0 & \phi_{23}(1) & \phi_{24}(1) \\ \phi_{31}(1) & \phi_{32}(1) & \phi_{33}(1) & 0 \\ \phi_{41}(1) & \phi_{42}(1) & 0 & 0 \end{bmatrix} \tag{20}$$

where the first row shows the long-run response of y to the shocks ε^{θ}, ε^{m}, ε^{τ} and ε^{c}, respectively. The second, third and fourth rows show the response of u, w, and p, respectively, to the same shocks.

It is convenient to re-express these restrictions in the following form:

$$R\,\mathrm{vec}(\Phi_0) = d \tag{21}$$

where the vec operator stacks the columns of a matrix into a single column vector; R is a full-rank matrix of dimension $n \times k^2$; d is a $n \times 1$ vector; k is the number of variables in the model (four in this case); and n is the number of restrictions.

Given that the number of distinct and reduced form parameters in Equation (15), $pk^2 + k(1+k)/2$, is less than the number of the structural form parameters in Equation (16), $(p+1)k^2$, the usual order conditions state that at least $k(k-1)/2$ restrictions are necessary in order to achieve identification of the structural form.

As is customary, the order conditions are necessary for identification but not sufficient. Hence the constraints must also satisfy the rank conditions to be able to generate an identified or over-identified model. By assuming the invertibility of the Φ_0 matrix, the true vector $\mathrm{vec}\,(\Phi_0^*)$ is locally identified iff the system $R(I \otimes \Phi_0)\widetilde{D}_n x = [0]$, with the matrix $R(I \otimes \Phi_0)\widetilde{D}_n$ evaluated at Φ_0^*, has only $x = [0]$ as the admissible solution.[14]

In the case of over-identification of the model, it is possible to construct a test based on the likelihood ratio principle (LR) to check the validity of the restrictions:

$$LR = 2\left(\log\left(\widehat{\Sigma}\right) - \log\left(\widetilde{\Sigma}\right)\right) \tag{22}$$

where $\widehat{\Sigma}$ and $\widetilde{\Sigma}$ are estimators of Σ for the unrestricted and the restricted model respectively. Under the null hypothesis (i.e., the validity of the restrictions being imposed), the test is asymptotically distributed as χ^2 with the number of degrees of freedom equal to the number of constraints minus $k(k-1)/2$.

Our system, including the constraints presented in (21), is *over-identified* and the test described in (22) gives $LR = 1.36$ with a p-value of 0.243. This suggests that we cannot reject the validity of the constraints being imposed at the usual levels of significance. Once the model is either identified or over-identified, one can proceed with the estimation stage.

[14] Details of matrix $\widetilde{D}_n$ are not reported here but are available upon request.

This type of *SVAR* model is called a "*C*-model" by Amisano and Giannini (1997), who propose the following two-step estimation technique. First, the reduced-form *VAR* is estimated by *OLS*; second, the coefficients in Φ_0 are determined by imposing the long run restrictions while the remaining free elements are estimated by maximization of the following log-likelihood function:

$$\log(\Phi_0) = a - \tfrac{T}{2}\log\left(|\Phi_0|^2\right) - \tfrac{T}{2}\operatorname{tr}\left(\left(\Phi_0^{-1}\right)'\Phi_0\widehat{\Sigma}\right) \tag{23}$$

where a is a constant, T is the sample size and $\widehat{\Sigma}$ is a consistent estimator of Σ. Then, in order to achieve local identification, this maximization is subject to the restrictions summarized in (21).

5. Results

Figure 6 shows the response functions of y, u, w and p (in levels) after receiving a shock of one standard error each in $\left(\varepsilon^{\theta}, \varepsilon^{m}, \varepsilon^{\tau} \text{ or } \varepsilon^{c}\right)$.[15] As expected, it was observed that neither a nominal shock, a labour supply shock, nor a non-wage labour costs shock had a long-run effect on output while a productivity shock increased output in both the short and long run. In the short run, nominal shocks had a positive effect on output, but this vanished in about three quarters. In regard to unemployment, a productivity shock reduced it in both the long run and short run. These responses seem counterintuitive at first since one would expect that, other things being equal, the higher the productivity, the higher the wages and lower the employment level would be, from the point of view of the employers. However, what such responses are showing is that β is greater than $(\alpha\lambda + \delta\lambda)$ in the third element on the right hand side of Equation (12). Recall that β is the loading factor for economic activity in Equation (3) of demand for labour, while α and δ are the coefficients relating real wages to labour demand and supply both of which are weighted by λ, the coefficient that links productivity to nominal wages. Hence, to have the increase in unemployment that Colombia had, either a raise in the real wage or a poor performance of the economy or both must have occurred.[16]

As in the results above, nominal shocks reduced unemployment in the short run, but did not have any effect in the long run. Unemployment increased in the short run when facing labour supply shocks. When the shock to unemployment came from the non-wage labour costs, the result was a permanent increase in the former.[17]

[15] The log-likelihood function is maximized using a numerical iterative procedure; for this purpose the computation program MALCOM was used. The confidence intervals of the impulse response functions were coded by the authors.

[16] This response from economic activity may be driven by productivity shocks, which were the only ones with permanent effects on output.

[17] This evidence should draw some attention from the policy makers who try to solve the pension problem by raising the contributions that employers make to the system. The effect is a permanent increase in the unemployment rate.

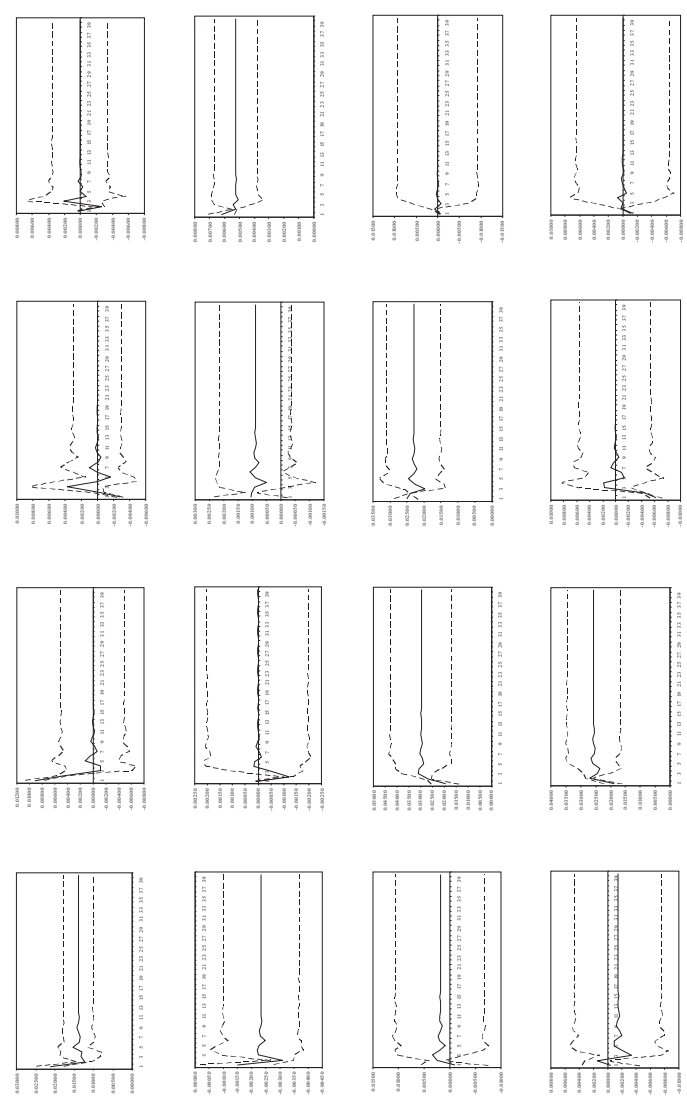


Figure 6. Impulse response functions with nominal wages in the system.

As for nominal wages, we observed that, given the significance of the response, productivity shocks did not generate any effect in either the short or the long run. A nominal shock increases nominal wages in both the short and the long run. A shock increasing the labour supply should have reduced real wages; however, we obtained the opposite response in the short as well as in the long run. In regard to prices, a productivity shock did not affect them in the short or the long run, while a nominal shock increased prices in both cases. Overall, according to the impulse response functions the model performs well since only one of them, the response of nominal wages to a labour supply shock, goes against intuition.

From this exercise it seems that, based on the magnitude of responses of nominal wages and prices to nominal shocks, there is an increase in the real wage caused by a shock from any such source. Thus, the next exercise we undertook was to modify the model to include the real wage instead of the nominal one. In this case, after a simple algebraic manipulation, Equation (13) is replaced by:

$$\begin{aligned}\Delta(w_t - p_t) &= \Delta w_t^r \\ &= -\frac{1}{1+\gamma}\left(\varepsilon_t^m - \varepsilon_{t-1}^m\right) + \frac{1}{1+\gamma}\left(\varepsilon_t^\theta - \varepsilon_{t-1}^\theta\right) + \lambda\,\varepsilon_t^\theta - \rho\,\varepsilon_t^\tau\end{aligned} \tag{13′}$$

where $w_t^r = w_t - p_t$ is the real wage. From Equation (13′), we can see that no long-run response should be expected from the real wage as a result of nominal shocks. With this modification, the restrictions to the system are now given by:

$$\Phi(1) = \begin{bmatrix} \phi_{11}(1) & 0 & 0 & 0 \\ \phi_{21}(1) & 0 & \phi_{23}(1) & \phi_{24}(1) \\ \phi_{31}(1) & 0 & \phi_{33}(1) & 0 \\ \phi_{41}(1) & \phi_{42}(1) & 0 & 0 \end{bmatrix} \tag{20′}$$

where, as before, the rows show the response in the long run of y, u, w^r and p to the shocks ε^θ, ε^m, ε^τ and ε^c respectively.

The system corresponding to this version of the model is also *over-identified*. In this case, the test described in (21), which gives $LR = 3.46$ with a p-value of 0.178, indicates that we cannot reject the validity of the constraints at usual significance levels. The conclusion of this exercise is that responses of the variables remain almost the same as in our benchmark case (see Figure 7). However, notice that the response of unemployment to a labour supply shock is now significant in both the long run and the short run. Notice also the short-run responses of output, unemployment and real wages to nominal shocks: the first one increases while the second one, as well as the real wage, decreases.

We retained this version of the model (with real instead of nominal wages) to carry out an additional empirical exercise without imposing long-run restrictions on the response of the unemployment rate to nominal shocks.

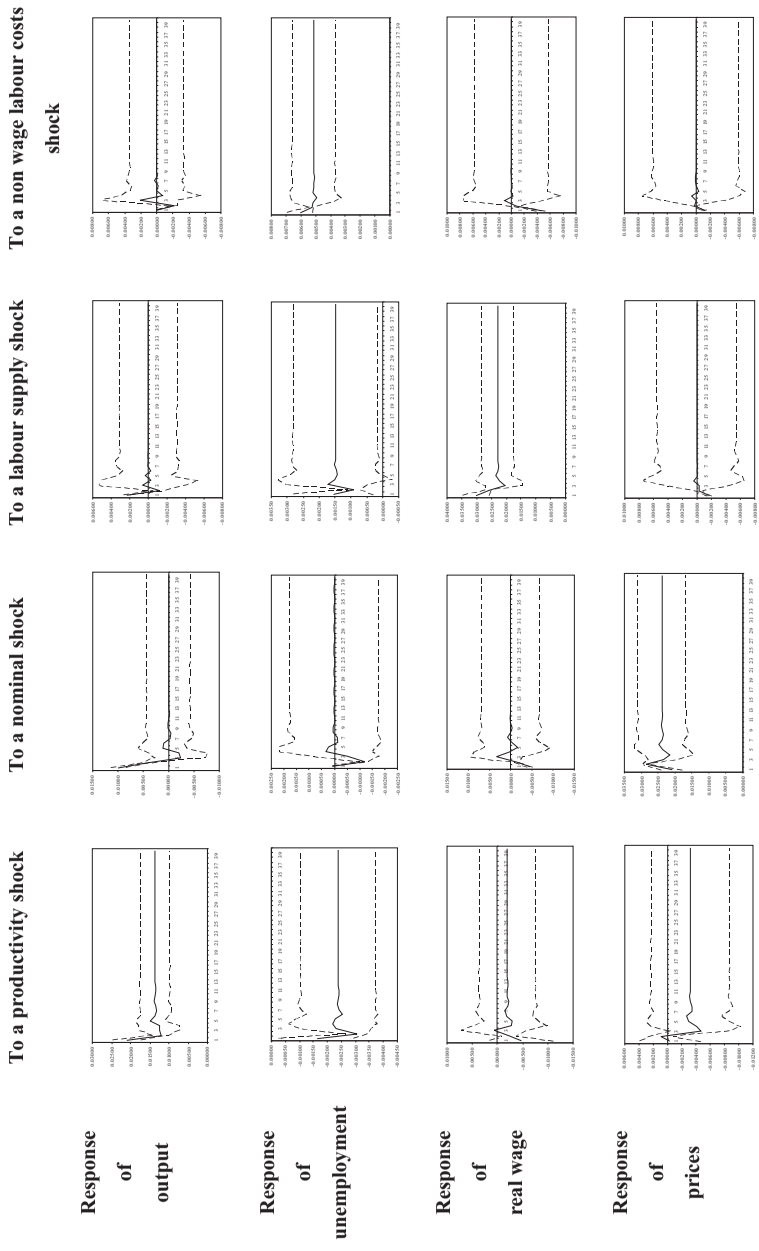


Figure 7. Impulse response functions with real wages in the system.

A nominal shock has the effect of reducing the unemployment rate in the short run. In this version of the model, output also reacts in the short run while the real wage moves downward. Notice, however, that these effects last only about one year; then the responses are not significant (see Figure 8). These reactions of the variables are fully consistent with backwards-formed expectations that the Colombian agents have as is sometimes argued.

Now, let us turn to an economy where a negative nominal shift is announced every year and put into effect by the monetary authority. However, the announcement is not believed by agents. The result is a negative response in output and an increase in both unemployment and real wage in the short run. No long-run effect in any of these variables is possible according to our results. However, this kind of expectation made this type of joint behavior on the part of the variables feasible during the last years of the 1990's. Thus, to improve the performance of economy, the announcements made by the monetary authority should be taken into account. If the policy announcements had been believed and taken into account when establishing wages, unemployment would have increased only as a result of the impact of labour supply and non-wage labour costs.

The last exercise might not be necessary since, according to the statistics, the long-run restrictions have not been rejected. However, some analysts of Colombian economy insisted (and still do) that a more active monetary policy was needed to push economy out of recession. Nevertheless, these results suggest that, if a more active policy had been pursued, the economy would have only a short-run reaction in its output, unemployment and real wages. The cost of this behavior would be a higher price level in both the short and the long run (Figure 8). Of course, if we assume that agents form expectations rationally, this policy could be applied just once, but if agents form expectations backwards, there is room for "managing the demand" over a few periods at the cost of higher inflation.

6. Final remarks

We present a small closed model of Colombian economy for the purpose of ascertaining some of the possible causes of the deepest recession the country has experienced in its last fifty years. The model consists of structural equations for the product and labour markets and a few other definitions and assumptions. By using a non-triangular *SVAR* empirical approach and quarterly data from 1984 to 2000, we obtain impulse response functions that appear sensible for output, unemployment, and prices but not for nominal or real wages. The results of the tests suggest that the long-run restrictions, which are assumed in the model, can be imposed on the variables response to productivity, nominal, labour supply, and non-wage labour costs shock.

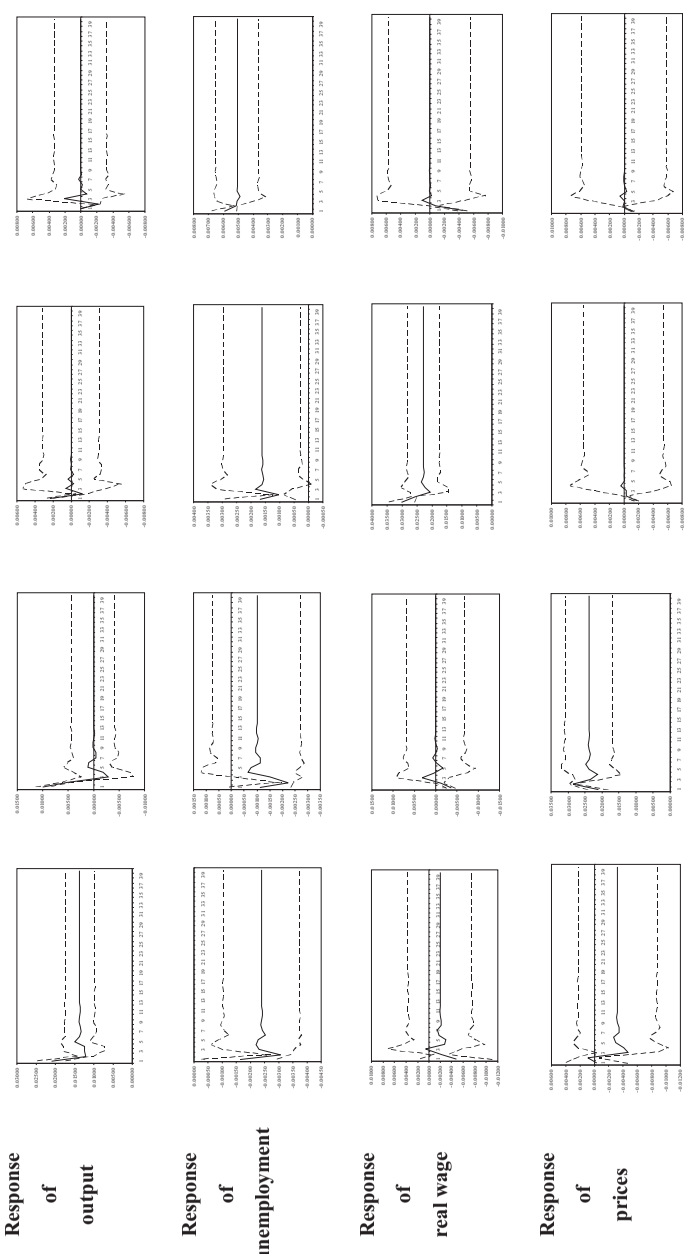


Figure 8. Impulse response functions with real wages in the system but without long-run restrictions on the response of unemployment to nominal shocks.

Evidence suggests that among the causes of recession, the type of expectations agents have (backward-formed) seems to hold a privileged place. Other shocks such as labour supply and non-wage labour costs also explain the increase in the unemployment rate. Most tellingly, the exercise also shows the long-run neutrality of nominal shocks towards both output and unemployment. However, these variables react in the short run to shocks from the same source.

Now, assuming that agents continue to have expectations as they did at the end of the last decade, the authorities might decide whether or not to exploit the differences between the expected and the observed inflation given the price reactions produced by these types of policies.

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