

THE SHORT-TERM EFFECTS OF FISCAL POLICY IN MEXICO: AN EMPIRICAL STUDY*

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Resumen: En este trabajo se investigan los efectos de corto plazo de la política fiscal en México. La evidencia empírica demuestra que una expansión fiscal, proveniente de una baja en los ingresos públicos, incrementa la base monetaria, la tasa de interés y los precios, deprecia el tipo de cambio real no obstante el pago de mayores intereses a los inversionistas, fortalece la actividad económica y deteriora la balanza comercial. Un hallazgo interesante es que la moneda se deprecie en términos reales a pesar de la tendencia alcista de las tasas de interés domésticas, lo cual es consistente con el enfoque riesgo país de la política fiscal.

Abstract: This paper investigates the short-term effects of fiscal policy on the Mexican economy. The empirical evidence shows that a fiscal expansion, resulting from a reduction in public sector revenues, produces the following effects: the money supply rises together with interest rates and prices, the real exchange rate depreciates despite higher interest payments to investors, economic activity increases and the trade balance deteriorates. An interesting finding is that fiscal expansion leads to real exchange rate depreciation in spite of an upward trend in interest rates, which is broadly consistent with the so-called country risk view of fiscal policy.

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1. Introduction

The purpose of this paper is to investigate the short-term effects of fiscal policy on the Mexican economy. To that end, we employ a Structural Vector Autoregression (SVAR) model reflecting some basic features of the Mexican economy, since it is consistent with a small open economy with a flexible exchange rate and free capital mobility. To improve the robustness of the findings, we also resort to the Generalized Vector Autoregression (GVAR) technique and make use of three different indicators of fiscal policy: government spending, government revenues and the budget deficit. These are the three basic indicators of fiscal policy proposed by Tanzi and Zee (1997) and every single one has been recently utilized in empirical macroeconomics. Indeed, previous empirical work does not provide conclusive support for the use of one particular indicator.¹

To deal with the stationarity issue, we follow two complementary approaches: one is to estimate typical VAR models with stationary variables, and the other is to estimate atypical VAR models with non-stationary variables but ensuring the overall stability of the system as suggested by Sims (1980), Doan (2000:283) and Lütkepohl (2006). In the latter case, we ensure model adequacy –among other things– by performing stability tests, given that stability is a sufficient condition for the “overall stationarity of the system”, notwithstanding the inclusion of individual nonstationary variables. Altogether, the above gives rise to twelve different model specifications, as we are using two distinct methodologies for estimation purposes (i.e., structural and nonstructural), two different approaches to deal with the stationarity issue (standard VARs in first or second differences, and nonstandard but stable VARs in levels), and three fiscal policy indices (spending, revenues and the deficit). Moreover, in order to evaluate the effects of fiscal policy shocks and their transmission channels, each specification is used to perform a battery of diagnostic tests and estimations. Our basic purpose is to start working with a benchmark specification and then test the robustness of the findings by means of alternative specifications.

As we shall see, a brief survey of the literature reveals that the economic effects of fiscal policy are still the subject of heated con-

¹ For instance, Martin and Fardmanesh (1990) make use of the three indicators to capture the stance of fiscal policy. For the same specific purpose, Easterly and Rebelo (1993) employ government spending, and Stokey and Rebelo (1995) use tax revenues. Finally, Catao and Terrones (2003), *inter alia*, utilize the government budget deficit.

troversy, which seems to be coupled with an increasing difficulty in attaining clear-cut empirical results in recent years. The empirical evidence presented in this paper suggests that a fiscal expansion, resulting from a fall in government revenues, produces the following effects: *i*) the money supply increases along with interest rates and the price level, *ii*) the domestic currency depreciates in real terms, despite the higher interest payments, and *iii*) economic activity rises and the trade balance deteriorates. Along these lines, one of the most interesting findings emerging from this study is that fiscal expansion leads to real exchange rate depreciation in spite of an upward trend in interest rates, which is broadly consistent with the so-called country risk view of fiscal policy. According to this view, fiscal loosening in developing countries such as Mexico may induce risk-averse investors to transfer funds abroad in order to avoid domestic inflationary taxes, exchange rate risk and other potential hazards commonly associated with unsound public finances. Such capital outflows may, in turn, weaken the domestic currency in real terms even with a higher rate of return on the peso-denominated bonds.

The remaining of this paper is organized as follows. Section 2 offers a brief review of the recent literature. Section 3 develops the theoretical framework, with emphasis on a benchmark model specification. Section 4 describes the dataset and conducts the integration analysis. The estimation results are presented in section 5. Finally, we conclude by summarizing the most relevant empirical findings and their policy implications.

2. Literature Review

With the advent of new econometric techniques, the short and long-term influence of fiscal policy on both aggregate demand and aggregate supply has been the subject of renewed attention. In this regard, we are interested in testing the relative validity of two major strands of literature: the Mundell-Fleming view, on the one hand, and the country risk view, on the other.

According to the Mundell-Fleming view, an expansionary fiscal policy raises both prices and interest rates. Interest rates tend to rise because a higher budget deficit typically involves an enhanced demand for loans. As the government borrows more in the domestic financial market, the competition for scarce funds intensifies, interest rates escalate and this, in turn, may crowd out private invest-

ment.² Concerning the external sector of the economy, this notion maintains that high real interest rates frequently give rise to massive capital inflows and exchange rate appreciation. A real appreciation of the domestic currency erodes international competitiveness (that is, it makes domestic goods more expensive abroad and foreign goods cheaper at home), thereby widening the current account deficit.³ Consequently, the net effect of fiscal policy on economic activity ultimately depends on factors such as the degree of openness of the economy, the output level compared to full capacity, and potential crowding-out effects arising from an increase in market interest rates, an exchange rate appreciation, or a price adjustment. It is worth mentioning that this approach is based on an amplified version of the Mundell-Fleming model (Frenkel and Razin, 1987), which focuses on economic policymaking in small open economies with free capital mobility and flexible exchange rates. Among the most relevant works in this particular area are: Blanchard (1981, 1984, 1985), Blanchard and Dornbusch (1984), Feldstein (1984), Branson, Fraga and Johnson (1985), Dornbusch (1986), and Reinhart and Sack (2000:175).

The country risk theory of fiscal policy brings the country risk premium into the picture. Within this analytical framework, even though fiscal expansion raises interest rates, the domestic currency is likely to depreciate. This latter assertion clearly contradicts the Mundell-Fleming notion, which claims that higher interest rates, caused by an increased budget deficit, lead to exchange rate appreciation. In fact, the central discrepancy between these two theories relates to the impact of fiscal developments on the exchange rate. As is well known, the effects of the budget deficit on the economy obviously depend on the underlying macroeconomic model and its array of intrinsic assumptions. In this respect, the country risk approach basically emphasizes the role played by the confidence factor in bringing about exchange rate depreciation following a fiscal expansion (or exchange rate appreciation after a fiscal retrenchment). The basic explanation

² An implicit assumption here is that the government borrows money domestically to finance its deficit.

³ Similarly, a restrictive fiscal policy lessens inflationary pressures and reduces interest rates to the extent that the government borrows less and the competition for scarce funds becomes less stringent. The decline in domestic interest rates stimulates private investment and economic growth but makes the peso-denominated bonds less attractive to investors, so that they shift funds away from Mexican securities and toward foreign securities. In such circumstances, the Mexican peso is likely to depreciate (as capital flows leave the country), trimming the current account deficit.

lies in the fact that international rating agencies (such as Moody's and Standard & Poor's) regard the government budget deficit as a key variable in assessing economic performance and country risk. Therefore, increasing budget deficits, especially in developing countries, are usually deemed as an early warning indicator (that is, as a signal of deterioration in the so-called economic fundamentals) not only by these rating agencies but also by international investors. So, in the face of expansionary fiscal policies, risk-averse investors may respond by transferring funds abroad to avoid domestic inflationary taxes, exchange rate risk and other inherent vulnerabilities of unsound public finances.⁴ The massive capital outflows originated in this manner may, in turn, be the source of exchange rate depreciation even with increased real interest rates.⁵ Some of the main proponents of this theory are: McDermott and Wescott (1996), Eichengreen (2000:67), and Cuevas and Chávez (2007).

3. Theoretical Framework

Although the empirical analysis is confined to the VAR framework, we employ two different estimation techniques to enhance the robustness of the findings: the generalized and the structural technique. The Generalized VAR (GVAR) method was developed by Pesaran and Shin (1998) in order to improve the so-called "recursive" VAR method introduced by Sims (1980). Even though the generalized and the recursive methodologies are both "nonstructural" by definition, the former has the advantage of producing empirical evidence that does not depend on the VAR ordering.⁶ Nonstructural VARs have become widely used in econometric analysis because economic theory plays no role in identifying and estimating the model (i.e., they allow the data to speak freely). Two circumstances were responsible for

⁴ The sensitivity of investors may vary depending not only on their attitude toward risk but also on factors such as the initial state of public finances, the magnitude and composition of the fiscal relaxation, and the pace of the implementation process.

⁵ By the same token, contractionary fiscal policies may result in exchange rate appreciation in spite of a fall in real interest rates induced by a lower public demand for loans.

⁶ By contrast, impulse responses and variance decompositions from recursive VARs may be sensitive to changes in the ordering of the equations, increasing the difficulty of obtaining clear-cut empirical results.

making the lack of theoretical restrictions a critical advantage: *i*) the persistent dispute among equally plausible theories with regard to the basic structure of the economy, and *ii*) the Lucas critique, which argues that the impact of government policies should not be predicted by means of simple empirical relations (such as the Phillips curve) or unsophisticated behavioral assumptions since those policies continuously alter the structure of the economy and the way people form their expectations about the future.⁷ In this perspective, nonstructural VARs basically rely on “pure” multiple time series analysis, so that the role played by economic theory is restricted to selecting the variables of the system. That is why these models are also referred to as atheoretical models.

On the other hand, Structural VAR (SVAR) models represent a further development in econometric theory and applied work. Under the SVAR methodology, economic theory does play an important role in identifying and estimating the model. Along these lines, SVAR models can be characterized as an intermediate approach, that is, as an approach lying somewhere in between the pure multiple time series models and the structured large-scale simultaneous equations models. To identify and estimate our SVAR model we shall draw heavily on the method proposed by Amisano and Giannini (1997).

Even though we use three different indicators (government spending, government revenues and the budget deficit) to study the effects of fiscal policy shocks, for expositional convenience we rely on the budget deficit to explain the theoretical underpinnings of our SVAR model. So, we start by saying that the model is made up of seven endogenous variables: budget deficit (BD_t), money supply (M_t), nominal interest rate (R_t), real exchange rate (Q_t), prices (P_t), output ($GEAI_t$) and trade balance (TB_t).⁸ We shall see that this model is broadly consistent with a small open economy with a flexible exchange rate and free capital mobility.

Equation (1) represents a SVAR model in its primary form:

$$AY_t = A_1Y_{t-1} + A_2Y_{t-2} + \dots + A_pY_{t-p} + B\varepsilon_t \quad (1)$$

where $Y_t = [BD_t, M_t, R_t, Q_t, P_t, GEAI_t, TB_t]'$ is a (7x1) vector of endogenous variables, A , B , and A_i are (7x7) coefficient matrices,

⁷ As a matter of fact, the growing popularity of nonstructural VARs can be ascribed to the implausible assumptions and theoretical biases behind the large-scale simultaneous equation models of the early years.

⁸ Since monthly GDP-data is not available in the case of Mexico, we make use of the Global Economic Activity Index (GEAI) as a *proxy* for output.

with $i = 1, 2, \dots, p$, and $\varepsilon_t = [\varepsilon_t^{BD}, \varepsilon_t^M, \varepsilon_t^R, \varepsilon_t^Q, \varepsilon_t^P, \varepsilon_t^{GEAI}, \varepsilon_t^{TB}]'$ is a (7x1) vector of structural shocks. The elements of ε_t are shocks to the different variables of the system. For instance, ε_t^{BD} denotes fiscal shocks, whereas ε_t^M and ε_t^Q stand for monetary and exchange rate shocks, respectively. We assume that the elements of vector ε_t are orthonormal, that is, they are uncorrelated with unit-variance and zero expected value. Therefore, the covariance matrix of structural shocks, $E(\varepsilon_t \varepsilon_t') = \Lambda$, is an identity matrix.⁹

The reduced-form or secondary SVAR model is given by equation:

$$Y_t = \Gamma_1 Y_{t-1} + \Gamma_2 Y_{t-2} + \dots + \Gamma_p Y_{t-p} + e_t \quad (2)$$

where $\Gamma_i = A^{-1}A_i$ are reduced-form coefficient matrices with $i = 1, 2, \dots, p$ and $e_t = A^{-1}B\varepsilon_t$ is the vector of reduced-form innovations. Estimation of equation (2) through the OLS method yields estimates of the reduced-form coefficient matrices, Γ_i , the reduced-form innovations, e_t , and their covariance matrix, $\Sigma = E(e_t e_t')$. The AB-method of Amisano and Giannini (1997) is used here to identify and estimate our SVAR model (see also Lütkepohl (2006), chapter 9). Equations (3) and (4) are useful in explaining such a method:

$$Ae_t = B\varepsilon_t \quad (3)$$

$$\Sigma = E(e_t e_t') = E(A^{-1}B\varepsilon_t \varepsilon_t' B' A^{-1'}) = A^{-1}BE(\varepsilon_t \varepsilon_t')B' A^{-1'} \quad (4)$$

$$= A^{-1}B\Lambda B' A^{-1'} = A^{-1}BI_n B' A^{-1'} = A^{-1}B B' A^{-1'}$$

Equation (3) arises from the fact that $e_t = A^{-1}B\varepsilon_t$ and draws attention to the relationship between structural shocks and reduced-form innovations. Equation (4), on the other hand, provides a means of explaining the identification procedure in an efficient way. In general, the elements of the vector of reduced-form innovations, e_t , will

⁹ Given that fiscal and price-shocks are uncorrelated, changes in government spending, revenues or the deficit are generated in real terms.

be correlated. Therefore, its covariance matrix, Σ , will be a non-diagonal symmetric matrix containing $n(n+1)/2$ independent parameters, where “ n ” denotes the number of endogenous variables of the model.¹⁰

Given that the covariance matrix of structural shocks is an identity matrix, no elements in Λ need to be estimated. In light of this assumption and the relationship between Σ and the coefficient matrices (namely, $\Sigma = A^{-1}BB'A^{-1'}$), the whole $n(n+1)/2$ distinct parameter estimates in Σ can be used to estimate A and B . Thus, restricting B to be a diagonal matrix (with only n elements to estimate) will leave us with $n(n+1)/2 - n = n(n-1)/2$ elements of free information, which is precisely the maximum number of parameters in the A matrix that can be estimated. Since only a portion of the n^2 unknown elements in A can be estimated (i.e., $n^2 > n(n-1)/2$), we have no choice but to impose a set of zero exclusion restrictions on A to identify the model.¹¹ The restrictions placed on A will be dictated by economic theory and a unique relation for $Ae_t = B\varepsilon_t$ will necessarily emerge. Such a unique relation, moreover, embodies a structure of contemporaneous correlations among the reduced-form residuals, which is consistent with economic theory.

The next step is to identify and estimate equation (3). In order to accomplish this task in a theoretically plausible manner, we place a set of zero exclusion restrictions on coefficient matrix “ A ” in such a

¹⁰ Broadly speaking, Σ is the variance/covariance matrix of the vector of reduced-form innovations, e_t . The main-diagonal elements are variances and will be denoted σ_i^2 , while the rest of the elements are covariances and will be denoted σ_{ij} . The Σ matrix can be represented as follows:

$$\Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \dots & \sigma_{1n} \\ \sigma_{21} & \sigma_2^2 & \dots & \sigma_{2n} \\ \cdot & \cdot & \cdot & \cdot \\ \sigma_{n1} & \sigma_{n2} & \dots & \sigma_n^2 \end{bmatrix}$$

where each covariance term is given by $\sigma_{ij} = \frac{1}{T} \sum_{t=1}^T e_{it}e_{jt}$. The above matrix is symmetric in the sense that $\sigma_{21} = \sigma_{12}$, $\sigma_{31} = \sigma_{13}$ and so forth. Therefore, Σ must contain exactly $n(n+1)/2$ free-information elements to be used in estimating the A and B matrices.

¹¹ Because A contains n^2 unknown elements, we have to impose $n^2 - n(n-1)/2 = n(n+1)/2$ zero exclusion restrictions in order to (exactly) identify and estimate the system.

way that the following two conditions are satisfied: one, the model is exactly identified and, two, the structure of contemporaneous correlations in equation (3) is consistent with a small open economy with a floating exchange rate system and free capital mobility. Equation (8) shows the result of this exercise:

$$\begin{aligned}
 Ae_t &= \begin{bmatrix} 1 & 0 & a_{13} & a_{14} & 0 & a_{16} & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & a_{32} & 1 & 0 & a_{35} & a_{36} & 0 \\ 0 & 0 & a_{43} & 1 & a_{45} & 0 & a_{47} \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & a_{56} & 0 \\ a_{61} & 0 & a_{63} & a_{64} & 0 & 1 & a_{67} \\ a_{71} & 0 & 0 & a_{74} & 0 & a_{76} & 1 \end{bmatrix} \begin{bmatrix} e_t^{BD} \\ e_t^M \\ e_t^R \\ e_t^Q \\ e_t^P \\ e_t^{GEAI} \\ e_t^{TB} \end{bmatrix} \quad (5) \\
 &= \begin{bmatrix} b_{11}\varepsilon_t^{BD} \\ b_{22}\varepsilon_t^M \\ b_{33}\varepsilon_t^R \\ b_{44}\varepsilon_t^Q \\ b_{55}\varepsilon_t^P \\ b_{66}\varepsilon_t^{GEAI} \\ b_{77}\varepsilon_t^{TB} \end{bmatrix} = B\varepsilon_t
 \end{aligned}$$

The estimation of system (5) is performed by Maximum Likelihood (ML) under the assumption that innovations follow a multivariate normal distribution.¹² The model under consideration must be thought of as the structure of contemporaneous correlations among the “orthogonalized innovations” and is expected to produce more theoretically meaningful impulse responses and variance decompositions. The elements of vector ε_t can be viewed as the structural shocks influencing each variable of the system (i.e., the so-called own shocks). Since the model allows for interpreting the empirical results with reference to a theoretical framework, impulse responses and variance decompositions can be useful in determining whether, and to what extent, shocks influence each variable as the underlying economic theory would suggest.

¹² As noted earlier, the identifying restrictions are based upon two assumptions: *i*) the vector of structural shocks (ε_t) is orthonormal, and *ii*) the B matrix is diagonal.

In a straightforward AB-model including seven variables (i.e., $n = 7$) we can estimate a total of twenty-one parameters in the A matrix (i.e., $n(n - 1)/2 = 21$ provided that $n = 7$), which amounts to imposing a total of twenty-eight zero identifying restrictions on A. Under the restrictions specified in (5), the relation $Ae_t = B\varepsilon_t$ can be written as:

$$e_t^{BD} = -a_{13}e_t^R - a_{14}e_t^Q - a_{16}e_t^{GEAI} + b_{11}\varepsilon_t^{BD} \quad (6.1)$$

$$e_t^M = b_{22}\varepsilon_t^M \quad (6.2)$$

$$e_t^R = -a_{32}e_t^M - a_{35}e_t^P - a_{36}e_t^{GEAI} + b_{33}\varepsilon_t^R \quad (6.3)$$

$$e_t^Q = -a_{43}e_t^R - a_{45}e_t^P - a_{47}e_t^{TB} + b_{44}\varepsilon_t^Q \quad (6.4)$$

$$e_t^P = -a_{51}e_t^{BD} - a_{52}e_t^M - a_{53}e_t^R - a_{54}e_t^Q - a_{56}e_t^{GEAI} + b_{55}\varepsilon_t^P \quad (6.5)$$

$$e_t^{GEAI} = -a_{61}e_t^{BD} - a_{63}e_t^R - a_{64}e_t^Q - a_{67}e_t^{TB} + b_{66}\varepsilon_t^{GEAI} \quad (6.6)$$

$$e_t^{TB} = -a_{71}e_t^{BD} - a_{74}e_t^Q - a_{76}e_t^{GEAI} + b_{77}\varepsilon_t^{TB} \quad (6.7)$$

According to the budget deficit equation (6.1), fiscal innovations are affected by innovations in the interest rate, the real exchange and the output level. As is well known, an interest rate hike tends to widen the budget deficit by increasing the cost of domestic government debt (i.e., $a_{13} < 0$ or $-a_{13} > 0$). The weighted average maturity of the peso-denominated government bonds plays a key role in determining the time required for a change in market interest rates to have a full impact on interest payments. The real exchange rate, on the other hand, is intended to capture the so-called Cardoso effect on government spending and the oil-export effect on government revenues. On the one hand, Cardoso (1992) argues that real currency depreciation increases the local currency value of external debt servicing, which, in turn, puts more pressure on the fiscal deficit. On the other hand, real exchange rate depreciation raises the domestic

currency value of crude oil export revenues, which, in turn, alleviates the pressure on the deficit. Therefore, the sign of parameter a_{14} is somewhat ambiguous. Economic activity, by contrast, is positively related to tax revenues and negatively related to the budget deficit (i.e., $a_{16} < 0$ or $-a_{16} > 0$). In summary, the specification of (6.1) is intended to reflect the vulnerability of public finances to sudden changes in economic conditions.

The money supply function (6.2) assumes that the supply of money is essentially determined by the central bank. This specification is consistent with the notion that, under a flexible exchange rate system, the central bank is able to influence the supply of money to a certain degree. Therefore, in (6.2) innovations in money supply are only affected by their own shocks (ε_t^M).

Equation (6.3) is a money demand or LM function. Note that interest rate innovations depend on innovations in money supply, prices and output. Holding the money supply constant, an increase in economic activity or prices raises the demand for money and, therefore, the interest rate (i.e., $a_{35} < 0$ and $a_{36} < 0$). Since the interest rate determines the opportunity cost of holding money, it must rise in order to restore the equilibrium in the money market.¹³ By the same token, given real economic activity and prices, a monetary expansion lowers the interest rate (i.e., $a_{32} > 0$). Lastly, under this view, an expansionary monetary policy not fully accommodated through an increase in output may result in inflationary pressure. In this manner, it is also possible to re-establish equilibrium by means of a higher price level.

Equation (6.4) simply reflects the dependence of real exchange rate innovations on innovations in interest rates, prices, and the trade balance. The real exchange rate, Q_t , is the relative price of imports in terms of domestic goods. Formally, $Q_t = \frac{S_t P_t^*}{P_t}$, where S_t is the nominal exchange rate, P_t^* is the foreign price level, and P_t was previously defined as the domestic price level. Therefore, an unexpected increase in the domestic price level, *everything else being constant*, produces a real exchange rate appreciation and vice versa. Moreover, an increase (decrease) in the domestic interest rate, *all else being equal*, produces massive capital inflows (outflows) and appreciates (depreciates) the

¹³ It is standard to assume that the demand for money is a decreasing function of the interest rate and an increasing function of prices and real economic activity. Thus, innovations in real economic activity and prices are used here as a broad measure of unexpected changes in money demand.

currency in real terms.¹⁴ Lastly, (6.4) reflects that innovations in the trade balance, like a sudden variation in international oil prices, can eventually alter the real exchange rate. For instance, an exogenous increase in the value of oil exports (resulting from a higher price and/or volume exported) may improve the trade balance and appreciate the peso in real terms.

Equation (6.5) is an inflation or price equation. In this case, we have allowed price innovations to be influenced by innovations in the following variables: budget deficit, money supply, interest rate, real exchange rate, and economic activity. A number of empirical papers identify these variables as key determinants of inflation in the Mexican economy. In a pioneer VAR analysis of the Mexican inflationary phenomenon, Arias and Guerrero (1988) show, among other things, that exchange rate shocks are a prominent source of price instability. More recently, Agénor and Hoffmaister (1997) confirm this finding by proving that inflation in Mexico is not only driven by nominal money growth but also by exchange rate depreciation.¹⁵ The work of Rogers and Wang (1994), by contrast, concludes that fiscal and monetary disturbances have more influence on prices than do exchange rate depreciations. Indeed, unlike previous research, Rogers and Wang (1994) do not consider the exchange rate as a key inflationary factor. The resulting dispute is to some extent solved by Baqueiro, Díaz de León, and Torres (2003), who provide robust empirical evidence indicating that the responsiveness of prices to exchange rate fluctuations decreases as the economy moves from a high- to a low-inflation scenario. In this perspective, (6.5) includes the government budget

¹⁴ To formalize this statement, we can assume that the following amplified version of the interest-parity condition holds: $i_t = i_t^* + \Delta S_t^e + \delta$ where i_t^* is the foreign nominal interest rate, ΔS_t^e is the expected rate of depreciation (or appreciation) of the nominal exchange rate, and δ is the country risk premium, which for simplicity is to be treated as a positive constant term. Given that domestic and foreign debt instruments are near substitutes to investors (who are risk-averse and will seek the highest risk-adjusted expected rate of return), any deviation from this condition will result in substantial capital flows from one country to another. To visualize this, suppose that an increase in the domestic interest rate leads to the following deviation from parity: $i_t > i_t^* + \Delta S_t^e + \delta$. In this case, the domestic bond market will offer a higher expected rate of return, attracting sizable capital flows into the country. This flood of foreign funds is likely to produce a real exchange rate appreciation until the equilibrium condition is restored; that is, until the domestic rate of interest, i_t , falls and incentives to transfer funds across national borders are arbitrated away.

¹⁵ Other empirical papers devoted to this topic are: Dornbusch, Sturzenegger and Wolf (1990), Pérez-López (1996), and Galindo and Catalán (2004).

deficit, the money supply and the real exchange rate as potential sources of inflation. Furthermore, we assume that interest rates and output may have an incidence on prices. Interest rates may work on prices through the cost of loans, whereas economic activity may serve (together with the budget deficit) as a proxy for aggregate demand.

Equation (6.6) is an amplified *IS* function. To represent the equilibrium in the goods market, we make output innovations dependant upon innovations in the government budget deficit,¹⁶ the interest rate, the real exchange rate and the trade balance. It is standard to assume that an expansionary fiscal policy (i.e., an increase in the deficit), or an improvement in the trade balance associated with a higher external demand for domestically produced goods and services, will stimulate aggregate demand and, therefore, economic activity. An interest rate increase, by contrast, is likely to slow down economic growth by discouraging interest-sensitive consumption spending and private investment. In addition to these standard assumptions, we have to consider that real exchange rate depreciation gives rise to both expansionary and contractionary effects, especially, in developing countries such as Mexico. The expansionary effect stems from enhanced international competitiveness and increased net exports, whereas the recessionary effect derives from the fact that real currency depreciation raises the local-currency price of imported intermediate goods (i.e., it provokes cost-push inflation). Lastly, the trade balance has been included in the *IS* function to capture the effects of external shocks to the home-country's demand for goods.¹⁷ Indeed, the theory of international business cycles suggests that economic activity can be transmitted from one country to another through the trade (or the current account) balance, provided that international trade links are strong. In this fashion, the US and the Mexican business cycles are positively correlated, so that a greater economic activity in the US is likely to stimulate domestic output by way of an improved trade balance.¹⁸ In summary, the expected parameter signs in this case are: $a_{61} < 0$, $a_{63} > 0$, $a_{64} > 0$, and $a_{67} < 0$.

¹⁶ Instead of government spending, an *IS* equation can incorporate other fiscal policy indices such as the budget deficit (See Blanchard and Fischer (1990:530)).

¹⁷ It is useful to recall that foreign output, denoted Y^* , is one of the basic determinants of the current account balance. Indeed, the current account balance is frequently specified as a function of the real exchange rate, domestic output, and foreign output.

¹⁸ See Backus and Kehoe (1992) and Gregory, Head and Raynauld (1997) for a detailed discussion on international business cycles.

Equation (6.7) is an empirical equation for the external sector of the economy. In this case, innovations in the trade balance¹⁹ rely on fiscal, exchange rate and output innovations. First, from the national income identity for an open economy we can infer that, *all other things equal*, an increase in the government budget deficit deteriorates the trade balance (and, therefore, the current account balance) while a decrease in the government budget deficit improves it.²⁰ If the data are consistent with such a relationship, then there will be grounds for studying the twin-deficit problem in the case of Mexico (given that the trade balance is part of the current account balance and the latter has been reporting a deficit for several years). Secondly, real currency depreciation enhances international competitiveness and improves the trade balance, whereas real currency appreciation has the opposite effect. Finally, a salient feature of developing countries such as Mexico is the strong positive relationship between economic activity and the volume of imports, especially of capital and intermediate goods. As a result, faster economic growth is commonly associated with trade balance deterioration.

4. Data Issues

On the basis of the previously depicted model, we have selected seven variables. All such variables are treated as endogenous and are used in conducting our empirical analysis. Thus, we gathered monthly data

¹⁹ Monthly data for the current account balance is not available, so that we use the trade balance to capture the external sector of the economy.

²⁰ Let NI be the symbol for national income, C for consumption, I for investment, G for government spending, and CAB for current account balance (as previously noted, due to data-related problems, the current account balance is proxied here by the trade balance). In this manner, the national income identity for an open economy can be represented as: $NI = C + I + G + CAB$. In order to finance the current account deficit, the Mexican economy must borrow from the rest of the world. Thus, the CAB measures the amount of funds that Mexico needs to borrow every year from the rest of the world. If we rearrange terms and introduce taxes, the national income identity becomes: $(NI - T) - C - (G - T) = I + CAB$. Given that private savings, S_P , equal $(NI - T) - C$ while government savings, S_G , equal $-(G - T)$, we can obtain: $S_P + S_G = I + CAB$. Next, considering that S_G is the negative of the government budget deficit [i.e., $S_G = (T - G) = -(G - T) = -BD$], we can rewrite the previous expression as: $CAB = S_P - I - BD$. According to this model, *all else equal*, an increase in the BD worsens the CAB while a fall in the BD improves it.

for each variable from January 1996 to January 2008 (145 observations in total).²¹

Before presenting the empirical evidence, some data-related issues have to be discussed:

1) As stated before, we shall use three fiscal policy indicators: *i*) the public sector budget deficit, *ii*) total public sector spending, and *iii*) total public sector revenues, which include tax and non-tax revenues such as products, services and duties. As is well known, the public sector comprises the federal government, the state-owned enterprises under budgetary control, and the non-budgetary sector.

2) Money supply is measured by the monetary base, given that it only includes the currency in the hands of the non-bank public and bank reserves. Thus, the central bank controls this variable better than any broader measure of money, such as M1 or M2. In consequence, the monetary base is probably the operational definition of money that best captures the stance of monetary policy.

3) In view of the fact that treasury bills (Certificados de la Tesorería) are the most important debt instrument of the Mexican money market, we resort to the 28-day treasury-bill rate to measure the nominal interest rate.

4) The real *effective* exchange rate index is used to reflect changes in international competitiveness. Such an index is based on consumer prices and measures changes in international competitiveness with respect to more than a hundred countries.

5) To measure changes in the price level, we utilized the National Consumer Price Index.

6) The Global Economic Activity Index (GEAI) is used as a proxy for output, due to the lack of monthly GDP-data for the Mexican economy.

7) Similarly, the trade balance is used here as a *proxy* for the current account balance, as monthly data is not available for the latter variable.

It is also worth mentioning that the X12 procedure was used to seasonally adjust all variables, except for the budget deficit and the trade balance. Since these variables involve negative values, we had

²¹ Source: INEGI and Bank of Mexico.

to employ the so-called Tramo/Seats method for seasonal adjustment. Moreover, all series were transformed into natural logarithms with the exception of interest rates, the budget deficit and the trade balance.

4.1. *Integration Analysis*

In view of the growing variety of unit root and stationarity tests and the fact that each test entails a different combination of pros and cons, we have deemed it appropriate to perform three different types of standard tests: Augmented Dickey-Fuller (ADF, 1979), Phillips-Perron (PP, 1988), and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992). A critical issue in testing for the presence of unit roots (or for the presence of stationarity) in a time series concerns the specification of the test equation. The basic choice here relates to whether to include a constant and a linear trend or only a constant, given that the KPSS test does not allow for removing the constant term from the test equation.²² To make such a determination we relied on Hamilton's methodology (1994:501), which means that on a case-by-case basis we selected the specification conveying the most plausible description of the data, both under the null and the alternative hypotheses. Moreover, a battery of F type tests was performed in an attempt to prove that the test equations were correctly specified. These tests, unlike the conventional F tests, are based on the critical values developed by Dickey and Fuller (1981); and Dickey, Bell and Miller (1986) through simulation processes involving nonstationary variables. The results of the unit root and stationarity tests are summarized in table 1.

The ADF and PP tests contrast the null hypothesis of a unit root with the alternative hypothesis of stationarity, whereas the KPSS test contrasts the null hypothesis of stationarity with the alternative of non-stationarity. The rationale for including a stationarity test, such as the KPSS test, lies in the lack of power of the unit root tests. Hence, to conclude that a given variable is stationary we must not only reject the unit root hypothesis in the ADF and PP tests, but also fail to reject the stationarity hypothesis in the KPSS test.

²² In some cases, however, we omitted both the constant and the linear trend and performed only unit root tests.

Table 1
Unit Root and Stationarity Tests

<i>Variable</i>	<i>Specification of the test equation</i>	<i>ADF (Ho: unit root)</i>	<i>PP (Ho: unit root)</i>	<i>KPSS (Ho: stationarity)</i>	<i>Order of integration</i>
BD_t	C and LT	-0.58	-0.79	0.33**	≥ 1
ΔBD_t	C	-16.60**	-15.81**	0.57*	Inconclusive
$\Delta^2 BD_t$	C	-11.59**	-102.13**	0.13	0
$\Delta^2 BD_t$	None	-11.63**	-102.53**	Not available	0
G_t	C and LT	-2.89	-2.90	0.35**	≥ 1
ΔG_t	C	-12.83**	-12.88**	0.57*	Inconclusive
$\Delta^2 G_t$	C	-12.59**	-59.07**	0.18	0
$\Delta^2 G_t$	None	-12.64**	-59.02**	Not available	0
T_t	C and LT	-3.21	-3.27	0.29**	≥ 1
ΔT_t	C	-11.20**	-11.21**	0.49*	Inconclusive
$\Delta^2 T_t$	C	-10.89**	-81.85**	0.30	0
$\Delta^2 T_t$	None	-10.92**	-80.05**	Not available	0
MB_t	C and LT	-2.33	-2.24	0.34**	≥ 1
ΔMB_t	C	-11.91**	-19.18**	1.17**	Inconclusive
$\Delta^2 MB_t$	C	-10.95**	-123.34**	0.33	0
$\Delta^2 MB_t$	None	-10.97**	-122.21**	Not available	0
R_t	C	-2.92*	-2.94*	1.26**	Inconclusive
ΔR_t	C	-13.09**	-13.09**	0.23	0
Q_t	C	-2.77	-2.96*	0.61*	Inconclusive

Table 1
(continued)

<i>Variable</i>	<i>Specification of the test equation</i>	<i>ADF</i> (<i>Ho: unit root</i>)	<i>PP</i> (<i>Ho: unit root</i>)	<i>KPSS</i> (<i>Ho: stationarity</i>)	<i>Order of integration</i>
ΔQ_t	C	-9.08**	-9.07**	0.59*	Inconclusive
$\Delta^2 Q_t$	C	-9.29**	-89.85**	0.14	0
$\Delta^2 Q_t$	None	-9.31**	-88.84**	Not available	0
P_t	C and LT	-5.04**	-7.04**	0.34**	Inconclusive
ΔP_t	C	-3.85**	-3.09*	1.27**	Inconclusive
$\Delta^2 P_t$	C	-9.21**	-22.34**	0.35	0
$\Delta^2 P_t$	None	-12.88**	-19.45**	Not available	0
$GEAI_t$	C and LT	-2.66	-2.10	0.20*	1
$\Delta GEAI_t$	C	-15.60**	-15.96**	0.19	0
TB_t	C	-3.75**	-3.28**	0.83**	Inconclusive
ΔTB_t	C	-12.64**	-17.69**	0.12	0
ΔTB_t	None	-12.57**	-17.47**	Not available	0

Notes: 1. C = Constant and LT = Linear Trend. 2. Asterisks * and ** denote rejection of the null hypothesis at the 5% and 1% significance levels, respectively. 3. The symbols Δ and Δ^2 are the first and second difference operators, respectively. 4. The ADF and PP test results are based on Mackinnon (1996) critical values and their associated one-sided p -values. In the ADF tests, the Schwarz Information Criterion is used to determine the lag length of each test equation. In the PP tests we control the bandwidth by way of the Newey-West bandwidth selection method and the Bartlett kernel. 5. The KPSS test results are based on the critical values proposed by Kwiatkowski, Phillips, Schmidt and Shin (1992). To control the bandwidth, we use the Newey-West bandwidth selection method and the Bartlett kernel.

As we can see in table 1, the use of different types of tests often leads to indeterminate or inconclusive results, but appropriate differentiation eventually produces clear-cut empirical conclusions. According to test results, the following series may involve more than one unit root: BD_t , G_t , T_t , MB_t , Q_t , and P_t . All of these series may be integrated of order two, or I(2) series, because they are stationary in second differences with an unclear outcome in first differences. On the other hand, there are two variables, R_t and TB_t , which are probably I(1). In each case, when working in levels the two unit root hypotheses (i.e., the hypotheses under the ADF and PP tests) are rejected but the stationarity hypothesis (i.e., the hypothesis under the KPSS test) is also rejected, leaving the order of integration open to doubt. First differencing of R_t and TB_t , however, would consistently produce a stationarity result. Lastly, economic activity, $GEAI_t$, is an I(1) series as it is non-stationary in levels and stationary in first differences.

5. Estimation Results

As noted earlier, we are resorting to two complementary estimation techniques (structural and non-structural VAR estimation), two approaches to deal with the stationarity issue (typical VARs in differences and atypical but stable VARs in levels), and three fiscal policy indicators (government spending, government revenues, and the budget deficit). Table 2 shows that, in light of these considerations, we have twelve different model specifications in all: one benchmark specification and eleven alternative specifications.

Table 2
Model Specifications for Empirical Analysis

<i>Estimation Technique</i>	<i>Levels versus Differences</i>	<i>Fiscal Policy Indicator</i>
1. SVAR	Stable model in levels	T
2. GVAR	Stable model in levels	T
3. SVAR	Stationary model in differences	T
4. GVAR	Stationary model in differences	T
5. SVAR	Stable model in levels	G
6. GVAR	Stable model in levels	G
7. SVAR	Stationary model in differences	G

Table 2
(continued)

<i>Estimation Technique</i>	<i>Levels versus Differences</i>	<i>Fiscal Policy Indicator</i>
8. GVAR	Stationary model in differences	<i>G</i>
9. SVAR	Stable model in levels	<i>BD</i>
10. GVAR	Stable model in levels	<i>BD</i>
11. SVAR	Stationary model in differences	<i>BD</i>
12. GVAR	Stationary model in differences	<i>BD</i>

Notes: 1. T = Government revenues, G = Government spending, BD = Budget deficit. 2. Specification 1 is to be used as a benchmark.

First, we are interested in estimating our benchmark specification, which is represented by a stable SVAR model in levels with government revenues as a fiscal policy indicator (specification 1 in table 2). The rationale for selecting such a model is twofold:

1. A SVAR model in levels allows for a richer empirical analysis while ensuring the robustness of the findings by means of stability checks. In fact, Sims (1980) and Doan (2000), inter alia, have argued against differencing when dealing with VAR models, even if the series involved are nonstationary.²³ The idea behind this argument is that differencing carries the risk of losing valuable information as to the co-movements of the series. Along these lines, Lütkepohl (2006) shows that it is the overall stationarity of the model, rather than the stationarity of the individual variables, that is necessary to ensure the robustness of the findings. Moreover, stability is a sufficient –but not a necessary– condition for the overall stationarity of the system.²⁴ In this perspective, a “stable” VAR model in levels is said to be well behaved, meaning that the cumulative effects of shocks are finite and measurable.

2. The use of government revenues as a fiscal policy indicator makes it easier to identify the effects of fiscal shocks on the remaining

²³ Fuller (1976, theorem 8.5.1) demonstrates that differencing does not improve asymptotic efficiency in VAR models, even if the underlying variables are nonstationary.

²⁴ See Patterson (2000, chapter 14) for details.

variables of the system, probably because government revenues operate through supply –and demand–side channels, whereas government expenditures and the deficit are mainly aimed at influencing aggregate demand. Blanchard (1993) provides some useful thinking on the subject of fiscal variables and their transmission channels.

In this manner, we first proceed to assess the effects of fiscal shocks by means of the benchmark specification and then we test the robustness of the findings through alternative model specifications.

5.1. *Diagnostic Tests*

Unless otherwise stated, from this point on we shall be referring to our benchmark specification, whose economic structure is described by equations (6.1) through (6.7). The lag length of the model was determined empirically, given that the use of different lag length criteria failed to achieve model congruency (i.e., it failed to generate relatively well-behaved residuals). Thus, the conclusion was that seven lags for each variable in each equation eliminates serial correlation and heteroskedasticity. The results of the multivariate serial correlation Lagrange Multiplier (LM) tests –that is, the LM statistics and their corresponding p -values– indicate the absence of serial correlation up to lag order thirteen. Similarly, the multivariate version of the White heteroskedasticity tests reveals that, at the 5% significance level, the null hypothesis of homoscedasticity cannot be rejected in any of the cases. Moreover, all the inverse roots of the characteristic autoregressive (AR) polynomial have moduli of less than one and lie within the unit circle, which means that the stability condition is satisfied. As a result, our model in levels is stable and, therefore, stationary.²⁵

By the same token, even though the residuals do not substantially depart from Gaussian white noise, strictly speaking, they don't follow a multivariate normal distribution.²⁶ The nonnormality of the residuals associated with variables such as the interest rate and the real exchange rate is basically due to the existence of a small number of statistically significant outliers, particularly in 1998 (the 28-day treasury-bill rate, for instance, rose from 22.6% in August to 39.9% in September, returning to 32.9% in October). In order to account for volatility episodes and their special effects, as well as to minimize departures from normality in the VAR residuals, we introduced two

²⁵ For the sake of brevity, these test results are available upon request.

²⁶ Multivariate normality tests for VAR residuals are also available.

impulse dummy variables. Although the estimated model is generally congruent (the lag structure is stable and residuals are for the most part well-behaved), we will resort to two different estimation procedures (the SVAR and the GVAR procedure) to rule out possible spurious results. Walsh (2003) recommends the use of different econometric methods to increase the robustness of the findings, given that this approach is useful in eliminating the bias associated with a particular methodology. As stated before, the GVAR approach is nonstructural and does not depend on the VAR ordering, so that it allows the data to speak freely.

5.2. Sensitivity Analysis and SVAR Parameter Estimates

The standard estimation procedure used in this case often fails to achieve convergence or the results are extremely poor, even if we set different initial values for the free parameters in matrices A and B, or if we randomly draw such initial values from a specific probability distribution. Table 3 presents the coefficient estimates for our benchmark model.

Note that only ten estimated coefficients are statistically significant and two of them (i.e., coefficients a_{53} and a_{67}) have signs contrary to conventional economic theory.²⁷ In this manner, a positive sign for a_{53} in equation (6.5) would mean that $-a_{53} < 0$ and, therefore, an interest rate increase would lower the price level. The above implies that the domestic interest rate is not influencing prices through the cost of loans as originally assumed. On the contrary, such an interest rate increase seems to be driven by a growing money demand (or demand for loans) associated with a higher-than-expected economic growth. In this context, higher interest rates would be consistent with falling inflationary pressures.

Table 3
Estimates of SVAR Parameters

<i>Coefficient</i>	<i>Estimate</i>	<i>Expected sign</i>	<i>Coefficient</i>	<i>Estimate</i>	<i>Expected sign</i>
a_{13}	-0.72	-	a_{61}	-1.11	-
a_{14}	0.05	- or +	a_{63}	-0.74	+
a_{16}	0.46	+	a_{64}	1.26	- or +

²⁷ The elements of matrix B are the standard deviations of the structural shocks, so that they are all positive.

Table 3
(continued)

<i>Coefficient</i>	<i>Estimate</i>	<i>Expected sign</i>	<i>Coefficient</i>	<i>Estimate</i>	<i>Expected sign</i>
a_{32}	-0.42	+	a_{67}	0.53*	-
a_{35}	1.96	-	a_{71}	-1.80	+
a_{36}	-0.90	-	a_{74}	-1.89**	-
a_{43}	-0.28	+	a_{76}	0.28	+
a_{45}	0.24	+	b_{11}	0.10	+
a_{47}	1.93	+	b_{22}	0.94***	+
a_{51}	-0.21***	-	b_{33}	1.17	+
a_{52}	-0.56***	-	b_{44}	0.54	+
a_{53}	0.93***	-	b_{55}	0.09***	+
a_{54}	-0.86***	-	b_{66}	0.53	+
a_{56}	-1.22***	-	b_{77}	0.24***	+

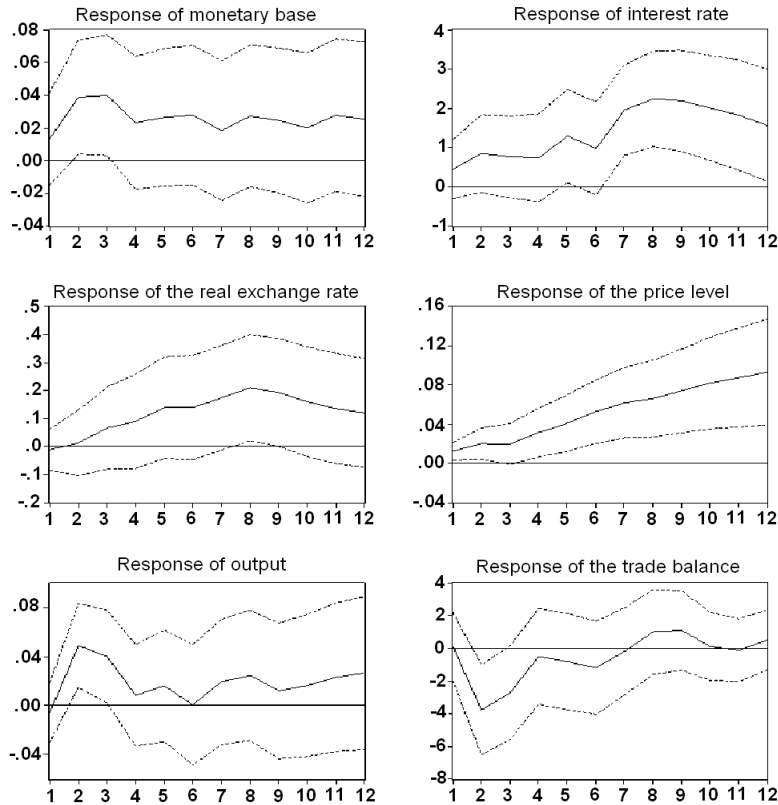
Notes: 1. Estimation by sevenrm ML. The log likelihood is maximized by the scoring methodology (analytic derivatives). 2. Asterisks *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

On the other hand, the meaning of a positive sign for a_{67} in equation (6.6) is that the trade balance is negatively related to output over the sample period, given that $-a_{67} < 0$. A plausible explanation for this result is that the Mexican economy is highly dependent on imported capital and intermediate goods, so that fast-paced (slow-paced) economic growth is usually accompanied by trade balance deterioration (improvement).²⁸ Notwithstanding the previous remarks, the resulting structure (i.e., the structure of contemporaneous correlations among the orthogonalized innovations depicted by equations (6.1) through (6.7)) generates impulse responses and variance decompositions, which are not only theoretically meaningful but also consistent with the ones obtained through the GVAR methodology, which does not rely on economic theory.

In figure 1 we have a set of twelve-month impulse response functions with two standard error bands, representing the dynamic response of each variable of the system to a fall in government revenues.

²⁸ The fact that this inverse relationship is captured by equation (6.6) and not by equation (6.7), given that coefficient a_{76} is not statistically significant, could be explained by the convergence problems that often arise when using the ML method.

Figure 1
Dynamic Effects of a Reduction in Government Revenues
(Stable SVAR Model in Levels)



In order for an impulse response function to be statistically significant, the corresponding upper and lower two standard error bounds must exclude the zero value at some point over the twelve-month horizon. Moreover, two important features of this setting are: *i*) the reduction in government revenues is of size one standard deviation and should be regarded as unexpected and temporary (i.e., the fall in public revenues is maintained for only one month), and *ii*) the dynamic responses are measured in percentage points.²⁹ Along these

²⁹ In this manner, 0.1 would be equal to 1/10th of a percentage point while

lines, figure 1 indicates that a reduction in public sector revenues produces the following effects:

1. The monetary base increases around the second month and this positive effect dies down very quickly. The economic intuition behind this particular finding is that lower government revenues entail a higher budget deficit, which is partially financed through money creation.

2. There is a long-lived positive effect on the interest rate, which becomes statistically significant in the course of the sixth month. Such an effect is probably the result of an enhanced public demand for funds associated with the fall in government revenues.

3. The real exchange rate depreciates around the eighth month notwithstanding the interest rate increase. This is consistent with the country risk view of fiscal policy, which states that fiscal expansion (especially in developing countries) may induce risk-averse investors to transfer funds abroad to avoid domestic inflationary taxes, exchange rate risks and other potential drawbacks of unsound public finances. This flow of funds out of the country may weaken the national currency, even in the face of higher interest payments to investors.

4. There is a long-lived positive effect on the price level³⁰ and a transitory increase in economic activity. This finding is consistent with the conventional view that an expansionary fiscal policy generates demand-pull inflation. Assuming that the fall in government revenues stems from a tax cut, the above findings are consistent with the notion that people spend a fraction of the *extra* after-tax income, raising not only consumption and aggregate demand but output as well. If the slack in production capacity is extremely restricted in some industries, prices will rapidly begin to rise (premature inflation) and the inflationary effect could be persistent over time. On the other hand, people save a fraction of the extra after-tax income, pulling up savings. But savings, or the supply of funds, increase by less than the public demand for funds linked to the decline in government revenues, so that interest rates go up as illustrated before.

0.01 would be equal to one basis point (or 1/100th of a percentage point).

³⁰ However, in the long run the impulse response of the price level asymptotes to zero, while the “accumulated” impulse response (that is, the accumulated sum of the impulse responses) is horizontal, that is, it asymptotes to a long-run positive value. This is consistent with a stable VAR model even though prices are downwardly inflexible.

5. Lastly, the trade balance deteriorates around the second month but this negative effect rapidly fades away. The trade balance deterioration is probably due to: *i*) the higher domestic absorption brought about by the expansionary fiscal policy, and *ii*) the rise in imports of capital and intermediate goods induced by a higher economic activity. Moreover, the hypothetical time path of the trade balance following a drop in public sector revenues suggests that the current account balance can be affected by fiscal developments. As a matter of fact, the relationship between the fiscal and current account deficits is commonly referred to as the “twin-deficit problem”.

Next, to establish robustness we resort to a different estimation technique: the GVAR technique. Figure 2 reports the impulse response functions associated with the second specification, which is a stable GVAR model in levels with government revenues as a fiscal policy indicator. The six graphs in figure 2 are quite similar to the previous case, showing that the structural approach is not leading to spurious impulse responses, despite the fact that some of the parameter signs reported in table 3 are inconsistent with standard economic theory.

As the reader might recall, the third and fourth specifications are stationary SVAR and GVAR models, respectively, in differences with government revenues as an indicator of fiscal policy. Under both specifications we can observe that a reduction in government revenues raises prices and output, on the one hand, and deteriorates the trade balance, on the other.³¹ The effects on the other variables are not statistically significant anymore, perhaps because differencing leads to losing valuable information as Sims (1980), Doan (2000) and others point out.³²

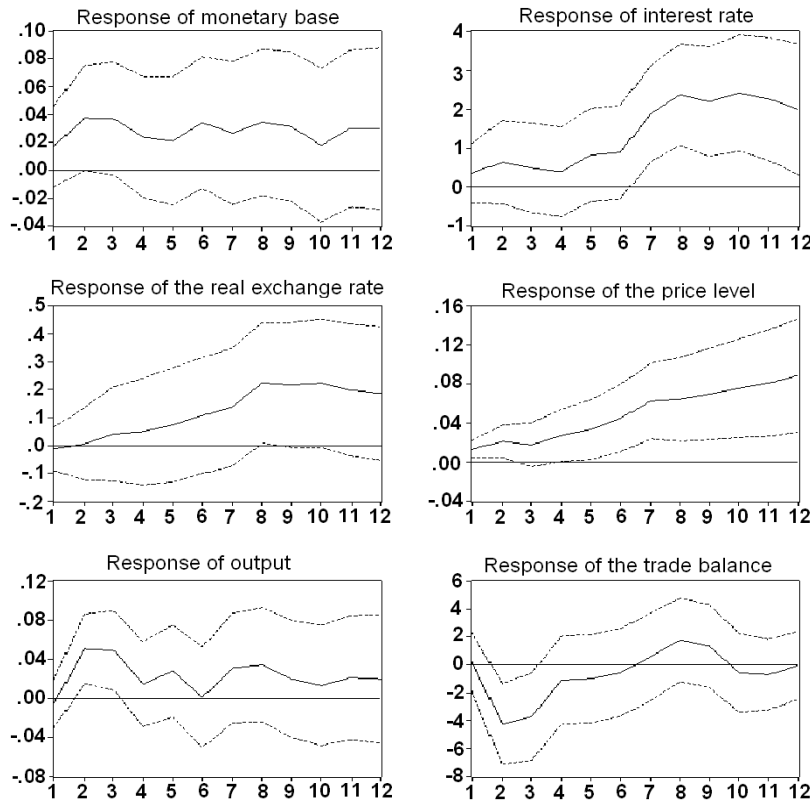
Generally speaking, the more we differentiate the variables of the system, the less significant impulse response functions become. Furthermore, the use of alternative fiscal policy indicators, that is, the use of government spending or the budget deficit, results in estimation difficulties or non-significant impulse response functions. The fifth and ninth specifications systematically produced near-singular Hessian matrices and could not be estimated, despite the use of several convergence criteria and the specification of different starting values

³¹ Under specifications 3 and 4, it is appropriate to replace the first difference of the price level, $\Delta P_t = P_t - P_{t-1}$, with the inflation rate, $\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}$. The empirical results are basically the same, but we can see that a fall in government revenues raises the rate of inflation for several months and then the effect dies away.

³² For the sake of brevity, impulse responses corresponding to specifications number 3 and 4 are available upon request.

and maximum number of iterations. The rest of the specifications, namely, specifications 6 through 8 and 10 through 12, basically yield non-significant impulse responses. There are, however, two notable exceptions: *i*) under the sixth specification, an increase in government spending worsens the trade balance, and *ii*) under the twelfth specification, a higher budget deficit causes a short-lived rise in the price level.³³

Figure 2
Dynamic Effects of a Reduction in Government Revenues
(Stable GVAR Model in Levels)



³³ These results are also available.

In this manner, government revenues seem better suited to the task of identifying the effects of fiscal shocks than government spending and the budget deficit. A plausible explanation for this result is that government revenues (the tax system, in particular) operate through supply- and demand-side channels, whereas government expenditures and the deficit are mainly aimed at influencing aggregate demand (Blanchard, 1993). Therefore, government revenues appear to capture a slightly different dimension of fiscal policy but further research is needed to properly establish such a notion.

5.3. *Forecast Error Variance Decompositions*

Next, the forecast error of each variable over different time horizons (i.e., 12 and 24 months) is decomposed into the components attributable to unexpected changes in all the variables of the system. Tables 4 and 5 report the variance decompositions of the first and second model specifications, respectively. As we can see, such tables are not only consistent with each other but also support the empirical evidence provided by figures 1 and 2. Table 4 shows that, 24 months ahead, shocks to government revenues explain a significant portion of the variations in the other variables of the system: 25.77% of money supply, 25.12% of the interest rate, 13.87% of the real exchange rate, 50.87% of the price level, 20.63% of output, and 8.72% of the trade balance.³⁴

In this manner, variance decompositions corresponding to our benchmark specification (i.e., the first specification in table 2) are consistent with impulse response functions in the sense that fiscal expansion may increase money supply, interest rates and prices, depreciate the domestic currency in real terms, stimulate economic activity and deteriorate the trade balance. Variance decompositions in Table 5 are similar as regards the explanatory power assigned to fiscal shocks, even though they correspond to an alternative model specification (i.e., the second specification).

³⁴ Even though these empirical results are sensitive to a number of factors (such as the time horizon and the number of variables of the system), fiscal shocks seem to have considerable influence on prices. This is probably due not only to the close links between fiscal and monetary policy in the long run but also to the short-run impact of public sector prices on production costs.

Table 4
Structural Variance Decompositions (Stable SVAR Model in Levels)

<i>Decomposition of variance for T_t</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	0.000248	42.01	34.41	4.03	1.52	3.72	3.73	10.58
24	0.000299	48.76	30.02	4.12	2.18	3.00	4.15	7.79
<i>Decomposition of variance for MB_t</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	0.034209	12.64	70.57	2.98	1.49	2.83	3.44	6.05
24	0.044619	25.77	59.95	2.01	2.09	2.78	2.08	5.32
<i>Decomposition of variance for R_t</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	3.839169	29.59	4.08	37.91	9.03	2.07	14.15	3.17
24	4.438464	25.12	4.81	30.79	11.52	1.74	22.64	3.37
<i>Decomposition of variance for Q_t</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	0.060223	13.57	0.28	9.97	70.68	3.74	1.17	0.59
24	0.068072	13.87	1.45	10.84	62.69	3.22	6.57	1.37

Table 4
(continued)

<i>Decomposition of variance for P_t</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	0.012743	43.77	0.67	13.03	5.45	33.83	2.30	0.95
24	0.020456	50.87	0.57	5.52	9.59	22.44	9.56	1.46
<i>Decomposition of variance for $GEAI_t$</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	0.017452	7.54	26.59	1.08	1.72	3.17	58.93	0.97
24	0.022597	20.63	25.91	0.75	5.25	3.80	43.01	0.64
<i>Decomposition of variance for TB_t</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	541.3063	8.59	5.72	1.43	1.37	5.00	11.35	66.52
24	550.1418	8.72	5.88	2.18	1.47	4.87	11.72	65.15

Notes: 1. S. E. = Standard Error. 2. The percentage of the variance resulting from shocks may not add up to 100.

Table 5
Generalized Variance Decompositions (Stable GVAR Model in Levels)

<i>Decomposition of variance for T_t</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	0.000261	42.03	34.50	2.40	1.56	5.63	2.90	10.97
24	0.000307	45.90	31.57	2.15	3.42	4.33	3.19	9.46
<i>Decomposition of variance for MB_t</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	0.035265	11.22	70.02	1.70	1.20	1.71	5.82	8.33
24	0.045563	22.47	60.41	1.07	2.14	1.27	4.19	8.46
<i>Decomposition of variance for R_t</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	3.797749	32.30	5.77	32.97	9.22	3.26	13.25	3.22
24	4.356974	30.76	6.25	25.55	9.62	3.00	20.61	4.194
<i>Decomposition of variance for Q_t</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	0.06231	15.87	0.18	7.88	72.11	2.50	1.26	0.20
24	0.069823	16.42	2.68	9.63	61.61	2.94	5.59	1.13

Table 5
(continued)

<i>Decomposition of variance for P_t</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	0.012296	39.60	1.71	19.85	7.12	28.31	2.92	0.48
24	0.019797	49.60	0.97	9.70	9.73	20.26	9.11	0.63
<i>Decomposition of variance for $GEAI_t$</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	0.017156	6.48	26.13	0.66	1.73	1.32	62.97	0.70
24	0.021851	15.15	24.87	1.53	8.20	0.95	48.73	0.57
<i>Decomposition of variance for TB_t</i>								
<i>Months Ahead</i>	<i>S. E.</i>	<i>Shock to T_t</i>	<i>Shock to MB_t</i>	<i>Shock to R_t</i>	<i>Shock to Q_t</i>	<i>Shock to P_t</i>	<i>Shock to $GEAI_t$</i>	<i>Shock to TB_t</i>
12	539.1701	11.61	4.75	0.69	2.42	4.89	9.49	66.15
24	551.2665	11.76	5.13	0.94	3.10	4.73	9.98	64.34

Notes: 1. S. E. = Standard Error. 2. The percentage of the variance resulting from shocks may not add up to 100.

6. Conclusions

Our analysis has focused on the short-term effects of fiscal policy on the Mexican economy. To that end, we employed twelve different model specifications and performed a variety of diagnostic tests and estimations. As already noted, our benchmark specification is a stable SVAR model in levels with government revenues as a fiscal policy indicator (specification 1 in table 2). Such a specification is consistent with a small open economy with a flexible exchange rate and free capital mobility.

First of all, the empirical evidence shows that using government revenues as a fiscal policy indicator makes it easier to identify the effects of fiscal policy shocks on the economy, probably because this particular variable operates through supply- and demand-side channels as Blanchard (1993) points out. Secondly, differencing the VAR variables leads to the loss of valuable information as Sims (1980) and Doan (2000), *inter alia*, have suggested. Along these lines, there are two model specifications pointing to clear-cut empirical conclusions: the stable SVAR and GVAR models in levels with government revenues as a fiscal policy indicator, corresponding to specifications 1 and 2 in table 2. Under these specifications an expansionary fiscal policy, resulting from a reduction in public sector revenues, brings about the following effects: *i*) the money supply rises, suggesting that lower revenues lead to a higher budget deficit which, in turn, is partially financed through money creation, *ii*) the interest rate notably escalates, presumably as a result of enhanced public demand for funds, *iii*) the real exchange rate depreciates in spite of the growing interest payments, *iv*) there is long-lived positive effect on prices and a transitory improvement in economic activity, which is consistent with the conventional view that lower public revenues lead to demand-pull inflation, and *v*) the trade balance deteriorates.

Even though some of the findings are broadly consistent with the Mundell-Fleming view (i.e., the increase in interest rates, prices and economic activity coupled with the trade balance worsening), the real exchange rate depreciation supports the country risk theory of fiscal policy. According to this theory, an expansionary fiscal policy, especially in developing countries, may induce risk-averse investors to transfer funds abroad in order to avoid domestic inflationary taxes, exchange rate risk and other inherent vulnerabilities of unsound public finances. The massive capital outflows so originated may, in turn, be the source of exchange rate depreciation even in the face of higher rates of return on the peso-denominated bonds. Under the Mundell-

Fleming model, by contrast, increased interest rates result in substantial capital inflows and exchange rate appreciation, notwithstanding the fiscal relaxation.

Lastly, it is worth mentioning that under the third and fourth model specifications (representing the SVAR and GVAR models in differences, respectively, with government revenues as a fiscal policy index) we can observe that a decline in public sector revenues raises prices and output, on the one hand, and deteriorates the trade balance, on the other. In any event, this evidence is still consistent with the notion that an expansionary fiscal policy generates demand-pull inflation.

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