

**Colección  
Economía y Finanzas**



**BANCO CENTRAL DE VENEZUELA**

# **Sources of macroeconomic fluctuations in Venezuela**

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**Serie Documentos de Trabajo  
Gerencia de Investigaciones Económicas**

**Versión Julio 2004**

**56**

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\* This paper benefited from the comments of the staff at Universidad Alberto Hurtado, Santiago de Chile, where it was presented on seminar. We are thankful for the valuable comments received at the IESA seminar by the staff professors. We are also grateful to Eduardo Zambrano, Juan Nagel, Oswaldo Rodríguez, José Guerra, Omar D. Bello, Osmel Mazano and José Gregorio Pineda for their valuable comments. We also thank Susana Carpio for her competent assistantship.

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Gerencia de Investigaciones Económicas

### **Producción editorial**

**Gerencia de Comunicaciones Institucionales**

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## **Resumen**

El objetivo de este artículo es determinar las fluctuaciones macroeconómicas en Venezuela puede ser explicada por choques de los ingresos petroleros o por choques domésticos de oferta o de demanda. Se realiza para ello un análisis empírico basado en la metodología de Blanchard y Quah, usando datos trimestrales para el período 1984-2003. Los resultados indican que los choques domésticos explican al rededor de un 70% de la volatilidad en el crecimiento del producto no petrolero. En particular, los choques de oferta, parecen ser la principal fuente de volatilidad en el producto no petrolero, mientras que los choques nominales podrían explicar más de la mitad de la variabilidad de la tasa de inflación. Podría pensarse que los choques domésticos están relacionados con la política económica. Sin embargo, esta metodología no puede determinar si el comportamiento errático de la política económica es el resultado de un marco institucional débil que se deriva de la naturaleza de una economía con abundancia de recursos, propensa a choques externos y a la búsqueda de rentas. Pero si consideramos a estas instituciones como dadas, parece que el impacto de las fluctuaciones del ingreso petrolero es limitado, aunque no despreciable. Estos resultados son robustos frente a diferentes especificaciones del modelo.

Palabras clave: Volatilidad y descomposición de varianza

Clasificación JEL: E32, E37, C32

## **Abstract**

The aim of this paper is to determine whether macroeconomic fluctuations in Venezuela can be explained by oil income shocks or by domestic supply or demand shocks. We conduct an empirical study based on the Blanchard and Quah method, using quarterly data for the period 1984-2003. We find that domestic shocks seem to explain around 70% of non-oil output growth volatility. In particular, supply shocks seem to be the main source of non-oil output growth volatility. Nominal shocks, on the other hand, seem to account for over half of inflation variability. Domestic supply and demand shocks may be policy related, but with the methodology used in this paper we cannot determine whether these shocks are the outcome of weak institutions resulting from the nature of a resource abundant economy, prone to external shocks and a rent-seeking behavior. But taking such institutions as given, it seems the impact of oil income fluctuations is limited, although not negligible. These findings are robust to different specifications.

**JEL Classification** E32, E37, C32

## Introduction

Output and inflation volatility in Venezuela are among the highest in Latin America, an already highly volatile region<sup>1</sup>. Given that exports are mostly concentrated on oil, volatility is usually attributed to the exposure of the economy to large external shocks, due to oil price variability in international markets. The aim of this paper is to examine to what extent this belief is true. We want to determine whether the variability of non-oil output growth, inflation and the real exchange rate can be explained by oil income shocks or by domestic supply or demand shocks. Domestic demand shocks may include variations in real fiscal expenditure or innovations in the money supply, while supply shocks can be associated with changes in productivity, labor supply shocks or structural reform.

Why should we be concerned about volatility? Recent empirical works explore the connection between volatility and variables that affect welfare. For instance, Ramey and Ramey (1995) demonstrate the existence of a strong negative link between volatility and growth in a panel of 92 countries and a subset of OECD countries. Aizenman and Marion (1993,1999) find a significant inverse relationship between private investment and macroeconomic uncertainty in developing countries. Gavin and Hausmann (1995), and Turnovsky and Chattopadhyay (2003) find that volatility of the terms of trade, and of fiscal and monetary policies have a significant negative impact on growth rates in developing economies, and particularly in highly volatile ones. All these findings point in the same direction: volatility is costly in terms of economic growth and welfare. During the past two decades the Venezuelan economy has exhibited large variations of macroeconomic variables coupled with a poor performance in terms of economic growth (Arreaza and Bello, 2000). Reducing volatility may well then contribute to improve growth performance in Venezuela.

In order to reduce volatility, it is then necessary to determine what causes it, since policy implications may vary depending on what its main source turns out to be. For example, if variations of oil income are a predominant source of fluctuations in Venezuela---and borrowing from abroad is limited---focus should be on seeking for mechanisms to smooth income and share risk, such as trading futures, options and commodity linked bonds of oil exports in international markets; or to implement self-insurance mechanisms, such as macroeconomic stabilization funds<sup>2</sup>. On the other hand, if most fluctuations are associated to domestic demand shocks, resorting to fiscal and monetary policies can be appropriate to "fine tune" the economy. If fluctuations come from the supply side (technological change, labor supply shocks or structural reform), they may be optimal responses of agents to uncertainty in the environment that affect productivity. In this case, focus should be on reducing economic uncertainty, rather than reducing fluctuations per se, by, for example, having a sound and stable institutional framework.

Hoffmaister and Roldos (1997) and (2001) and Ahmed (2003) conduct empirical studies using VARs to determine the sources of macroeconomic fluctuations in small open developing countries. These authors analyze the relative importance of external shocks---terms of trade, world income and international interest rates---and domestic shocks---

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<sup>1</sup> See Gavin and Hausmann (1995) and Hausmann (2001).

<sup>2</sup> See Hausmann, Powell and Rigobon (1993).

supply and demand---to explain volatility. In order to perform impulse response analysis and variance decompositions, we need to “recover” the structural residuals associated with external, supply and demand shocks, from the estimated residuals of the VAR. For this we need to impose a minimum set of restrictions that allow us to achieve proper identification. Following Blanchard and Quah (1989), Hoffmaister and Roldos employ long-run restrictions, while Ahmed sets restrictions on the contemporaneous relations between the variables. In both cases, the authors find evidence suggesting that domestic shocks are the most important source of output growth variability in the emerging economies analyzed.

In this paper we conduct an empirical study for Venezuela based on the Blanchard and Quah method. We believe that for our set of variables long-run restrictions are theoretically more appealing than short-run restrictions. Variance decompositions trace the relative contribution of each type of structural innovation to the variance of the forecast error of non-oil output growth rate, inflation and the real exchange rate, and will be the center of our analysis. Impulse response functions allow us to check whether the results derived from our model are consistent with economic theory.

Using quarterly data for the Venezuelan economy for the period 1984-2003<sup>3</sup>, we find that domestic shocks seem to explain around 70% of non-oil output growth volatility<sup>4</sup>. In particular, supply shocks seem to be the main source of non-oil output growth volatility. Nominal shocks, on the other hand, seem to account for over half of inflation variability. The results are not at odds with findings that the secular decline in growth rates in the last two decades may be attributed to the descent of real per capita oil exports. What our results imply is that the variability of growth rates, not the trend, is mostly determined by domestic shocks, which may be policy related. With this methodology we cannot determine if domestic shocks associated to poor domestic policies are the outcome of weak institutions resulting from the nature of a resource abundant economy, prone to a rent-seeking behavior. But taking such institutions as given, it seems that the impact of oil income fluctuations is limited, accounting for 30% of the volatility of non-oil GDP growth rates at most. These results are robust to different specifications of the model and similar to the findings in Hoffmaister and Roldos (1997, 2001) and Ahmed (2003) for other Latin American economies.

The paper is structured as follows. Section 2 shows some stylized facts about the Venezuelan economy. Section 3 describes the methodology employed. Section 4 presents the econometric analysis and main findings, and Section 5 has some final comments.

## **Stylized Facts**

Over the course of the past 20 years, the Venezuelan economy has experienced various structural reforms, episodes of political instability, multiple exchange rate regimes, a balance of payments crisis in 1989, a banking crisis in 1994-96, along with oil-income

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<sup>3</sup> It would be ideal to study a longer period, but we are subject to data limitations that do not allow us to go further back in time.

<sup>4</sup> In the next section we explain why we focus on non-oil GDP rather than total GDP.

shocks. It is not our goal in this paper to present a detailed account of the performance of the economy during this period, since other authors have already done that<sup>5</sup>. We limit ourselves to include a list of the main reforms that took place between 1983 and 2003 in the Appendix A, as a depiction of the volatile institutional framework that prevailed during the period. To provide a very general context to such list, we may say that while the eighties were a decade of tightening controls and regulations on the economy, starting with the liberalization program implemented in 1989 there has been shift towards a market economy. This path has nevertheless been bumpy: in the mid-nineties, some of the market reforms were reversed to be re-established after the banking crises, and yet again in 2003 controls are back in the spotlight. Thus, it is not surprising that the combination of all these factors generated volatile growth rates. In the rest of this section, we present a brief and very general description of the statistical properties of the variables we use in the study.

Figure 1 displays the logs and the first differences of the logs of quarterly observations of real GDP and GDP excluding oil production, between 1983 and 2002. During this period, oil production represented, on average, approximately 25% of GDP. Since Venezuela is an active member of the OPEC, oil production is subject to quotas oriented to satisfy the international demand, which do not respond to domestic market conditions. Therefore, in the rest of our analysis we exclude oil sector production to obtain a measure of GDP that we consider a better representation of domestic conditions, i.e., non-oil output.

In panel (a) we observe a break in the trend of non-oil GDP around 1992, followed by a break in the trend of total GDP around 1994, when both trends start to flatten<sup>6</sup>. In 1998 there seems to be another break in both trends and they become negative. Panel (b) shows growth rates of quarterly total GDP and non-oil GDP. Both series are highly correlated and their standard deviation is around 5%, which is high compared to Latin American standards, not to mention to OECD countries<sup>7</sup>.

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<sup>5</sup> For some detailed accounts of the period see: Naim (1993) for economic reforms in the late eighties and early nineties; Espinasa (1996) and Clemente and Puente (2001) for developments of the oil industry and relation between oil shocks and fiscal policy; Arreaza and Bello (2000) for a general overview of the recent dynamics of the main economic variables; García, Rodríguez and Salvato (1998) and Krivoy (2002) for the banking 1994 crisis; Guerra and Pineda (2002) and Guerra and Zavarce (1994) for exchange rate regimes; García (1995) and Ríos (2003) for fiscal dynamics; Mirabal and Villavicencio (1991) and Mirabal (2000) for monetary policy management; Betancourt, Freije and Marquez (1995) and García (1997) for labor market issues and reforms.

<sup>6</sup> We use a lax definition of the term “trend” here, referring to the Hodrick-Presscott filtered trend. Ideally, we would need a longer period to speak of growth trends in the sense it is done in growth studies. Unfortunately, there are data availability problems that prevent us from studying a longer period.

<sup>7</sup> See Gavin and Hausmann (1995).

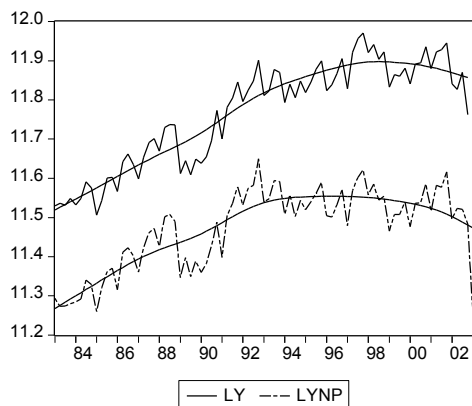
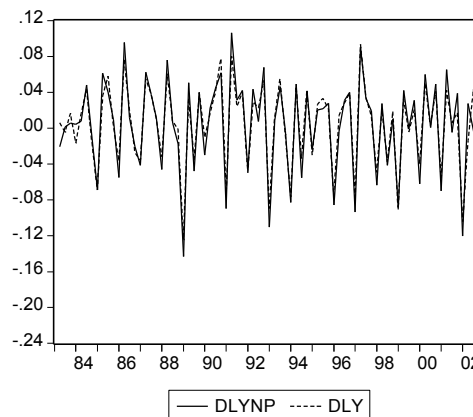
**Figure 1****(a) Total GDP and Non-Oil GDP****(b) Total GDP and Non-Oil GDP Growth**

Figure 2 displays the logs of oil exports, fiscal revenues derived from oil exports, both in dollars, (panel a) and the log of oil prices of the Venezuelan basket (panel b). To account for external shocks, we wanted to consider oil exports income rather than just oil prices. To a large extent, oil income is channeled to the non-oil sector through fiscal expansions. The government obtains oil revenues by taxing the state owned oil company, Petroleos de Venezuela (PDVSA) and then injects those resources into the economy through expenditure. In fact, there is a close relationship between oil revenues and government expenditure in Venezuela<sup>8</sup>. Thus, we want to look at oil fiscal revenues and oil exports to account for the ways in which oil income fluctuations can affect the non-oil sector.

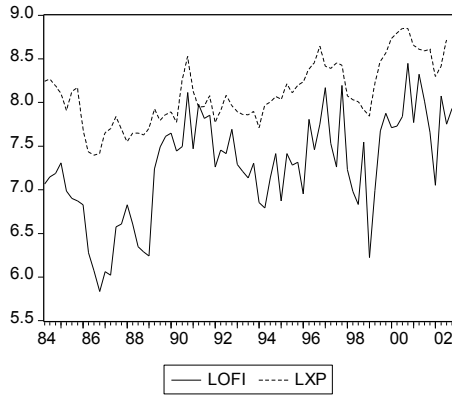
Aside from high variations in oil prices, as reflected in panel (b), production policies within the oil industry in Venezuela have changed throughout this period, which also affect oil income dynamics<sup>9</sup>. Oil exports and fiscal revenue derived from oil exports exhibit a high positive correlation, but oil fiscal revenue seems more volatile, possibly due to lags in tax collection. During the seventies and early eighties oil revenues represented about 70% of total fiscal revenues, but this fraction has progressively declined during the past 20 years, accounting for less than 50% of total fiscal revenues by 2002<sup>10</sup>. In spite of showing a declining trend, oil revenues still represent today a large chunk of fiscal revenues and as such can affect fiscal performance to a large extent.

<sup>8</sup> See García (1995), Clemente and Puente (2001) and Ríos (2003).

<sup>9</sup> Until the early eighties Venezuela followed OPEC's strategy focused on attaining high prices in international markets. Starting from the mid-eighties PDVSA's "internationalization process" meant a new emphasis on securing international markets for oil exports by buying refineries in North America and Europe, rather than targeting prices, at a time when OPEC production quotas became more lax. This process was reinforced throughout the nineties with the "Apertura Petrolera", destined to increase potential production and competitiveness by attracting private investment, foreign or domestic, in the form of strategic alliances or outsourcing. (See Clemente and Puente, 2001). Prices dropped during the nineties after reaching a peak during the Gulf war, but oil income did not fall in the same proportion due to production increases. Since 1999 though, OPEC's strategy has turned again towards defending prices by cutting down production.

<sup>10</sup> Ríos (2003).

**Figure 2**  
**(a) Oil Exports and Oil Fiscal Income**



**(b) Oil Prices**

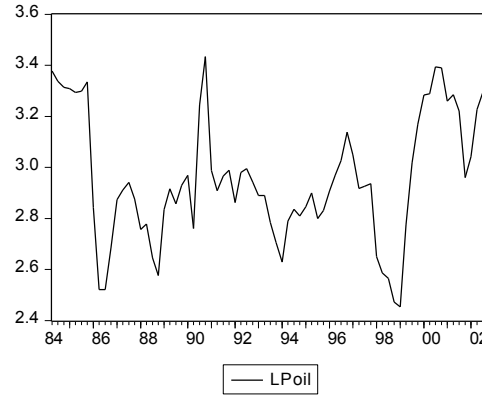
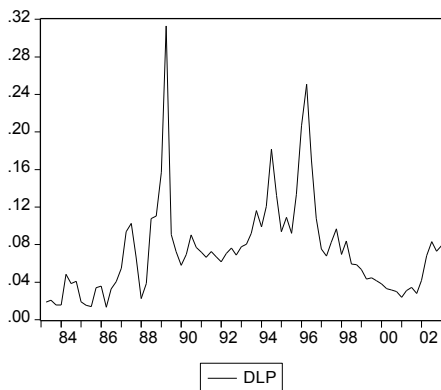
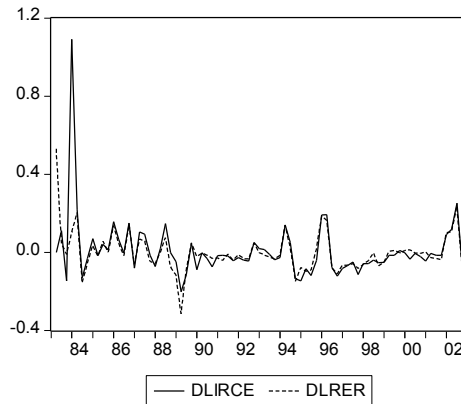


Figure 3 shows the log differences of CPI (panel a) and of the logs of the terms of trade and the real exchange rate (panel b). There is an upward trend in inflation until 1996, with spikes in 1989 and 1996 that coincide with price liberalization in 1989 and large devaluations of the nominal exchange rate. From 1996 to 2002 there is a decline in inflation that coincides with the flotation bands for the exchange rate, and then the trend picks up again when the regime is abandoned in 2002. Comparing the rate of change of the real exchange rate to that of the terms of trade<sup>11</sup> in panel b, we notice that the terms of trade are somewhat more volatile, since they are more sensitive to variations of oil prices and nominal devaluations than the real exchange rate. This is because domestic prices of non-tradable goods are not affected as much as the price of tradable goods by oil prices and devaluation of the nominal exchange rate.

**Figure 3**  
**(a) Inflation**



**(b) Real exchange rate and terms of trade**



These figures reveal that during the past 20 years economic aggregates in Venezuela have been highly volatile and exposed to shocks of diverse nature. Our task in this

<sup>11</sup> The real exchange rate is proxied by the US producer price index multiplied by the domestic nominal exchange rate and divided by the domestic consumer price index. The numerator contains prices of tradable goods of our main trade partner, while the denominator has prices of tradable and non-tradable goods, so their ratio gives us an idea of the price of tradable relative to non-tradable goods. The terms of trade index is the IRCE computed by the Venezuelan central bank, which contains information of prices of tradable goods with Venezuela's main trade partners.

project is to find the relative contribution of domestic and external innovations to volatility.

An essential step in the analysis of time series data is to determine whether the variables are stationary. For this purpose, we performed a number of tests: standard Dickey-Fuller tests, recursive, rolling and sequential tests to check for the presence of stationarity around a deterministic trend or mean with a shift against a unit root. The sequential test is particularly important since, from the previous analysis, we may expect the presence of structural breaks in the series. The sequential tests are more powerful than the recursive and rolling tests (Banerjee, Lumsdaine and Stock, 1992). The statistics are reported in Table 1.

**Table 1. Testing for Unit Roots and Structural Breaks. Sample: 1983:1-2002:4**

Variable	ADF	Recursive (Min DF)	Rolling (Min DF)	Sequential Mean shift	
				(F max)	(Min DF)
GDP	-1.89	-3.66	-3.44	9.43	-4.14
Non-oil GDP	-2.03	-3.27	-4.27	10.14	-4.34
Oil Prices	-3.30**	-3.08	-4.52	12.15	-4.25
Oil Exports	-3.37*	-3.48	-4.76*	11.81	-5.41***
Oil Fiscal Income	-4.42***	-3.65	-4.44	14.07	-4.42
CPI	-2.11	-2.48	-5.82***	5.81	-2.92
Real Exchange Rate	-0.81	-4.11*	-4.46	10.42	-2.91
Terms of Trade	-7.22***	-4.92***	-3.29	11.07	-2.89
US T. Bill real rate	-2.73	-3.15	-4.28	8.89	-3.86

Notes: Values reported are test statistics. (\*) Significant at 10% level. (\*\*) Significant at 5% level. (\*\*\*) Significant at 1% level. The sample for the terms of trade is 1983:1-2002:04. ADFs are compared against critical values in Davidson and Mac Kinnon (1993). Regressions included constant terms and dynamic terms whenever significant. Lag length for each variable was set according to SIC for the full sample. The Recursive, Rolling and Sequential tests are compared to critical values in Banerjee, Lumsdaine and Stock (1992) for T=100. The window sizes were set following Banerjee et al. Note that we have 80 observations at most, so results based on these tests should be taken carefully.

According to the different tests, the null of a unit root cannot be rejected for the logs of GDP, Non-oil GDP, CPI, the real exchange rate and the terms of trade. On the other hand, some tests suggest that oil prices, oil exports and particularly oil fiscal income may be stationary. Keeping in mind that sequential tests have more power than the recursive and the rolling ADF tests, but that the critical values for these tests are designed for more observations than our sample has, we opted for including all variables in first differences for the VAR analysis<sup>12</sup>.

## The model

For the purpose of identifying the relative importance of domestic and external shocks we used an approach similar to that in Hoffmaister and Roldos (1997) and (2001). These authors extend the original Blanchard and Quah (1989) structural decomposition, conceived to analyze supply and demand factors in macroeconomic fluctuations, to the case of small open economies where external factors also play a role. This method centers on imposing restrictions on the cumulative impulse response functions (long-run restrictions) to identify VARs.

<sup>12</sup> Including oil exports and oil fiscal income in levels did not alter the results dramatically.

We start from a stationary VAR  $Y = (\Delta x, \Delta y, \Delta tcr, \mathbf{p})$ , where  $x$  stands for the log of oil income,  $y$  represents the log of non-oil GDP,  $tcr$  is the log of the real exchange rate and  $\pi$  is the first difference of the log of CPI.

$$A_0 y_t = \sum_{j=1}^p A(j) y_{t-j} + B e_t \quad (1)$$

$A_0$  is a matrix of contemporaneous relations between the endogenous variables,  $B$  is a matrix of non-zero off diagonal elements that allow some structural shocks to have a direct effect on more than one endogenous variable, and  $e$  is a vector of structural orthonormal residuals with variance-covariance matrix  $Var(e) = I$ . The Blanchard and Quah method poses  $A_0 = I$ , which implies no contemporaneous relations between the endogenous variables<sup>13</sup>.

Since  $Y$  is stationary, from the Wold theorem it follows that  $Y$  has a VMA representation that expresses the long-run effect of the structural shocks on the endogenous variables:

$$\begin{aligned} y_t &= \left( I - \sum_{j=1}^p A(j) \right)^{-1} B e_t \\ &= -\Pi^{-1} B e_t \end{aligned} \quad (2)$$

Structural shocks are conceived here as “exogenous” variables that impact the endogenous variables in the system. In this paper we assume that there are four types of shocks affecting the economy: external shocks, domestic supply shocks, and domestic demand shocks (nominal and real), so that  $e' = (e_{xt}, e_{st}, e_{rdt}, e_{ndt})$ . These shocks are not observable, but we are able to recover them from the estimated reduced form of  $Y$ :

$$y_t = \sum_{j=1}^p \hat{A}(j) y_{t-j} + v_t \quad (3)$$

Where  $v$  is a vector of estimated residuals with variance-covariance matrix  $Var(v) = \Omega$ . Note that Equations (1) and (3) imply that the estimated residuals are a linear combination of the structural residuals,  $Be = v$ .

The VMA representation of (3) is given by

$$y_t = -\hat{\Pi}^{-1} v_t \quad (4)$$

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<sup>13</sup> For a good comparison between alternative methods of identifying VARs, see Favero (2001).

Combining equations (1) through (4) we obtain the long-run effects of the structural shocks on  $Y$  as a function of the estimates of  $\Pi$  and the matrix  $B$ , as expressed in equation (5)

$$y_t = -\hat{\Pi}^{-1} B e_t \quad (5)$$

In a  $k$  variable VAR, we need to identify  $k^2$  parameters. From the relation  $Be = v$  we can derive

$$\begin{aligned} Var(v) &= E(vv') = E[Bee' B'] \\ \Omega &= BB' \end{aligned} \quad (6)$$

Since  $\Omega$  is symmetric, we can identify  $k(k+1)/2$  different elements. Thus, in order to attain exact identification, we need to obtain  $k^2 - k(k+1)/2$  additional restrictions. That we do by imposing long-run restrictions on  $B$  based on standard models for small open economies.

In our 4 variable system, equation (6) provides ten restrictions. For the additional six restrictions needed for exact identification, we follow Hoffmaister and Roldos (1997 and 2001). Essentially, we assume that:

- Domestic shocks do not affect the dynamics of oil income in the long run<sup>14</sup>.
- Demand shocks---real or nominal---do not affect output in the long run<sup>15</sup>.
- Nominal demand shocks do not affect the real exchange rate level in the long run<sup>16</sup>.

As in such papers, we associate domestic supply shocks to changes in productivity, labor supply or structural reform. A positive supply shock is then expected to cause a permanent positive effect on output, an appreciation of the real exchange rate and a decrease in the price level.

Real demand shocks are taken as real government expenditure, with ambiguous temporary effects on output. A fiscal expansion increases aggregate demand, which has a temporary positive effect on output, but it also induces the real exchange rate to appreciate, by increasing the price of non-tradables<sup>17</sup>, thereby reducing non-oil exports and possibly output. Nominal demand shocks represent money supply shocks with no permanent effects on output or on the real exchange rate, in line with money neutrality.

It is important to note that by setting  $A_0 = I$ , we assume that domestic variables are not contemporaneously correlated with external variables. The orthogonality of the structural residuals implies, on the other hand, that demand shocks are not contemporaneously correlated with oil income shocks. But as we mentioned above, fiscal expenditure in Venezuela is highly correlated with oil income, which seems

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<sup>14</sup> This gives us 3 assumptions, since it implies that none of the three types of domestic shocks (supply, real demand and nominal) affect oil income.

<sup>15</sup> This provides 2 identifying assumptions, since it prevents real demand and nominal shocks to affect output in the long run.

<sup>16</sup> This implies 1 identification assumption.

<sup>17</sup> See Froot and Roggoff, 1991.

inconsistent with this assumption. Therefore real demand shocks should be interpreted as that part of expenditure not related to oil income fluctuations, e.g., increases in fiscal expenditure related to the electoral cycle, which may not have a large impact on the economy.

In contrast to Hoffmaister and Roldos (2001) and Ahmed (2003), who study different sources of external shocks such as world income, terms of trade and foreign interest rates, we identify oil income variations as the main source of external shocks in Venezuela<sup>18</sup>. We think it is more appropriate to include oil income in the system as an endogenous variable rather than oil prices or world demand. As we explain next, oil prices and quantities exported may be exogenous in the long run, but short-run production variations in response to domestic variables--such as fiscal requirements--are admissible, and justify the inclusion of oil income in the system as an endogenous variable.

In spite of Venezuela's membership in OPEC, it is unlikely that domestic conditions affect the cartel's supply, Venezuela's quota or world prices in the long run. In general terms, the cartel's supply is adjusted so that oil prices fall within a certain range, considering global demand for oil and expected supply of non-OPEC countries. Once OPEC determines its supply, it then allocates production among its members according to predetermined percentages. Venezuela's quota is just 10% of total OPEC production. Even during the nineties, when OPEC quotas were somewhat lax, it is very unlikely that oil output deviated from the long-run trend derived from PDVSA's industrial policy to increase its potential capacity to satisfy world demand<sup>19</sup>. Therefore, it seems reasonable to assume that domestic shocks do not have a long-run impact on income derived from oil exports, although there may be short-run feedback from domestic variables.

We expect increases in oil income (due to higher prices or production levels) to have ambiguous effects on output. First of all it is important to mention that an increase in oil prices does not translate into a negative supply shock in Venezuela, since domestic gas prices are heavily subsidized and fixed by the government<sup>20</sup>. More likely, for a given production level, a rise in oil prices implies higher fiscal revenues that allow fiscal expansions. By this token, an oil income shock operates more like a real demand shock in Venezuela, with ambiguous effects as mentioned before, channeled through direct fiscal expansions and the links between the oil industry and the non-oil sector of the economy.

Finally, as restrictive as these assumptions may be, we think they are reasonable and useful for the purpose of our analysis.

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<sup>18</sup> Hoffmaister and Roldos identify external shocks with movements in the terms of trade, foreign output and foreign interest rate. Oil income fluctuations can somehow comprise fluctuations in the terms of trade and foreign output, since OPEC supply accommodates world demand so that prices remain within a given range.

<sup>19</sup> Clemente and Puente (2001) also consider oil sector output to be independent from monetary policy and to a large extent from fiscal policy in the long run. The validity of this assumption after 2003 is questionable, but for the period under analysis, we think it is a sensible assumption.

<sup>20</sup> The price of gasoline in Venezuela in 2003 is \$ 0.07 per liter.

## Results

We estimate a number of VARs to analyze impulse response functions and variance decompositions. Lag length in each case is set according to the Schwarz and Hannan-Quinn information criteria, adding lags if necessary to correct for autocorrelation. We include dummy variables to control for the implementation of the liberalization program in 1989 and for the capital control regime between 1994 and 1996. For all VARs we check that the residuals are serially uncorrelated, normal and homoskedastic, and that AR inverse root graphs indicate that the VARs are stable.

Calvo, Leiderman and Reinhart (1993), and Gavin, Hausmann and Leiderman (1995) stress the importance of the international interest rate in determining the course of capital flows to emerging markets and thereby affecting growth performance<sup>21</sup>. Therefore, we include lags of changes in the US Treasury bill rate as an exogenous variable in our system to control for the effect of international interest rates<sup>22</sup>.

First, we estimate 4-variable VARs that include log differences of oil income, non-oil GDP, real exchange rate and inflation as endogenous variables. Accumulated impulse response functions and variance decomposition are presented next.

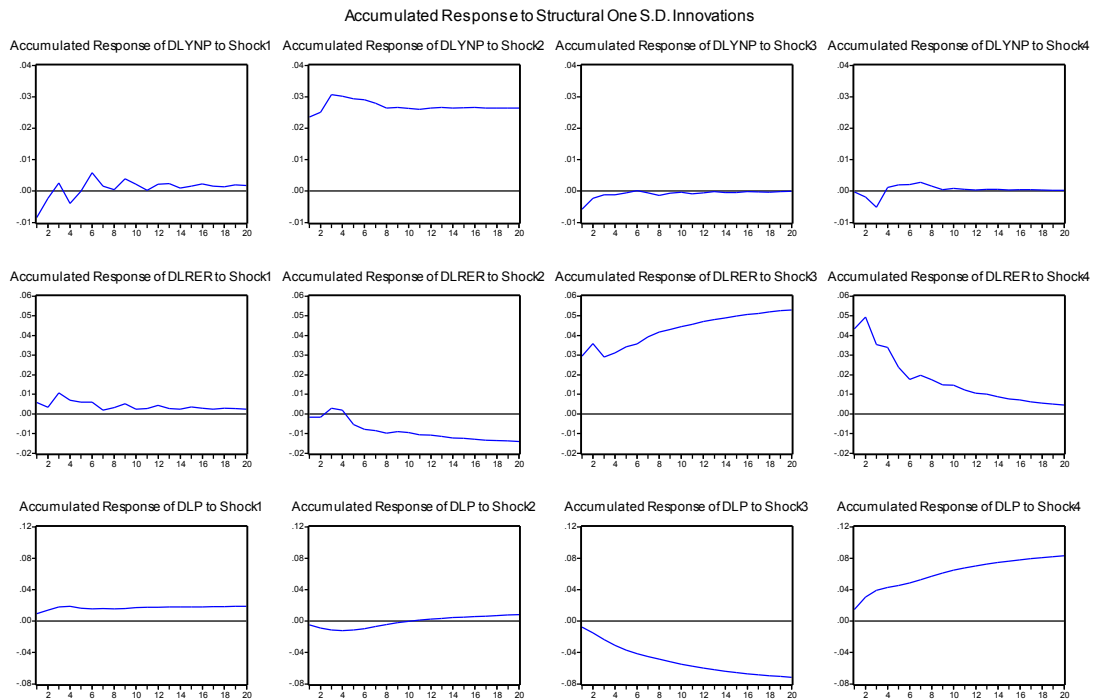
Figure 4 displays impulse response functions of non-oil output (DLYNP), real exchange rate (DLRER) and prices (DLP) to oil income shocks and domestic supply and demand shocks. The first row shows the accumulated responses of non-oil income to one standard deviation innovations of oil income (Shock 1), supply (Shock 2), real and nominal demand (Shock 3 and Shock 4 respectively). The second row shows the accumulated responses of the real exchange rate to the same shocks, and so does the last row the same for inflation.

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<sup>21</sup> After 1970, there is evidence of a correlation between the turning points of the cycles of capital flows to Latin America and important changes in the world interest rates. When the interest rates were low in the industrialized world, investors turned to emerging markets.

<sup>22</sup> Several papers include the external variables as endogenous in VARs, assuming a lower triangular structure of the matrix of contemporaneous correlations with the external variables ordered first (Eichenbaum and Evans, 1995, Ahmed, 2003). Including the US real interest rate in our system as an endogenous variable does not alter our results, as seen in Appendix B.

**Figure 4 Accumulated impulse response functions of external and domestic shocks on non-oil output, real exchange rate and prices\***



\* Shock 1 = oil income shock, Shock 2 = supply shock. Shock 3 = real demand shock. Shock 4 = nominal shock.

In Figure 4 a variation of oil income increases non-oil output, depreciates the real exchange rate and increases the price level. A supply shock generates a permanent increase in non-oil output, a permanent appreciation of the real exchange rate and a temporary drop in the price level.

A positive real demand shock (e.g. an increase in government expenditure) seems to have a temporary negative effect on output, a depreciation of the real exchange rate and a drop in prices.

Nominal demand shocks have a negligible effect on output, generate a temporary depreciation of the real exchange rate and a permanent increase in the price level.

As we mentioned before, real demand shocks can have positive or negative effects on output. Recent empirical work though, shows that increases in government expenditure in Venezuela are generally followed by short-lived output expansions<sup>23</sup>. On the other hand, it is hard to explain a real demand shock to cause depreciation in the real exchange rate. Since government expenditure tends to concentrate more on non-tradable goods, we further built an output aggregate with the non-tradable components of non-oil output<sup>24</sup> and repeated the exercise, expecting real demand shocks to have a positive effect on output and to appreciate the real exchange rate. As shown in Figure B1 in Appendix B, the results that we obtain are very similar to previous ones, but the effect

<sup>23</sup> See for example Arreaza, Blanco y Dorta (2003).

<sup>24</sup> Non-tradable output includes: Electricity and water, construction, trading services, transportation, telecommunications, financial institutions and insurance companies, real state services, and government services.

of real demand shocks on output is now negligible. It may be the case that our assumptions do not properly identify real demand shocks, that expenditure shocks not contemporaneously correlated with oil income shocks are very small, or that the proxy for the real exchange rate is not appropriate<sup>25</sup>.

Variance decompositions of this exercise are displayed in Table 2.

**Table 2. Variance Decompositions**

<b>Variance Decomposition of Non-Oil Output Growth:</b>				
<b>Period</b>	<b>External</b>	<b>Supply</b>	<b>Real Dem.</b>	<b>Nominal</b>
1	10.94577	83.89446	5.143834	0.015932
2	15.45307	77.71098	6.469858	0.366091
4	20.48433	67.93797	5.485499	6.092193
8	26.12879	62.75603	5.231662	5.883512
16	27.93874	60.95741	5.223619	5.880232
<b>Variance Decomposition of changes in RER:</b>				
<b>Period</b>	<b>External</b>	<b>Supply</b>	<b>Real Dem.</b>	<b>Nominal</b>
1	1.223684	0.101741	31.10200	67.57258
2	1.386106	0.098907	31.61221	66.90277
4	3.342858	0.805992	29.77574	66.07541
8	3.629491	2.536168	28.41938	65.41496
16	4.077904	2.601070	28.31443	65.00659
<b>Variance Decomposition of DLP:</b>				
<b>Period</b>	<b>External</b>	<b>Supply</b>	<b>Real Dem.</b>	<b>Nominal</b>
1	22.94447	5.581833	15.50830	55.96539
2	14.76531	5.369134	15.94874	63.91682
4	13.15690	4.753712	24.84052	57.24887
8	11.87001	5.604199	28.56894	53.95685
16	10.86541	6.287173	29.41683	53.43059

It seems that domestic shocks, even in short horizons, are the main source of non-oil output growth volatility. In particular, supply shocks seem to account for nearly two thirds of output growth variability after 4 quarters. Demand (real and nominal) shocks only account for 10% of output growth volatility. The fraction of non-oil output growth variability explained by external shocks is around 25% after 8 quarters. The results are not greatly affected when we use oil exports as a proxy for oil income<sup>26</sup>, instead of oil fiscal revenues.

Nominal shocks appear as the main source of fluctuations of the real exchange rate, followed by real demand shocks. It seems that nominal shocks are the most important source of inflation variability, explaining over half of inflation volatility, followed by demand shocks and oil shocks. This result is important since it shows that the Central Bank has a limited scope to control inflation variability, although this need not be the case for the level of inflation. When replicating the experiment for non-tradable output the results do not vary greatly, as indicated in Table B1 in Appendix B.

<sup>25</sup> We also used the ratio of the domestic manufacture price index and the consumer price index to approximate the real exchange rate and obtained similar results.

<sup>26</sup> Availability of these results upon request from the authors.

These findings should not be that surprising considering the period under analysis. As mentioned in Section 2, during the past 20 years the economy has experienced multiple structural shifts and regime swings. Such frequent changes may well have affected productivity, so that supply shocks had a larger impact on volatility than the variations of oil income throughout the period.

According to our results, a self-insurance mechanism such a stabilization fund may be useful to reduce oil income fluctuations, but it would not be enough to solve the problem of volatility. This finding is provocative since the policy implication that follows would be to reduce economically relevant uncertainty, i.e. by implementing sound and stable institutions, rather than merely focusing on reducing oil income volatility. On the other hand, institutional instability may be the outcome of political economy problems associated to resource rich economies (Sachs and Warner, 1995). This aspect cannot be gauged by the methodology employed in this paper, though.

These findings are not inconsistent with the results in Hausmann (2001) or Rodríguez (2003) that attribute the declining trend of GDP growth mostly to a substantial decline in oil income. Notice that their analysis focuses on the trend of output, while ours is centered on the variance of growth rates. In a growth accounting exercise Ayala and Bello (2003) state that the variance of non-oil output per worker growth in Venezuela can be mostly explained by the variance of total factor productivity, which seems in tune with our findings here, as supply shocks may be associated with productivity shocks.

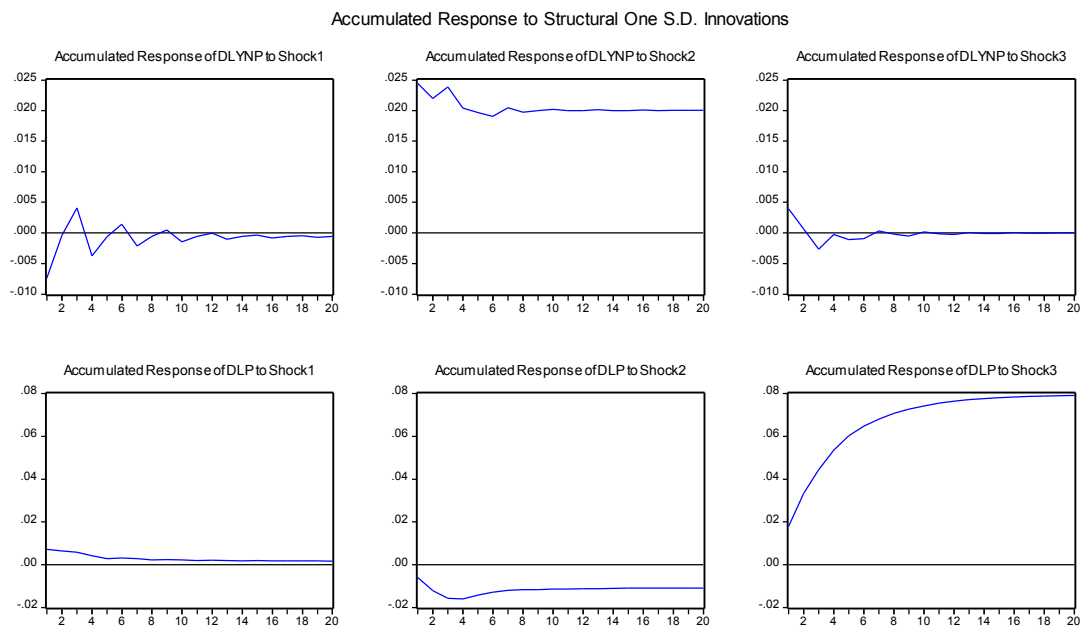
Considering that in the previous exercises we may not be correctly identifying real demand shocks and that our proxy for the real exchange rate could be inaccurate, we decided to do another exercise just considering oil income shocks, supply shocks and demand shocks. For this purpose we constructed a three-variable VAR that included non-oil output growth, oil income and inflation. For exact identification of the three variable VAR, we just required nine identifying assumptions. Again, equation (6) provided six identifying assumptions and the three remaining were derived from theory. For that purpose we assumed that domestic shocks do not affect the dynamics of oil income in the long run<sup>27</sup>, and that demand shocks do not affect output in the long run.

Figure 5 displays accumulated impulse response functions. The first row contains the response of non-oil output (DLYNP) to oil income shocks (Shock 1), supply and demand shocks (Shock 2 and Shock 3 respectively). The second row shows the responses of prices (DLP) to the same shocks. The results look very similar to the ones presented before: supply shocks seem to have the strong positive effect on non-oil output, and a negative impact on prices. The effects of demand shocks on non-oil output are small and short-lived, but are larger and permanent on prices. Oil income shocks have a negative effect on output and a positive effect on prices.

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<sup>27</sup> This assumption implies in fact two restrictions: that neither demand nor supply shocks affect oil income.

**Figure 5. Accumulated impulse response functions of external and domestic demand and supply shocks on non-oil output and prices\***



\* Shock 1 = oil income shock, Shock 2 = supply shock. Shock 3 = demand shock.

The variance decompositions in Table 3 again suggest that domestic shocks, particularly supply shocks, are the main drive of non-oil output growth volatility, even on short horizons. Oil income shocks explain up to 25% of output growth variability after 8 quarters, while the rest is explained by domestic shocks and mainly supply shocks, which is consistent with the results previously obtained.

**Table 3. Variance Decompositions**

<b>Variance Decomposition of Non-Oil output growth:</b>			
<b>Period</b>	<b>External</b>	<b>Supply</b>	<b>Demand</b>
1	8.175494	89.53475	2.289757
2	14.10326	82.33735	3.559389
4	21.92154	73.03678	5.041683
8	24.29148	70.55941	5.149110
16	24.88515	69.92590	5.188950

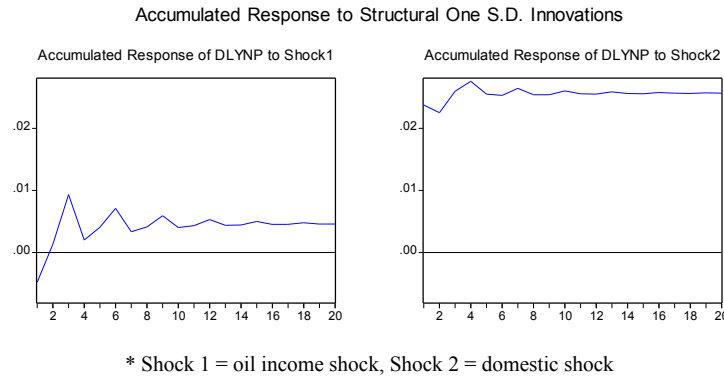
  

<b>Variance Decomposition of Inflation</b>			
<b>Period</b>	<b>External</b>	<b>Supply</b>	<b>Demand</b>
1	12.73444	8.492855	78.77271
2	7.633639	10.76497	81.60139
4	6.128879	9.500474	84.37065
8	5.801419	9.223618	84.97496
16	5.760587	9.139763	85.09965

Also shown in Table 3, demand shocks explain most of inflation variability, which is similar to the results we got before.

For a robustness check of our results, we further restricted the experiment to a two variable VAR: oil income and non-oil output, affected by oil income shocks and domestic shocks. For identification purposes, we just assume that domestic shocks do not have long run effects on oil income. The results of this experiment are presented next.

**Figure 6. Impulse responses of non-oil output to external and domestic shocks**



**Table 4.**  
**Variance decomposition of non-oil output**

Period	External	Domestic
1	3.935117	96.06488
2	9.734055	90.26595
4	23.47449	76.52551
8	26.00774	73.99226
16	26.82821	73.17179

Variance decompositions in Table 4 are again consistent with the results we have obtained so far, i.e., domestic shocks are the main source of output growth volatility in Venezuela. Once again, oil income variations only account for about 25% of non-oil output growth volatility after 8 quarters, while domestic shocks explain the bulk of variability. This result in particular seems to be robust to different specifications.

## Final Comments

In this paper we address the sources of macroeconomic fluctuations. We were interested in the determination of whether non-oil output volatility, inflation and the real exchange rate was due to oil income shocks (external shocks) or to domestic shocks. Using an extended version of the Blanchard and Quah structural VAR analysis applied to the case of a small open economy, we found that non-oil output growth volatility in Venezuela is mostly determined by domestic shocks, particularly, by supply shocks. Oil income fluctuations can only account for about 25% of non-oil output growth volatility. For the period under analysis, marked by multiple regime changes and structural reform, our findings should not come as a surprise. These results are consistent to those obtained by

Hoffmaister and Roldos (1997, 2001) for emerging economies and Ahmed (2003) for Latin American economies.

Regarding inflation volatility, domestic demand shocks (mostly nominal shocks) seem explain the bulk of inflation variability. Nominal shocks also seem to be the main source of variability of changes in the real exchange rate, which may be related to fluctuations in the nominal exchange rate. This last result should be taken very carefully though, since we may not be using an adequate proxy for the real exchange rate.

Domestic supply and demand shocks may be policy related, but with the methodology used in this paper we cannot determine whether these shocks are the outcome of weak institutions resulting from the nature of a resource abundant economy, prone to external shocks and a rent-seeking behavior. But taking such institutions as given, it seems the impact of oil income fluctuations is limited, although not negligible. These findings are robust to different specifications.

According to our results, a self-insurance mechanism such a stabilization fund may be useful to reduce oil income fluctuations, but it would not be enough to solve the problem of volatility. This result is provocative since the policy implication that follows would be to reduce economically relevant uncertainty by sound and stable rules and institutions in general, rather than merely focusing on reducing oil income volatility.

## Appendix A

### Main Reforms and Changes in the Legal Framework between 1983 and 2003

#### Fiscal and Tax Reforms

- 1985: *Income tax law modified* for early-collection purposes.
- 1988: *Introduction of payroll taxes for social security and technical training (INCE)*.  
Income tax exemptions for agricultural activities.
- 1989: Introduction of additional payroll taxes for unemployment insurance and other employee benefits.  
*Privatization of public enterprises begins*, as part of the liberalization program.
- 1990: Instrumentation of social programs and direct subsidies.
- 1991: *A New Income Tax Law was passed*.  
Additional payroll taxes were introduced for daycare programs.
- 1993: *Added value tax (IVA) and corporate assets taxes were introduced* for the first time.
- 1994: *The Income Tax Law is reformed*. The minimum exemption is now subject to indexed tax units.  
The National Tax Collection Service (SENIAT) was created.  
*The IVA is substituted for general wholesale taxes and luxury taxes*.  
*A transaction-based bank debit tax is introduced for a year*.
- 1996: More public enterprises are privatized.
- 1998: *Creation of the Macroeconomic Stabilization Fund (FIEM)*.
- 1999: *The transaction-based bank debit tax is introduced again for the year*.  
*The wholesale tax is substituted for the added value tax (IVA) and the tax rate is reduced*.  
The FIEM law is modified in order to finance the public budget.
- 2000: *New General Law for Financial Administration of the Public Sector (LOAF)*, contemplates fiscal budget rules such as an intertemporal balanced budget<sup>28</sup>, an annual policy agreement between the central bank and the department of finance, accountability and transparency for public entities, among other things.
- 2001: New modification of the FIEM law.
- 2002: *Tax reform for the oil industry and IVA law*.  
Another reform in the FIEM law.  
*The Law of the Central Bank is modified* so the executive can collect central bank profits for exchange rate operations periodically.  
*Transaction-based bank debit tax is introduced again*.
- 2003: Another modification of the FIEM law.

## Price Controls

- 1983: *Prices of all goods and services were fixed. A system of administered prices was implemented allowing eventual price adjustments.*
- 1984: *Interest rates were fixed.*
  - Prices were adjusted according to accommodate the new exchange rate levels.
  - A law to set costs, prices and wages is passed.
- 1985: Prices of “basic consumption goods” were adjusted.
- 1986: New price adjustments for all goods, except for “basic consumption goods”.
- 1987: Enlargement of the list of “basic consumption goods” with administered prices.
- 1988: New price adjustments.
- 1989: *Price liberalization of all goods except for a number of “basic consumption goods”, which remain administered. Gasoline prices were increased.*
- 1990: Reduction of the list of administered prices and adjustment of those that remained administered.
- 1992: *Adjustment of public transportation fees and utility prices.*
- 1994: *Price controls were set for certain goods and services.*
- 1996: *Price controls were levied for most goods and services.*
- 1997: Gasoline prices are adjusted.
- 2003: *New price controls for 50,7% of goods and services on the CPI basket.*

## International Trade Reforms

- 1984: *Trade barriers for imports of certain goods were imposed.*
- 1985: Implementation of a new regulation for foreign patents, trademarks and royalties, in order to expedite administrative procedures.
- 1986: Economic cooperation agreements with Spain, Portugal, Korea, Algeria, Yugoslavia and Peru.
- 1987: Creation of a state program to promote raw material exports other than oil.
- 1988: The government facilitated credit lines for non-oil exports.
- 1989: Trade liberalization: reduction of trade barriers and simplification of trade related administrative procedures.
- 1990: Maximum tariffs were reduced by 50%.
- 1991: Further tariff reductions.
- 1992: The maximum tariff is reduced from 40% to 20%.
  - The Antidumping Law is passed.
- 1994: Venezuela joins the Marrakech agreement, which rules WTO.
- 1995: Free trade agreement between Colombia, Mexico and Venezuela is signed, which contemplates a common tariff.

- 1996: The oil industry offered joint ventures to privates (foreign or nationals) for strategic associations for the first time after nationalization.
- 1998: Tax agreements are signed within the Comunidad Andina de las Naciones (CAN).

### **Financial sector**

- 1987: Partial reform of the Law of the Central Bank, to increase its scope of action on the stock market and the banking sector.
- 1988: New General Banking Law and other credit institutions, allowing the central bank to set minimum reserve rates.
- 1989: Liberalization program allowed banks to freely set interest rates.
- 1992: Foreign banks are allowed to operate in the country.  
New Law of the Central Bank allows the bank to set interest rates to regulate the spread between loan and saving rates.
- 1994: Banking crisis starts.  
New General Laws for Banking and Financial Institutions and National Saving and Loan Entities.
- 1995: Nationalization and intervention of some banks.  
New law for regulating financial emergencies and insured deposits substituted the existing regulation.  
Banks are required to allocate 17% of their loan portfolio to agricultural activities.
- 1996: Interest rates are liberated.  
Nationalized and intervened banks are privatized.  
More foreign banks enter the domestic market.
- 1997: A new and stricter Law of Banking Surveillance and Supervision was passed, in the aftermath of the banking crisis.
- 1998: A new Law for Capital Markets.
- 1999: A merging process of private banks started.
- 2000: New Financial Regulation Law.
- 2001: A New Law of the Central Bank was sanctioned.
- 2002: Reforms to the General Law of the Banking and financial institutions Law.  
Changes to the banking accounting regulations.  
*The Law of the Central Bank is modified.*

### **Constitutional Reforms**

- 1989: Economic rights contemplated in the Constitution, such as right to strike, free choice of business activity and free transit, limited since 1961, were re-enacted.
- 1994: Because of the banking crisis, some constitutional economic rights were suspended.
- 1999: New Constitution substitutes the 1961 Constitution.

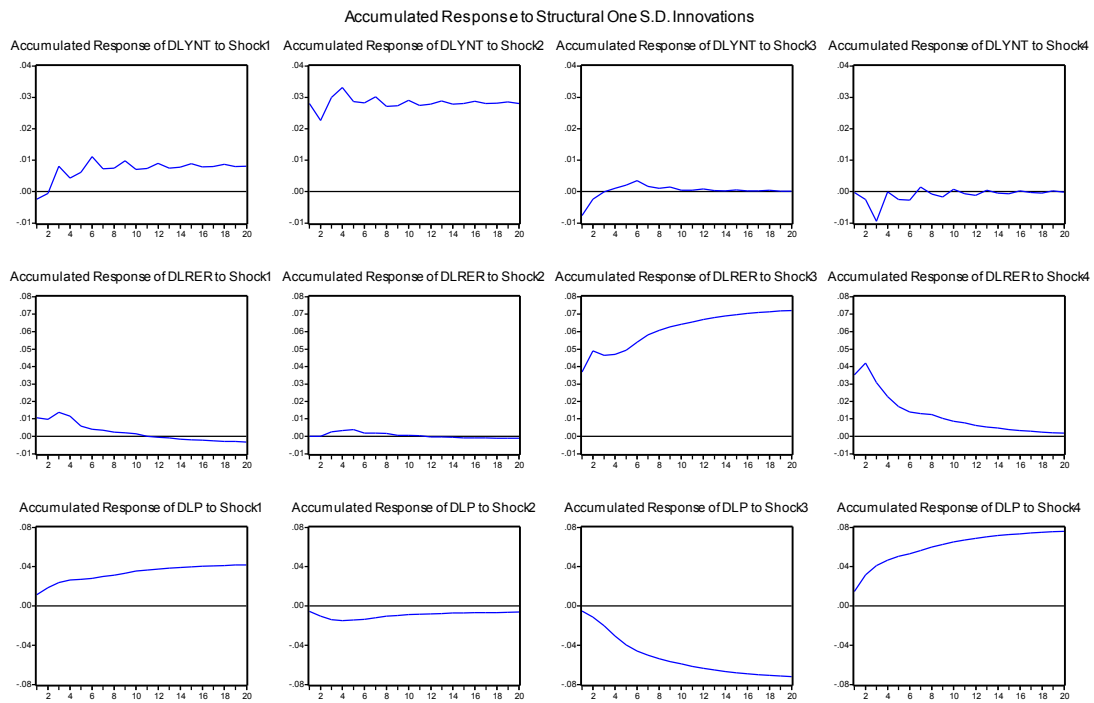
- 2001: New laws regulating economic and property rights are passed. (Leyes Habilitantes)

### **Labor Regulation Reforms**

- 1984: Implementation of employee benefits (transportation bonus, dining halls for workers).  
Firms were forced to increase employees by 10%.
- 1985: Minimum wages started to be actively set by law.
- 1987: Government enforced a compensation bonus for all workers.
- 1989: A temporary laying-off ban is set for a period of 3 months.
- 1990: Unemployment insurance was created and the previous year ban levied.
- 1991: Firms are enforced to provide or fund day care for worker's children.
- 1992: New wage schedule for public employees.
- 1994: Wages were increased by 66% of the minimum wage. Food and transportation bonuses for workers were granted to public employees.
- 1995: Subsidies were granted for private sector employees.  
Changes in the Pension System.
- 1997: Reform in the Labor and Employment Law to modify some employee benefits (Prestaciones Sociales).  
A temporary laying-off ban is set for a period of 3 months.
- 1999: New law for employee benefits.  
A government direct employment program was implemented.
- 2001: A temporary laying-off ban is set for a month.
- 2002: Another temporary laying-off ban is set for 2 months and was extended three times for the same period of time.

# Appendix B

**Figure B1. Accumulated impulse response functions of external and domestic shocks on non-tradable output, real exchange rate and prices\***

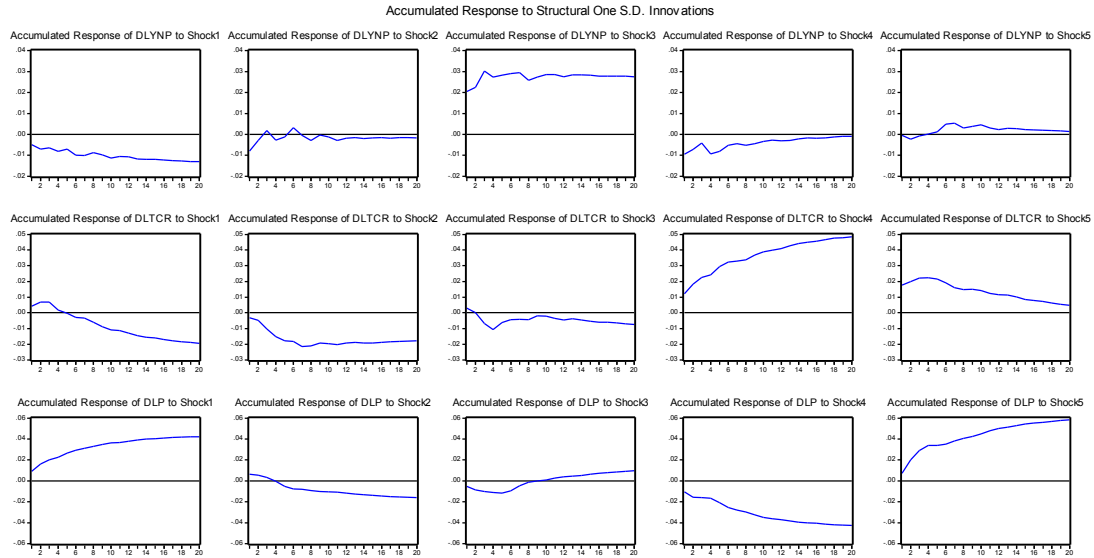


\* Shock 1 = oil income shock, Shock 2 = supply shock. Shock 3 = real demand shock. Shock 4 = nominal shock.

<b>Table B1. Variance Decompositions of Non-Tradable Output Growth, changes in the real exchange rate and inflation</b>				
<b>Variance Decomposition of Non-tradable Output Growth:</b>				
<b>Period</b>	<b>External</b>	<b>Supply</b>	<b>Real Dem.</b>	<b>Nominal</b>
1	0.717785	92.34981	6.924643	0.007765
2	1.059299	88.92234	9.438290	0.580067
4	8.096427	72.58802	7.692475	11.62307
8	10.82369	68.78748	7.534927	12.85390
16	11.97315	67.15841	7.423955	13.44449
<b>Variance Decomposition of changes in LRER:</b>				
<b>Period</b>	<b>External</b>	<b>Supply</b>	<b>Real Dem.</b>	<b>Nominal</b>
1	4.155579	0.000200	50.05922	45.78500
2	3.902245	0.000421	51.76777	44.32957
4	4.285031	0.220019	48.25299	47.24196
8	5.221032	0.340486	47.83537	46.60311
16	5.280870	0.383457	47.77424	46.56143
<b>Variance Decomposition of inflation:</b>				
<b>Period</b>	<b>External</b>	<b>Supply</b>	<b>Real Dem.</b>	<b>Nominal</b>
1	31.98832	7.760552	6.719175	53.53196
2	22.49333	6.761901	7.944396	62.80037
4	18.57881	5.895570	21.57009	53.95553
8	16.26157	5.443177	29.30556	48.98969
16	16.28303	5.307945	30.09233	48.31670

We replicate the exercises in Section 4 including variations of the international real interest rate as an endogenous variable to study its importance as a source of external shocks. For identification purposes, we assumed that neither domestic shocks nor oil income shocks affect the foreign interest rate in the long run. If we additionally overidentify the system by imposing that the interest rate does not affect oil income in the long run, this does not alter our main findings. An increase in international interest rates generates a drop in non-oil output, an appreciation of the real exchange rate and an increase in prices. Results of the variance decompositions confirm what we previously found, i.e., domestic shocks explain the bulk of non-oil output fluctuations, being supply shocks the largest source of its variations. International interest rate shocks appear to explain a small fraction of non-output growth, exchange rate or inflation volatility in Venezuela. Impulse responses and variance decompositions of these experiments are presented next.

**Figure B.2. Accumulated impulse response functions of foreign interest rate, oil income and domestic shocks (supply, real demand and nominal) on non-oil output, real exchange rate and prices\***



\* Shock 1= foreign interest rate. Shock 2 = oil income shock, Shock 3 = supply shock. Shock 4 = real demand shock. Shock 5 = nominal shock.

**Table B.2. Variance decompositions**

<b>Variance Decomposition of Non-oil output growth:</b>					
Period	Shock1	Shock2	Shock3	Shock4	Shock5
1	4.051225	10.67183	69.97704	15.24760	0.052300
2	4.493175	13.90217	65.94841	15.09864	0.557607
4	4.017154	16.52509	61.81540	16.79004	0.852320
8	4.799109	19.33904	56.67699	16.13225	3.052609
16	5.178481	19.95172	55.50623	15.91564	3.447929

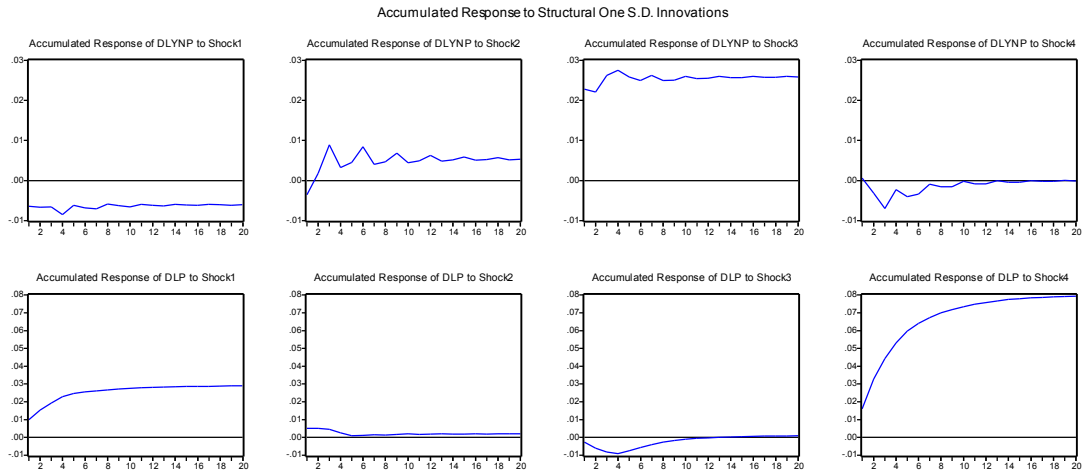
<b>Variance Decomposition of real exchange rate growth:</b>					
Period	Shock1	Shock2	Shock3	Shock4	Shock5
1	3.407956	2.136152	1.852781	30.14980	62.45331
2	4.494824	2.362235	3.258614	33.24707	56.63726
4	7.073459	9.242145	11.01182	28.50094	44.17164
8	8.264077	10.09042	12.41679	29.05657	40.17214
16	9.847704	9.943400	12.72660	29.28894	38.19335

<b>Variance Decomposition of Inflation:</b>					
Period	Shock1	Shock2	Shock3	Shock4	Shock5
1	26.50728	12.93603	8.632704	34.21867	17.70532
2	23.28689	7.432598	7.002038	23.90155	38.37693
4	21.74909	8.334561	6.031895	19.05187	44.83258
8	21.03298	10.39351	9.489781	20.99333	38.09039
16	20.40919	10.07002	9.841115	21.38174	38.29794

Shock 1= foreign interest rate. Shock 2 = oil income shock, Shock 3 = supply shock. Shock 4 = real demand shock. Shock 5 = nominal shock.

**Figure B.3. Accumulated impulse response functions of foreign interest rate, oil income and domestic shocks (supply and demand) on non-oil output and prices\***



\* Shock 1= foreign interest rate. Shock 2 = oil income shock, Shock 3 = supply shock. Shock 4 = demand shock.

**Table B.3. Variance decompositions**

**Variance Decomposition of Non-oil output growth:**

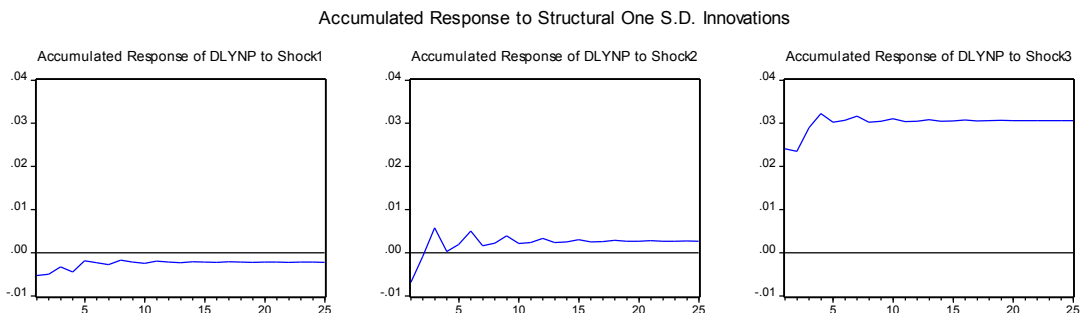
Period	Shock1	Shock2	Shock3	Shock4
1	7.115749	2.219857	90.59477	0.069623
2	6.622276	6.773876	84.29444	2.309411
4	5.857517	16.26276	71.05554	6.824182
8	6.281424	19.50721	66.66467	7.546696
16	6.237117	20.91202	65.14749	7.703365

**Variance Decomposition of Inflation:**

Period	Shock1	Shock2	Shock3	Shock4
1	25.63079	6.644738	1.891106	65.83337
2	18.14974	3.646818	2.510999	75.69245
4	16.35187	3.163253	2.451695	78.03319
8	15.27606	3.123840	3.226208	78.37389
16	15.14278	3.113325	3.343183	78.40071

Shock 1= foreign interest rate. Shock 2 = oil income shock, Shock 3 = supply shock. Shock 4 = demand shock.

**Figure B.3. Accumulated impulse response functions of foreign interest rate, oil income and domestic shocks on non-oil output\***



\* Shock 1= foreign interest rate. Shock 2 = oil income shock, Shock 3 = domestic shock.

**Table B.3 Variance Decomposition of Non-oil output growth:**

<b>Period</b>	<b>Shock1</b>	<b>Shock2</b>	<b>Shock3</b>
1	4.224217	7.049495	88.72629
2	4.012149	11.92284	84.06501
4	3.938480	19.27997	76.78155
8	4.717152	21.27946	74.00338
16	4.744016	22.01722	73.23876

Shock 1= foreign interest rate. Shock 2 = oil income shock, Shock 3 = supply shock. Shock 4 = demand shock.

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