

## FISCAL POLICY AND NATIONAL SAVING IN MEXICO, 1980-2006\*

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*Resumen:* Se aplican modelos estructurales de vectores autorregresivos para caracterizar el impacto dinámico de la política fiscal sobre el ahorro nacional, modelos ampliamente utilizados en el caso de la política monetaria. Usamos datos ajustados por inflación, fuga de capital, pérdida del valor de la deuda y efectos cíclicos, en vez de trabajar con medidas tradicionales. Nuestros resultados sugieren que, políticas fiscales que aumentan el superávit estructural, tienen impacto positivo sobre el ahorro nacional, cierto impacto negativo sobre el ahorro privado en el corto plazo, pero ninguno en el largo plazo, así como un efecto negativo sobre la brecha del producto.

*Abstract:* This paper uses structural vector autoregression (SVAR) models to characterize the dynamic impact of fiscal policy on national saving. SVARs have extensively been used in case of monetary policy. Data adjusted for inflation, capital flight, the value loss of debt and cyclical effects, is used rather than traditional measures. Our results suggest that fiscal policy that increases the structural surplus has a positive impact on national saving, some negative impact on private savings in shorter horizons but any significant effect over longer horizons, and a negative effect on the output gap.

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*Palabras clave: fiscal policy, national saving, private saving, política fiscal, ahorro nacional, ahorro privado*

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## 1. Introduction

During the last three decades the relationship between fiscal policy and national saving has been at the center of many theoretical and policy debates, amid the repeated economic and financial crises that Mexico has experienced. The 1988 crisis, which had a global effect, was caused by huge deficits that quickly went beyond the government's capacity to repay. During the "*Tequila Crisis*" of 1994, low national saving contributed to huge macroeconomic problems. Although many authors, including Hernandez and Villagómez (2001) argue that the lack of national saving was not the cause of this crisis, they nonetheless agree that it helped to accelerate the process, leaving the country with huge liquidity constraints and restricted access to capital markets, thus curtailing its ability to grow. In the aftermath of these events, public policy makers and economic theorists suggested raising national saving levels by maintaining sound finances, and identified fiscal policy as the most important transmission channel.

It is known that public deficits reduce national savings and investment, and contribute to current account deficits. One common explanation for this phenomenon is that deficits tend to raise real interest rates which lead, in the short run, to a negative effect on balance sheets inducing individuals to consume less, invest less and save more, just like a negative wealth effect. However, in the long run, this effect on saving will be reverted by a fall in output. Most economists agree that public deficits reduce, in the long run, domestic capital stocks, and increase foreign debt, thus increasing the burden for future generations. Other economists that believe that public deficits do not matter at all, since they will be offset by the same amount of private saving in the long run. In any case, the impact of fiscal policy on national saving is an unsolved question in macroeconomics and justifies further empirical investigation.

This paper uses structural vector autoregression (SVAR) models to characterize the dynamic impact of fiscal policy on national saving. SVAR's have been used extensively to characterize the impact of monetary policy on the economy, *e.g.* Sims and Zha (1998), Bernanke and Mihov (1998) among others, but have not been applied as often to fiscal policy. This paper focuses on the impact of fiscal policy on national saving. One important aspect of this research is the use of data adjusted for inflation, capital flight, the value loss of debt,<sup>1</sup> and

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<sup>1</sup> The decrease in the real value of debt due to inflation.

cyclical effects, following the work of Amador (2004), and Pastor and Villagómez (2007), rather than using official data.

## 2. Review of the Theoretical and Empirical Literature

There are three major theories that explain the relationship between fiscal policy and national saving (Hayford, 2005). The first one, as presented in macroeconomic textbooks, predicts that increases in government purchases and/or cuts in taxes reduce national saving. This is the traditional Keynesian view (Mankiw, 2007), where consumption is independent of government purchases, and consumption increases whenever taxes net of transfer payments decrease. Distinctions between temporary versus permanent changes in fiscal policy do not matter in this theory.

A second view is based on the finite horizon life-cycle model (LCM, Modigliani and Ando, 1963), and shows that the impact of changes in taxes net of transfer payments depends on the expected duration of the change. Temporary changes in taxes net of transfer payments have a small impact on national saving. A different version of the finite LCM is the infinite LCM, which is similar to the permanent income model if there are operative intergenerational transfers. By introducing government's budgetary constraint in this model, the Ricardian Equivalence theorem (RET) is obtained (Barro, 1974).

This third view holds that tax cuts that leave the present value of government spending constant have no impact on national saving. In this perspective, people, save their tax cut, since they realize that tax cuts with no change in government spending imply simply a deferment of taxes. Therefore, the reduction in the government budgetary surplus is exactly offset by an increase in private saving leaving national saving at the same level.

In the RET view, the impact of changes in government purchases depend on whether they are considered to be temporary or permanent. Permanent increases in government purchases as percentage of output imply a permanent increase in taxes, thus causing private saving to increase by the same amount as the increase in government purchases. In this case, there will be no impact on national saving as percentage of output. However, a temporary increase in government purchases will cause a smaller increase in private saving, thus reducing national saving.

To sum up, holding the present value of government purchases constant, increases in taxes net of transfer payments increase national

saving according to the traditional Keynesian view and have no impact on national saving according to the RET. The LCM is between the Keynesian view and the RET, if the tax change is perceived as permanent. All three alternative views of the impact of fiscal policy on national saving hold that increases in government purchases decrease national saving, particularly in the LCM and RET, if the change in government purchases is viewed as temporary.

The empirical literature has addressed the impact of fiscal policy on national saving in Mexico and around the world. This literature has focused on different kinds of data as well as estimation methods, supporting the RET in some cases and the Keynesian view in others (Burnside, Schmidt-Hebbel, and Servén, 1999). Gramlich (1989) addresses the importance of data adjustments when estimating the impact of fiscal policy on national saving, including adjustments for interest payments, and business cycle corrections. In a similar context, Loayza, Schmidt-Hebbel, and Servén (1998) have constructed a very large savings database, that includes a broader set of countries than earlier databases (150 countries), corrects inconsistencies in national accounts data and savings determinants, standardizes definitions relating to the composition of the public sector, and includes a set of related savings and consumption determinants, such as income growth rates, interest rates, monetary aggregates, and demographic indicators. Using the generalized method of moments (GMM) they find that the RET doesn't hold in its strict version, i.e. government consumption is not offset totally by private saving. They claim that this is due to the strong assumptions the RET implies *a priori*. Similar studies analyze the substitutability or complementarity of public and private saving in cross-country panels, finding most of the time that private saving is a non-perfect substitute for public saving (Haque and Montiel, 1989; Campbell y Mankiw, 1990; Corbo and Schmidt-Hebbel, 1992; Karras, 1994; Evans and Karras, 1996; Khalid, 1996; and Loayza, Schmidt-Hebbel, and Servén, 2000).

On the other hand, other types of studies on the impact of fiscal policy on national saving have found that the Keynesian view prevails. Using an error correction framework, Pradhan and Upadhyaya (2001), find that increases in budget deficits reduce national saving. Blanchard and Perotti (2002) use structural vector autoregressions to characterize the dynamic response of output to tax and government spending shocks. They find that, consistent with standard textbook macroeconomics, positive shocks to government spending and negative shocks to taxes increase output. Hayford (2005) performs a similar analysis using data obtained from the Congressional Budget

Office (CBO), rather than a constructed measure of fiscal policy as in Blanchard and Perotti (2002).

The impact of fiscal policy on national saving, using different data-adjustments, has been studied for the case of Mexico as well. There are several different methodologies for adjusting savings data in Mexico, but the main adjustments are for gains and losses due to inflation, for advanced payments of debt due to external and internal inflation and for foreign interest payments (Arrau and Oks, 1992; Eggerstedt, Hall, and van Wijnbergen, 1995; Carstens and Gil Díaz, 1996; Puchet, 1996; Burnside, Schmidt-Hebbel, and Servén, 1999; and Amador, 2004). These adjustments are important since Mexico has experienced high inflation during the past two decades. Other adjustments attempt to correct for business cycle fluctuations and seasonal patterns in order to obtain structural measures (Pastor and Villagómez, 2007).

“The logic behind structural measures is that one problem in identifying the effects of fiscal policy on national saving is that government revenues and transfer payments respond to fluctuations in economic activity as well as potentially cause fluctuations in economy activity. One way to deal with this problem is to control for the effects of cyclical fluctuations by using cyclical adjusted or structural measures of fiscal policy...” (Hayford, 2005:983).

Several studies have addressed the impact of fiscal policy on national saving in Mexico, finding in most cases no support for the RET. Gómez-Oliver (1989) shows independence between public saving and private saving, while Arrau and Van Wijnbergen (1991) and Oks (1992) find the same result by showing that consumers perceive public debt as wealth. Corbo and Schmidt-Hebbel (1992) also obtain this result by showing the existence of consumer’s liquidity constraints.

However, some studies find that the RET holds partially, i.e. government purchases are not totally offset by private saving. Buira (1990) analyzes the determinants of the fall in national saving, finding that private saving is the second most important variable, explaining approximately 35 percent of the decrease. Burnside, Schmidt-Hebbel, and Servén, (1999) find that public saving has a negative and significant impact on private saving. Finally, the most recent study made by Burnside (2000), using structural vector autorregressions (SVAR), finds that positive shocks on world oil prices, on the monetary policy of the US, and on the tax revenues of the Mexican government have a negative effect on the Mexican private saving rate, while positive shocks on government consumption-innovations and on the peso depreciation rate have a positive effect.

### 3. Empirical Methodology

#### 3.1. Data and Variables

This study uses available quarterly data from the first quarter of 1980 to the first quarter of 2006, a total of 105 observations. The variables included in the analysis are the adjusted primary structural surplus as a percentage of potential GDP,<sup>2</sup> the output gap, and adjusted national and private saving as a percentage of actual real GDP.<sup>3</sup>

The potential GDP is what an economy can produce in a given period of time without causing destabilizing inflationary pressures. Two measures of potential GDP were used in this study (graph 1). They are obtained using the Hodrick-Prescott filter and a vector autoregression model (VAR).<sup>4</sup> As mentioned before, the reason for using potential GDP is to maintain the structural character of the primary surplus in order to avoid the possibility that the series is responding to fluctuations in economy activity as well as potentially causing them. Variables taken as a percentage of these two measures of potential GDP are denoted with the endings HP and VAR respectively.

Three adjustments were performed, following the discussion presented in Amador (2004). The first adjustment was for the inflation tax, which refers to the value loss of money due to inflation. When the economy goes through a period of high inflation, money loses its purchasing power in terms of goods it can buy, although the nominal amount remains the same. This adjustment takes into account the fact that the government can finance its expenditures by printing

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<sup>2</sup> The primary surplus includes the publically-owned sector and leaves out interest payments. Interest payments are left out since they have a strong cyclical component which we want to avoid. Surplus is used instead of deficit because of ease of interpretation.

<sup>3</sup> In this paper the concept of national saving is what an economy saves inside its boundaries, without distinguishing between foreign and domestic saving.

<sup>4</sup> Following the discussion of Pastor and Villagómez (2007), the VAR was estimated with two lags, including 105 quarterly observations during the period of 1980 to 2006, of two exogenous variables: the industrial production of the United States and the real Mexican petroleum exports (reported by the International Monetary Fund Statistics and the *Instituto Nacional de Estadística, Geografía e Informática* (INEGI), respectively), and three endogenous variables: the real Mexican GDP, the employment level and the monetary aggregate M1 (reported by INEGI and *Banxico*). All series were seasonally adjusted using e-views additive X11.

money, as Mexico did before the Salinas presidency. The inflation tax is estimated by multiplying the average monetary base times the inflation of the INPC<sup>5</sup> of corresponding periods. This adjustment accounts for 6, 4.2 and 1.3 percent of annual GDP, when inflation reached 75 percent in 1982, 110 percent in 1988 and 32 percent in 1995, respectively (graph 2).

The second adjustment was for the value loss of internal<sup>6</sup> and external<sup>7</sup> debt, due to internal and external inflation, respectively. The spikes shown in graph 3 correspond to peaks in the rate of inflation in 1982 and 1987, when the value loss of debt accounted for 11.4 and 20 percent of annual GDP, respectively. The value loss of debt was calculated assuming that all debt was contracted with the US.<sup>8</sup>

The third adjustment was for capital flight: asset-flows ending abroad which are not captured by the current account. Since the capital flight normally has a positive value, omitting this adjustment would lead to an overestimation of the amount of foreign saving and underestimation of national saving. The capital flight is obtained by an indirect method; adding the debt flow and the FDI and then subtracting the current account balance, which is the change in international reserves and the change in public assets abroad. This adjustment assumes that the debt flow and the FDI should finance the current account deficit or the accumulation of public reserves. The residual value of these transfers is thus the capital flight, meaning, when positive, that capital is going out of the country and when negative, that capital is flowing into the country. Finally, interest rates on Mexican assets held abroad are estimated with a weighted return rate and then added to this residual.<sup>9</sup>

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<sup>5</sup> *Índice nacional de precios al consumidor* (national consumer price index) reported by the *Banco de México*.

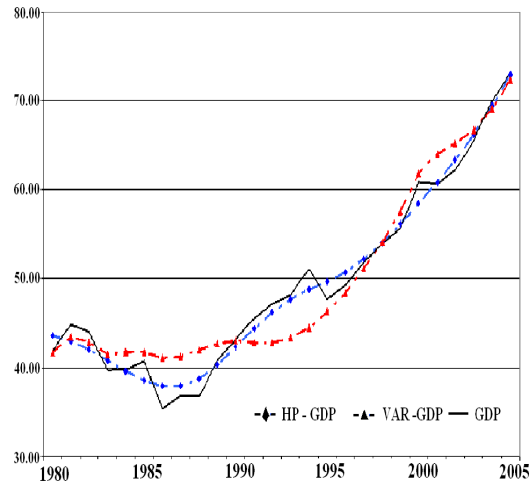
<sup>6</sup> In order to obtain the value loss of internal debt due to inflation, the broad internal economical debt, reported by *Banxico*, was multiplied by the change in the INPC.

<sup>7</sup> To calculate the value loss of external debt due to foreign inflation, the broad external debt reported by *Banxico* was multiplied by the change in the CPI of the United States.

<sup>8</sup> This is not quite true. However, Amador suggests that this is a good approximation for the real value loss, since most of the debt has been contracted with the US and the rest with European countries and Japan, which have similar rates of inflation.

<sup>9</sup> For a more detailed explanation see Amador (2004).

**Graph 1**  
*Actual GDP, HP-GDP and VAR-GDP (billions of pesos of 2002)*



Source: INEGI and estimations based on the methodology suggested in Pastor and Villagómez (2007).

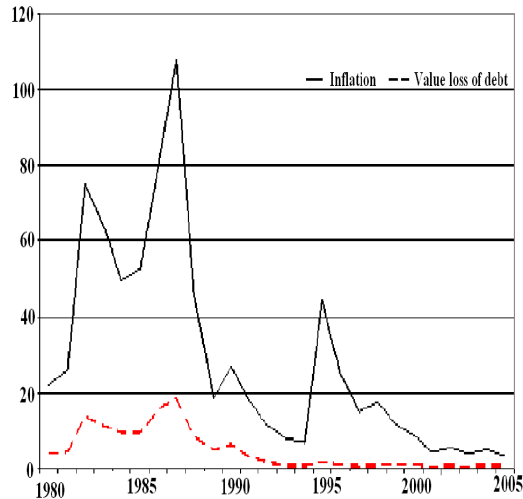
**Graph 2**  
*Inflationary Tax as Percentage of GDP*



Source: Banco de México.



**Graph 3**  
*Inflation and Value Loss of Debt as Percentage of GDP*



Source: *Banco de México*, and estimations based on the methodology suggested in Amador (2004).

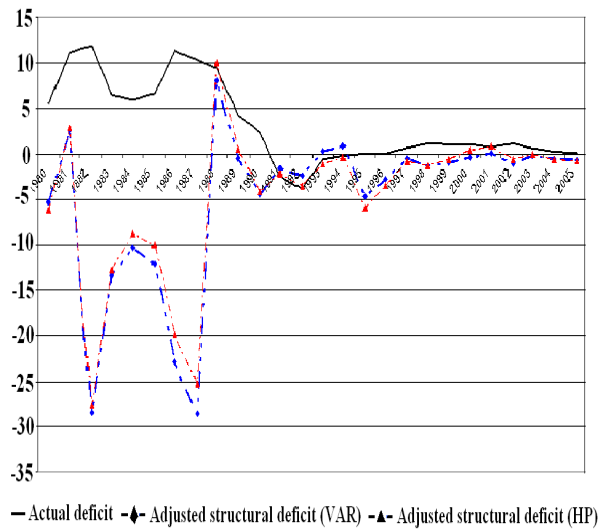
The primary structural surplus<sup>10</sup> is obtained by taking the difference between the budgetary income and expenses, adjusting the fiscal component of the budgetary income. This adjustment is made by multiplying income from taxes times the potential GDP to actual GDP ratio raised to the power of the tax-income elasticity<sup>11</sup> with respect to actual real GDP. To obtain the adjusted primary structural surplus (SUPA\_HP or SUPA\_VAR) as a percentage of potential GDP the inflation tax and the value loss of debt are added. Just as the income tax needs to be adjusted when calculating the traditional primary structural surplus, in this case, the inflation tax has to be adjusted

<sup>10</sup> Data was obtained from *Secretaría de Hacienda y Crédito Público* (SHCP). Budgetary data was used rather than actual income and expenses, since this data was not available for 2006 when we were running the models.

<sup>11</sup> The product elasticity is obtained by running a regression of the income from taxes against the actual GDP, both in logarithms. By using this approach the cyclical impact of actual GDP over tax income is mitigated, since it prevents overestimation or underestimation of its value during an expansive or recessive phase.

as well, by multiplying it by ratio of the potential GDP to actual GDP ratio raised to the power of its elasticity with respect to the actual real GDP (graph 4).

**Graph 4**  
*Actual and Adjusted Structural Deficits as Percentage of GDP*



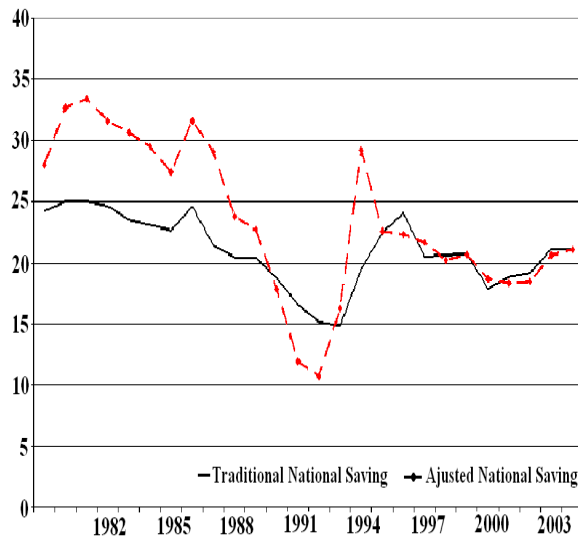
Source: *Subsecretaría de Hacienda y Crédito Público, Dirección General de Planeación Hacendaria, Sistema de Finanzas y Deuda Pública.*

National saving was calculated as the difference between total saving and foreign saving. Total saving is the sum of gross capital formation and inventory changes, while foreign saving is just measured by the current account.<sup>12</sup> To obtain the adjusted national saving series as a percentage of GDP (ANS), the value loss of debt and capital flight were subtracted from foreign saving. Adjusted national saving is obtained by taking the difference between total saving and the adjusted foreign saving series. This new series, as graph 5 shows,

<sup>12</sup> All saving series were obtained from the INEGI.

presents a deeper fall than the official series due to the capital repatriation during 1988-1993.

**Graph 5**  
*Traditional and Adjusted National Saving as Percentage of GDP*



Source: INEGI, and estimations based on the methodology suggested in Amador (2004).

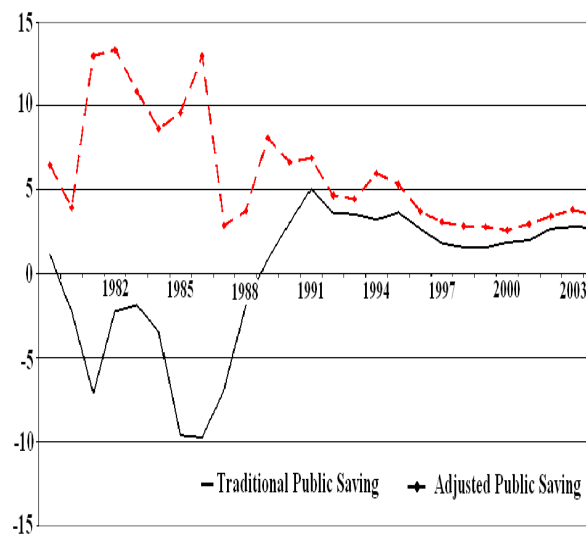
Private saving is calculated by subtracting public saving from national saving, while public saving is calculated by taking the difference between capital expenditures (public investment) and the economic deficit<sup>13</sup> (graph 6). The adjusted private saving series is obtained as the difference between adjusted national and public saving. Adjusted public saving is calculated by adding the inflation tax and the value

<sup>13</sup> The economic deficit includes the public sector but doesn't discount interest payments as does the primary deficit. Capital expenditures are the sum of three components: physical investment, financial investment, and capital expenditures under the net transference category (to other states and public sector dependencies).

loss of debt. The main difference between the official series and the adjusted series, as graph 7 shows, is that the adjusted private saving series as percentage of GDP (APS) has a deeper fall before the 1994 crisis, accounting for 6.18 and 5.19 percent annually during the two years before the crisis.

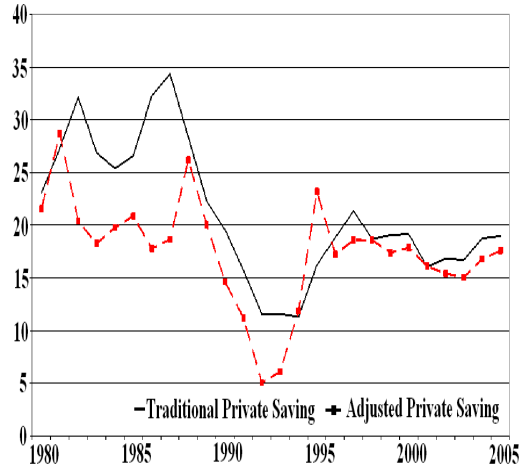
Finally the output gap is calculated as the deviation of actual GDP from potential GDP (graph 8). This variable indicates whether the economy is in an expansive or recessive phase. The output gap is included in the analysis because this variable should represent the stabilization motive of fiscal policy, reflecting the trade-off between having major surpluses, which improve the budgetary sustainability, and having a negative impact in the short run on the output gap. There are two measures of output gap; one considers the HP-potential GDP, and the other the VAR-potential GDP. These two measures are denoted as GAP\_HP and GAP\_VAR, respectively.

**Graph 6**  
*Traditional and Adjusted Public Saving as Percentage of GDP*



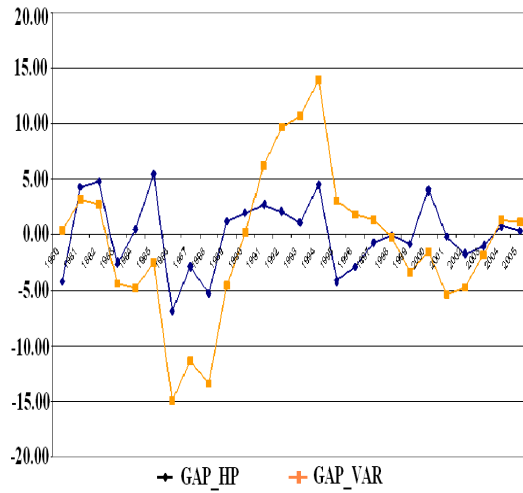
Source: INEGI, and estimations based on the methodology suggested in Amador (2004).

**Graph 7**  
*Traditional and Adjusted Private Saving as Percentage of GDP*



Source: INEGI, and estimations based on the methodology suggested in Amador (2004).

**Graph 8**  
*Output Gap HP and VAR*



Source: INEGI.

Summing up, three major adjustments have been made to the series, namely the inflation tax, the value loss of debt and the capital flight. Adjusted primary structural surplus is calculated by correcting for the inflation tax and the value loss of debt. Adjusted national saving was obtained by correcting foreign saving for the value loss of debt and the capital flight, while adjusted private saving was obtained as the residual of adjusted national saving and adjusted public saving, the latter being corrected by the inflation tax and the value loss of debt. The output gap is included because this variable should represent the stabilization motive of fiscal policy.

### 3.2. *Econometric Model*

This paper uses structural vector autoregression (SVAR) models to characterize the dynamic impact of fiscal policy on national saving. The general specification of the model is given by:

$$AX_t = B(L)X_{t-1} + \varepsilon_t \quad (1)$$

where  $X_t$  is a  $(nx1)$  vector of endogenous variables,  $A$  is a  $(nxn)$  parameter matrix with ones on its main diagonal and with off diagonal elements capturing the contemporaneous relationships between the endogenous variables,  $B(L)$  is a polynomial matrix in the lag operator, and  $\varepsilon_t$  is a  $(nx1)$  vector of structural shocks. The reduced form of (1) is given by the standard VAR model:

$$X_t = D(L)X_{t-1} + u_t \quad (2)$$

Where  $D(L) = A^{-1}B(L)$  and  $u_t = A^{-1}\varepsilon_t$ . Notice that (1) is a system of simultaneous equations and needs to be identified in order to have proper economic interpretation. Econometrically, if the system is identified, then it will be possible to recover the parameters of the structural model (1) from the estimates of the reduced form given by (2). One common procedure for identification is to impose restrictions on the coefficients of matrix  $A$  such that it becomes triangular. This procedure, which results in a recursive system, was first proposed by Sims (1980) and is widely used in the macroeconomic literature. In this paper, we will pursue a similar approach for identification. It is important to remark that this procedure implies imposing certain exogeneity restrictions on the variables in  $X_t$ , which needs theoretical or empirical justification. In terms of impulse-response analysis, identification is crucial since it makes it possible to properly simulate

the effects of structural shocks ( $\varepsilon_t$ ) on the dynamics of the system, which are different from reduced form shocks ( $u_t$ ). Technically, the elements in the error vector  $u_t$  are in fact linear combinations of the pure structural shocks in  $\varepsilon_t$  and it is necessary to establish these relationships in order to have a proper economic interpretation. This is possible when the system is identified. It is well known that a necessary condition for identification of system (1) can be obtained by imposing  $n(n-1)/2$  restrictions on the  $A$  matrix (Enders, 1995; and Lütkepohl and Kräzig, 2002).

To be more specific, in the present study  $X$  will be a three-dimensional vector defined as  $X'_t = [x_{1t}, x_{2t}, x_{3t}]$ , where  $x_{1t}$  is the adjusted structural surplus,  $x_{2t}$  is the output gap, and  $x_{3t}$  is adjusted national saving or adjusted private saving. Let  $\varepsilon'_t = [\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t}]$  be the corresponding vector of structural shocks. Without loss of generality, we can assume that  $B(L) = 0$  and express the original structural system as:

$$\begin{bmatrix} 1 & a_{12} & a_{13} \\ a_{21} & 1 & a_{23} \\ a_{31} & a_{32} & 1 \end{bmatrix} \times \begin{bmatrix} x_{1t} \\ x_{2t} \\ x_{3t} \end{bmatrix} = \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \quad (3)$$

Since  $n = 3$ , only three restrictions on the elements of matrix  $A$  are needed in order to identify the system. To this end, we follow the argument that: "Given the inside lags of fiscal policy, Blanchard and Perotti (2002) argue that discretionary changes in fiscal policy will not respond contemporaneously to the economy" (Hayford, 2005:985). This implies that  $a_{12} = a_{13} = 0$ , leaving one additional restriction to be imposed.<sup>14</sup> One possibility is to set  $a_{21} = 0$  which implies that national saving does not depend contemporaneously on the output gap, an assumption that might be difficult to defend. A more plausible alternative is to set  $a_{23} = 0$ , which implies that the output gap does not depend contemporaneously on national saving, for example to shocks on consumption.

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<sup>14</sup> Suggestions were made to control for the possibility that discretionary fiscal policy changes on taxation and public saving could have different effects on private and national saving. However, since the theoretical framework that assesses these effects, is approached through a consumption function, it is not possible to control for these effects under the proposed system of equations, which is based on a saving function. Furthermore, Mexican data on consumption has been recorded since 1993; this reduces the number of observation available and consequently decreases the robustness of any analysis.

One possible justification for this assumption is that shocks to national saving are initially absorbed by changes in inventories and only in later periods will they impact the output gap.

Altogether, the previous restrictions produce a recursive system as suggested by Sims (1980). These restrictions imply that the output gap is contemporaneously affected only by the structural surplus while adjusted saving is contemporaneously affected by both the structural surplus and the output gap. Given that these identification restrictions imposed on matrix  $A$  are crucial to the rest of the analysis they will be tested explicitly as discussed in the following section.

### 3.3. *Empirical Strategy*

In the first place we perform unit root tests on all the variables. As percentages of either potential GDP or actual GDP, all variables are bounded between 0 and 100 percent and hence on logical grounds they are stationary variables. However, given the limited sample size, and as graphical inspection suggests, the dynamics of the variables in levels appears to be consistent with processes with stochastic trends, i.e. unit root processes. It is important to consider, though, that the bounded feature of all variables strongly suggests that if indeed they can be described by unit root processes they are unlikely to have drifts for otherwise they will have an ever increasing or ever decreasing pattern which would not be consistent with their character and observed behavior. In practice, this means that if the variables can be modeled as unit root processes they should not have intercepts or time trends.<sup>15</sup>

Given the previous scenario, we believe that the best strategy to follow is the one developed by Perron (1988), who suggests a sequential testing procedure to determine if a process have unit roots and, in addition, if they include deterministic components or not. The sequence of tests starts with the more general case under the alternative hypothesis, which is a model with an intercept and a time trend. If no deterministic components are found, the final model un-

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<sup>15</sup> Strictly, these processes would be better modeled as bounded random walks as suggested by Nicolau (2002). Although they are stationary processes they behave exactly like random walks except that they are stochastically bounded by upper and lower finite limits. We thank an anonymous referee for suggesting this clarification.



der the null hypothesis will be a unit root process without drift.<sup>16</sup> We clearly expect to find that this is indeed the case for all of our variables. Next, and before going on to estimation of the model, some descriptive analysis based on dynamic correlations is in order, and as well as attempts to provide a preliminary picture of the dynamic interrelationships among the variables under study.

Since we have to perform some tests of hypothesis, particularly the identification restrictions discussed in the previous sub-section, the model must be stationary. Thus, if indeed our variables can be characterized as unit root processes (without drifts) we proceed to estimate the SVAR model with the variables in first differences. Four sets of estimations will be performed depending on the type of measure considered (relative to potential GDP estimated by HP filter or a VAR model) and the measure of savings (national or private).

In order to test for the validity of the identification restrictions discussed in the previous section ( $a_{12} = a_{13} = a_{23} = 0$ ) we will carry out Wald and Likelihood-ratio tests. In the first case, we estimate the SVAR model in unrestricted form while in the second case we estimate both the restricted and unrestricted specifications. The unrestricted model assumes that all coefficients in matrix  $A$  are different from zero while the restricted model assumes that  $a_{12} = a_{13} = a_{23} = 0$  as discussed in section 3.2. Both tests will be contrasted with critical values from a *Chi*-squared distribution with 3 degrees of freedom. All specifications for this purpose will be estimated by maximum likelihood.<sup>17</sup>

Finally, once the identification restrictions are validated we will estimate the proposed SVAR models. For practical considerations we will only report results on the impulse-response functions, focusing on the impact of structural policy shocks. The following section discusses the most relevant empirical findings.

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<sup>16</sup> If deterministic components were found, then we will consider the more powerful unit root tests by Elliot, Rothenberg, and Stock (1996) and Ng and Perron (2001). Also, we will use the test by Kwiatkowsky *et al.* (1992), popularly known as KPSS test, which considers stationarity under the null hypothesis.

<sup>17</sup> It is important to remark that this testing procedure directly evaluates the contemporaneous relationship among the variables in the system and the validity of the assumed exogenous or endogenous character of the variables. Notice that we do not follow Granger-causality tests since they would only shed light on whether lagged values of a variable will influence actual values of another variable but not on the contemporaneous relationship among variables.

## 4. Estimations and Results

### 4.1. *Unit Root Tests*

Table 1 shows the results of the sequential unit root testing implemented following Perron (1988). The sequence of tests for each variable is shown in each column. Starting from the most general model, the sequential testing procedure continues to the next test as long as the null hypothesis is not rejected. Specifically, if test 1 accepts the null unit root, we go on with test 2 which is a joint test of the null of unit root and no time trend in the model. If this test accepts the null, we proceed with test 3 which is a unit root test in a model that only has an intercept since the time trend was discarded by the previous test. Provided test 3 accepts the null of unit root we apply test 4 which tests the null of unit root and no drift (intercept) in the model. If this hypothesis is accepted we conclude that the process has a unit root but does not have intercept or trend. In order to reconfirm the previous result we finally test for a unit root in a model without deterministic components, which is done through test 5. For completeness, we report in the last row of table 1 the ADF test applied to the first differences of the variables.

In all cases, tests 1 through 4 show unambiguously non-rejection of the null hypotheses confirming that all variables can be modeled as unit root processes without trends or intercepts, which is consistent with their bounded feature. The results of test 5 reconfirm (at the 1 percent significance level) that all the variables can be modeled as unit root processes and the results of test (6) in the last row indicate that the first differences of all variables are stationary.<sup>18</sup>

### 4.2. *Dynamic Cross-Correlation Analysis*

Before presenting and discussing the main results, dynamic cross-correlations of adjusted national saving and adjusted private saving with the other variables are shown in order to provide stylized

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<sup>18</sup> In the case of test (5) we find that it is significant at the 5 percent level for one variable and at the 10 percent level for two variables pointing to possibly stationary processes. However, given the results from tests (1) through (4) and test (6) we will assume that all processes have a unit root. Further research to achieve a more definite characterization of these processes is certainly necessary.

findings that may be consistent with the regression analysis. Table 2.1 shows the dynamic cross-correlations between adjusted national saving (ANS) and both adjusted structural surpluses (SUPA\_HP and SUPA\_VAR), and both measures of the output gap (GAP\_HP and GAP\_VAR), for four lags and leads.

The most striking finding from the correlation matrix in table 2.1 is the strong positive contemporaneous correlation between ANS and both measures of adjusted structural surpluses. This strong correlation persists at leads and lags, suggesting the possibility that the Keynesian view holds.

Another interesting feature of the data is that the negative correlation with the GAP\_VAR is greater than with the GAP\_HP, although both of them show a slight asymmetry between lead and lag. In dynamic cross-correlation analysis, asymmetries are often taken as an indication of a lead-lag relationship between two variables. For example, whenever adjusted national saving is more highly correlated with future output gap than past output gap, we might say that output gap lags adjusted national saving. This finding suggests that when adjusted national saving is high the output gap will fall in the next periods.

Table 2.2 provides the correlation matrix for adjusted private saving (APS) and both adjusted structural surpluses and output gap measures.

Contrary to what was found in table 2.1, APS contemporaneous correlation with both adjusted structural surpluses is near to zero, positive and symmetrical. This finding indicates possible non-completion of the RET. The negative correlations between APS and both output gaps show an asymmetry towards the leads, even though the only strong correlation is between APS and GAP\_VAR. This would suggest, as in the former case in which the correlations between ANS and both output gaps is discussed, that APS leads the output gap, which is not so surprising since APS forms part of ANS.

Summing up, both measures of the adjusted structural surplus show positive and non dynamic cross-correlation with ANS and APS, respectively, while both measures of the output gap show negative dynamic cross-correlations with ANS and APS with asymmetries, suggesting that both saving measures lead both output gap measures.

#### 4.3. *Testing the Exogeneity Restrictions*

As mentioned in section 3.2. the order of the variables in the SVAR model is as follows: first we include the adjusted structural surplus,

**Table 1**  
*Unit Root Tests*

<i>Model and Null Hypothesis</i>	<i>Variable</i>					
	<i>ANS</i>	<i>APS</i>	<i>GAP_HP</i>	<i>GAP_VAR</i>	<i>SUPA_HP</i>	<i>SUPA_VAR</i>
<i>Model A: <math>\Delta y_t = \alpha + \beta t + \delta y_{t-1} + v_t</math></i>						
(1) $H_0 : \delta = 0$	-2.05	-2.34	-2.16	-1.958	-1.35	-1.33
(2) $H_0 : \delta = 0, \beta = 0$	2.11	2.76	2.39	1.92	1.05	1.01
<i>Model B: <math>\Delta y_t = \alpha + \delta y_{t-1} + v_t</math></i>						
(3) $H_0 : \delta = 0$	-1.55	-2.29	-2.18	-1.88	-1.09	-1.08
(4) $H_0 : \delta = 0, \alpha = 0$	1.22	2.64	2.38	1.79	1.45	1.37
<i>Model C: <math>\Delta y_t = \delta y_{t-1} + v_t</math></i>						
(5) $H_0 : \delta = 0$	-0.67	-0.68	-2.19**	-1.90*	-1.71*	-1.66
<i>Model D: <math>\Delta^2 y_t = \delta \Delta y_{t-1} + v_t</math></i>						
(6) $H_0 : \delta = 0$	-15***	-15***	-7.9***	-2.5**	-9.5***	-9.5***

Note: The sequential testing includes tests (1) through (5). Hypotheses (1), (3) and (5) are evaluated with ADF  $t$ -tests and  $p$ -values in parenthesis are based on MacKinnon's response surface tables. Hypotheses (2) and (4) are evaluated with ADF  $F$ -tests. Critical values at the 5% and 10% levels are approximately 8.73 and 6.49 for (2) and 6.70 and 4.71 for hypothesis (4). The last row reports ADF  $t$ -tests applied to the first differences of the variables as specified by model D. In all cases the term  $v_t$  includes  $p$  lags of the corresponding left hand side variable of each model with  $p$  determined by the modified AIC criterion. The symbols \*, \*\*, \*\*\* indicate respectively, 10, 5 and 1 percent significance levels.

**Table 2.1***Dynamic Cross-Correlation between Adjusted National Saving and  $X_{t+i}$* 

$\times$	$Corr(ANS_t, X_{t+i})$								
$i$	-4	-3	-2	-1	0	1	2	3	4
<i>SUPA_HP</i>	0.548	0.5949	0.5909	0.6133	<b>0.6588</b>	0.6452	0.5732	0.5812	0.5586
<i>GAP_HP</i>	-0.0829	-0.17	-0.14	-0.166	<b>-0.1784</b>	-0.2982	-0.2378	-0.2045	-0.1325
<i>SUPA_VAR</i>	0.5516	0.5997	0.5978	0.6204	<b>0.6648</b>	0.6526	0.5843	0.5923	0.5697
<i>GAP_VAR</i>	-0.3215	-0.4112	-0.4373	-0.489	<b>-0.5213</b>	-0.6128	-0.5966	-0.589	-0.5528

**Table 2.2***Dynamic Cross-Correlation between Adjusted Private Saving and  $X_{t+i}$* 

$\times$	$Corr(APS_t, X_{t+i})$								
$i$	-4	-3	-2	-1	0	1	2	3	4
<i>SUPA_HP</i>	0.2952	0.3102	0.2324	0.1688	<b>0.15</b>	0.2264	0.2141	0.2711	0.3028
<i>GAP_HP</i>	-0.1761	-0.2705	-0.1994	-0.2235	<b>-0.0873</b>	-0.1881	-0.0838	-0.0838	-0.0193
<i>SUPA_VAR</i>	0.3013	0.318	0.2446	0.1826	<b>0.1633</b>	0.2388	0.2287	0.2838	0.3136
<i>GAP_VAR</i>	-0.3059	-0.4021	-0.4147	-0.4687	<b>-0.4134</b>	-0.4947	-0.451	-0.4574	-0.4168

then the output gap, and finally one measure of adjusted savings, either ANS or APS. This ordering, together with the identification restrictions imposed on the  $A$  matrix imply that structural adjusted surplus is fully exogenous, i.e. it affects but is not affected by all other variables, while saving (national or private) is fully endogenous. On the other hand, the output gap variable is endogenous with respect to the structural surplus and exogenous to adjusted savings.

Before estimating the SVAR models we tested the previous identification restrictions, and found strong support for their validity in all four cases considered.<sup>19</sup> Specifically, the Wald test statistics are 1.43, 0.19, 2.39 and 1.74 and the Likelihood Ratio tests are 2.05, 0.69, 3.94 and 4.39. None of these values are significant when contrasted with critical values from a *Chi*-square distribution with 3 degrees of freedom, and therefore the joint hypothesis that  $a_{12} = a_{13} = a_{23} = 0$  cannot be rejected implying that the assumption on the exogenous or endogenous nature of the variables postulated in this exercise is statistically valid.

#### 4.4. SVAR Impulse-Response Analysis

Following our discussion in section 3.2. we specify two SVAR models. Model 1 includes adjusted national saving (ANS) and model 2 includes adjusted private saving (APS). Both models include structural surplus and output gap measures. Two versions of each model have been estimated depending on whether these measures are taken as percentage of the potential GDP obtained from the HP-filter or the VAR model. The order of the variables is as follows: first we include the adjusted structural surplus, then the output gap, and finally one measure of adjusted savings, either ANS or APS.

Since all variables are considered in first differences the SVAR model was estimated without constant or linear trends. The Akaike Information Criterion suggests five lags in all cases. Figure 1 shows the impulse-response function for model 1 which considers ANS and HP filtered measures of the other variables. The results show that adjusted national saving as percentage of actual GDP (ANS) responds positively to positive shocks of the adjusted structural surplus as percentage of potential GDP (SUPA\_HP). It is important to note, though, that the effects are clearly positive and different from zero with 95% confidence for periods 1, 4 and 6. For all other periods the effects

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<sup>19</sup> In the next section we describe each of these cases.

continue to be positive but they are different from zero with less than 95% confidence. A negative effect on the output gap (GAP\_HP) due to a positive shock to SUPA\_HP can be observed as well and this happens at any conventional significance level. This result indicates that when the adjusted structural surplus increases, output falls, which is logical since countercyclical government policies reduce expenditures and hence make output fall. Summarizing, the results for model 1 indicate that positive shocks to the adjusted structural surplus will increase adjusted national saving while contracting output below its potential level.

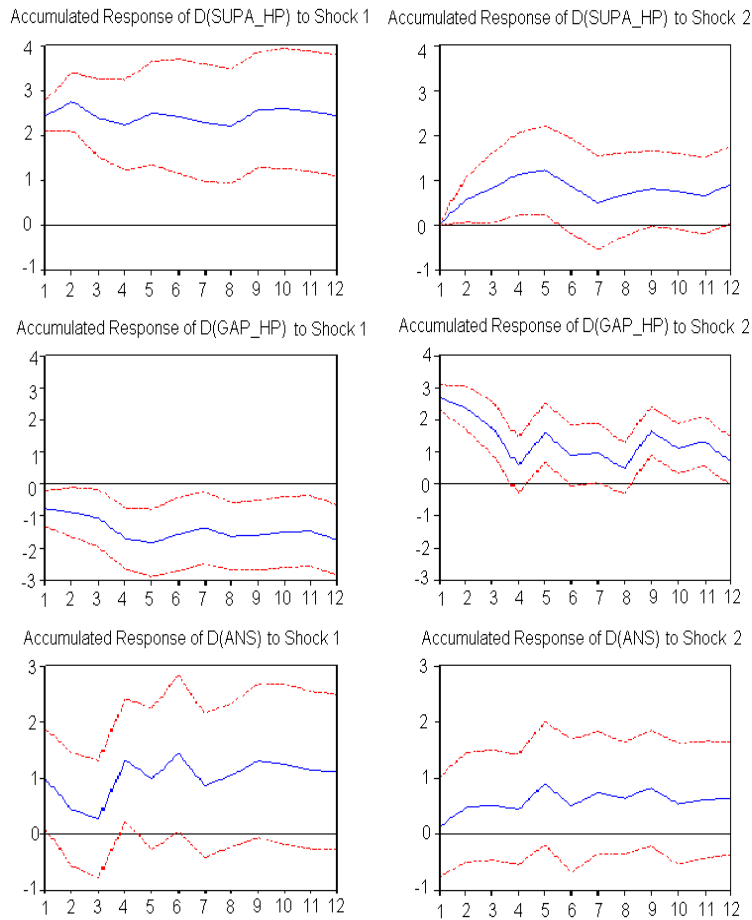
When we consider model 2, which includes adjusted private saving (APS) as a percentage of GDP, we find that a positive shock to the adjusted structural surplus as percentage of GDP measured by the HP-filter has a negative effect on the output gap. The response of APS to the SUPA\_HP shock indicates a negative effect during the first three periods. This effect remains negative after the third period but is not significantly different from zero. These results combined with the result for model 1 provide some support for the traditional Keynesian view: a positive shock to the structural surplus increases national saving, reduces private saving over short horizons but has no significant impact over longer horizons, and contracts output below its potential level.

According to the Keynesian view, consumption and hence private saving are independent of government purchases and national saving increase whenever taxes net of transfer payments increase or government expenditure falls. These kind of results are found in Gómez-Oliver (1989), Arrau and Van Wijnbergen (1991), Oks (1992), Corbo and Schmidt-Hebbel (1992). In contrast, Buira (1990), Burnside, Schmidt-Hebbel and Serven (1999), and Burnside (2000), find that the RET holds in a partial manner. The authors who claim that the RET doesn't hold argue that the assumptions made for this theory to hold are too strong and do not necessarily apply in countries like Mexico. Regarding the responses of positive shocks to the output gap, we find that while they have some positive effect on national saving over the following four quarters, they have negative but not significant effect on private saving. This finding suggests that the wealth effect caused due by an increase in income is netted out by the substitution effect.

Figures 3 and 4 show the results obtained for the same previous models using variables measured as percentage of potential GDP estimated by the VAR model. The results are very similar to those obtained using the HP measure, reflecting the fact that the differences

in both types of measures are not important. Graph 1 shows both potential GDPs and actual GDP; there is no great difference between both potential GDPs. The only difference is that the potential GDP estimated by the VAR model holds a more constant potential GDP to actual GDP ratio.

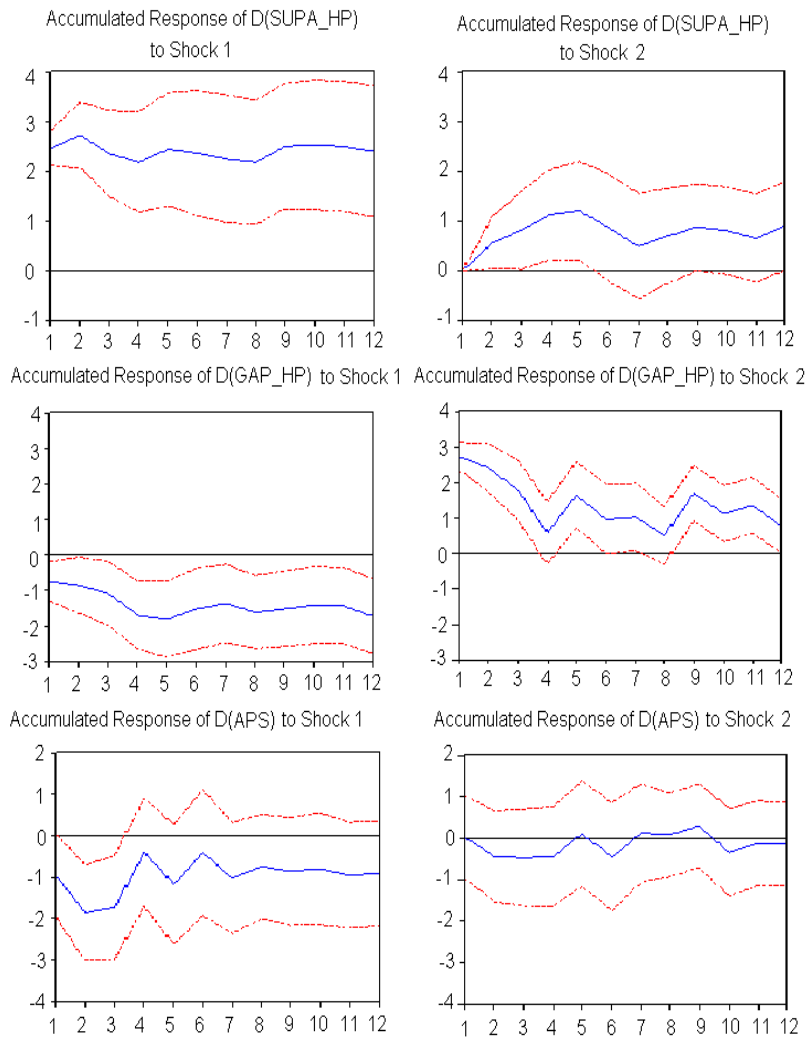
**Figure 1**  
*Accumulated Responses of Adjusted National Savings (HP)\**



Note: \*Shock 1 and shock 2 refer to one standard deviation structural shocks to SUPA\_HP and GAP\_HP respectively.



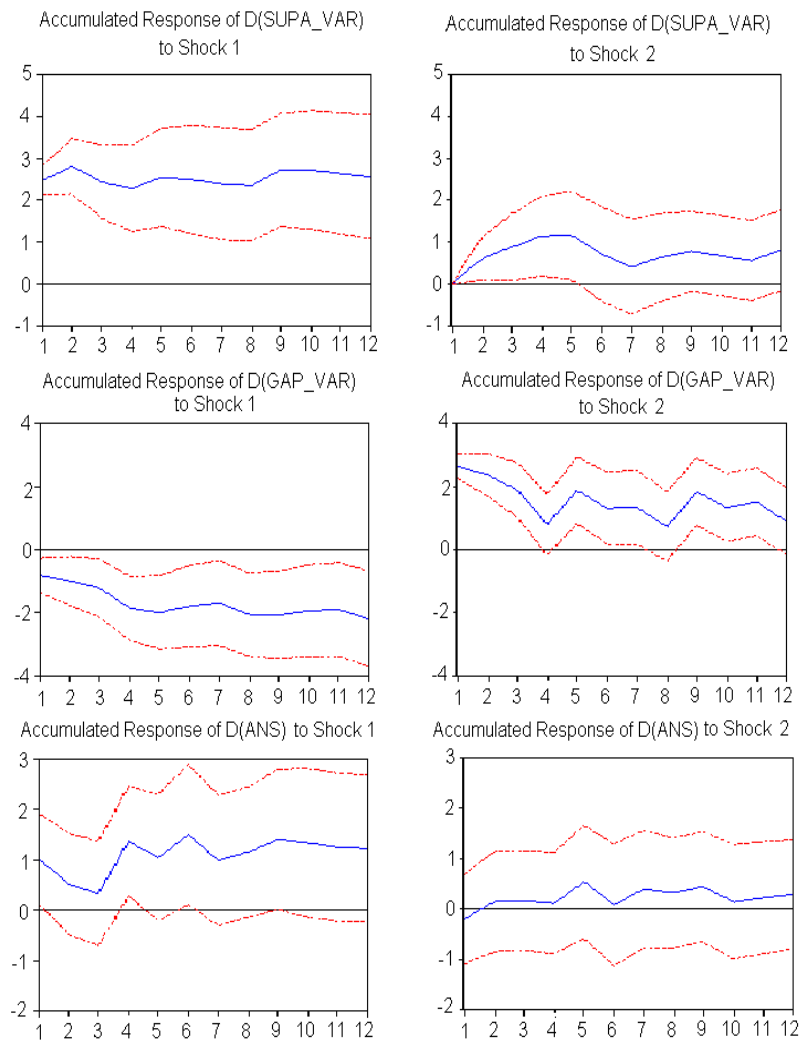
**Figure 2**  
*Accumulated Responses of Adjusted Private Savings (HP)\**



Note: \*Shock 1 and shock 2 refer to one standard deviation structural shocks to SUPA\_HP and GAP\_HP respectively.

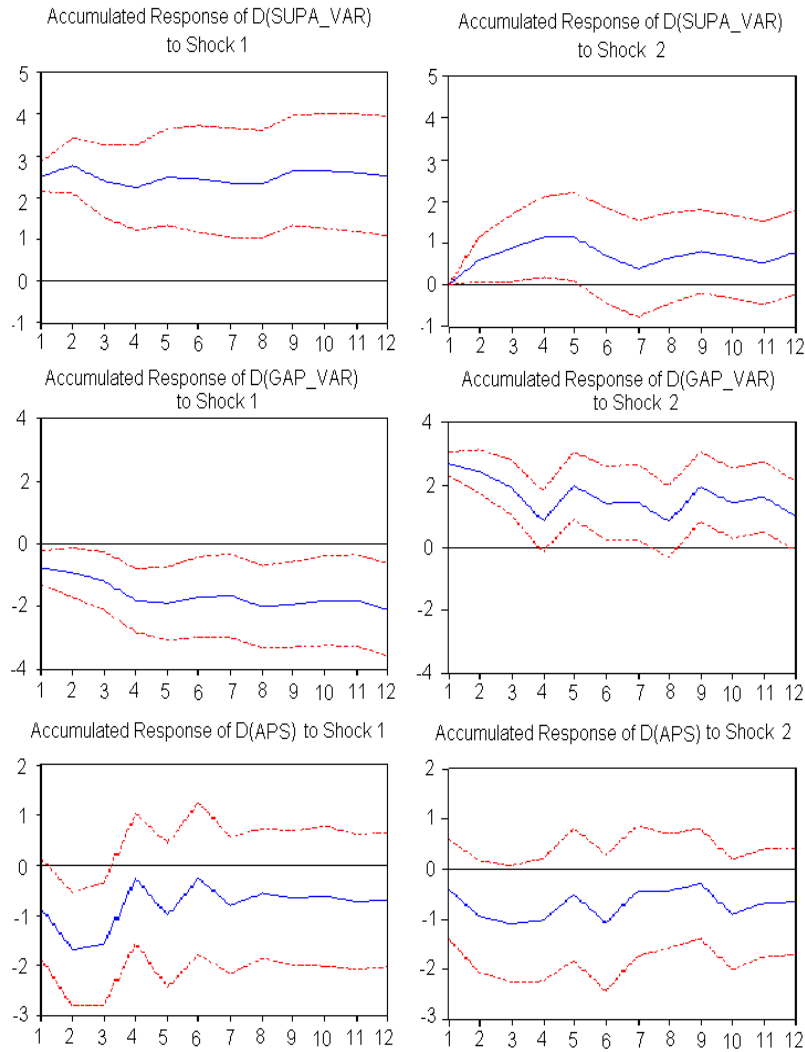
**Figure 3**

*Accumulated Responses of Adjusted National Savings (VAR)\**



Note: \*Shock 1 and shock 2 refer to one standard deviation structural shocks to SUPA\_VAR and GAP\_VAR respectively.

**Figure 4**  
*Accumulated Responses of Adjusted Private Savings (VAR)\**



Note: \*Shock 1 and shock 2 refer to one standard deviation structural shocks to SUPA\_VAR and GAP\_VAR respectively.

These results are, certainly, conditional on the limited availability of the data, which can affect the accuracy of the tests and estimators. More importantly, given this limitation, the issue of possible structural change has not been approached, although the adjusted data seem to show a pattern that may be consistent with possible structural changes. Certainly, this issue can have important implications and may explain why different authors find opposite results.<sup>20</sup> Also, a new discussion concerning debt sustainability and official debt targets has arisen recently. The response of actual public saving levels to the previous debt levels has shown different results for the EU and analysis of this kind of relationship for the Mexican case in order to evaluate the government's performance achieved by pursuing debt targets seems desirable. All previous issues are, however, beyond the scope of this paper and deserve further investigation.

## 5. Conclusions

This paper shows that fiscal policy has an important impact on national saving, some negative impact on private savings over short horizons but none over the longer term, and a negative effect on the output gap. On the other hand, positive shocks to the output gap do not seem to have significant effects on private savings over any period of time.

Assuming that the adjustments are correct and relevant for the Mexican case, the main implication of this study would be that fiscal policies that improve the government's budgetary position will contribute to increase national saving. Throughout Mexican history, especially during the 1994 crisis, the country has suffered the consequences of low levels of national saving. High levels of national saving would assure enough liquidity for bad times, and leave the country in better position to face old and new debt commitments.

Further research to overcome the limitations of sample size, possible structural changes as well as to assess the government's performance achieved by pursuing debt targets would contribute significantly to this policy debate and is recommended.

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<sup>20</sup> The authors acknowledge an anonymous referee for pointing this out.

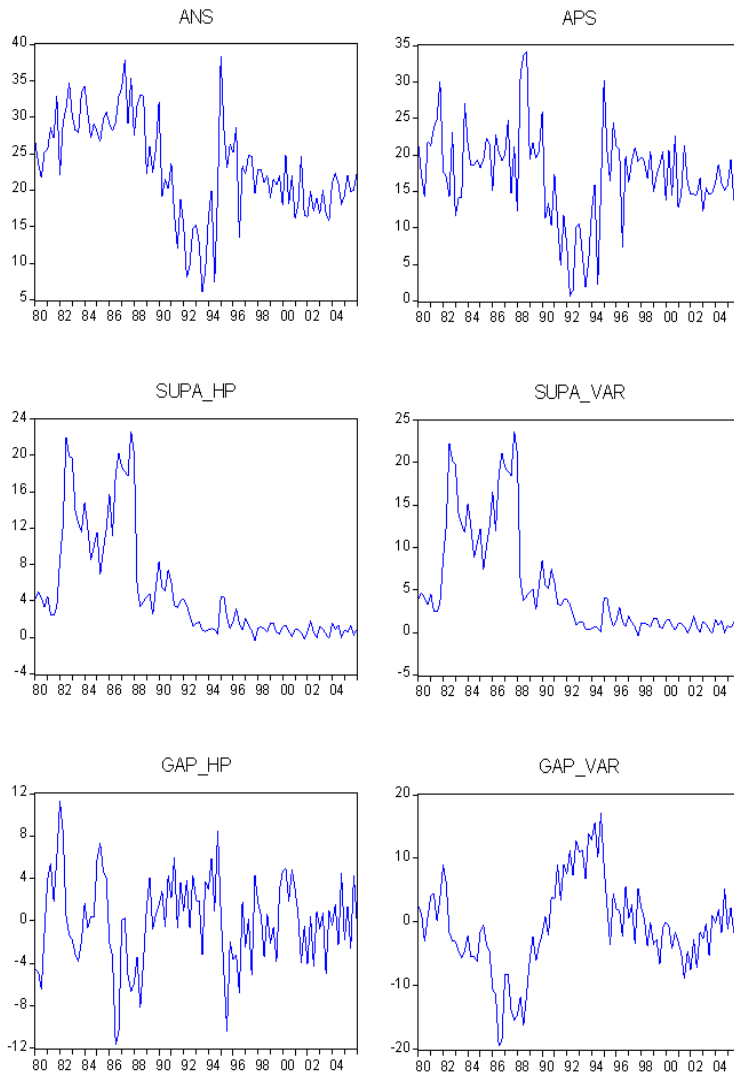
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Appendix

*Quarterly Series in Levels*



*Quarterly Series in First Differences*

