Oil-dependent Revenues and Macroeconomic Stability Under Fiscal and Monetary Rules: An Analysis for Mexico

Ana María Aguilar and Claudia Ramírez
Banco de México

XI Emerging Markets Workshop

November 5, 2013

The opinions expressed in this article are solely those of the authors and do not necessarily refect the views of Banco de Mexico.

- Fiscal Policy in EMEs
  - Even though standard economic theory suggests that fiscal policy should be countercyclical, in practice some governments seemed to follow pro-cyclical policies [Talvi and Vegh (2005), Gavin and Perotti (1997), Stein et al. (1999), Lane (2003)].

- Fiscal Policy in EMEs
  - Even though standard economic theory suggests that fiscal policy should be countercyclical, in practice some governments seemed to follow pro-cyclical policies [Talvi and Vegh (2005), Gavin and Perotti (1997), Stein et al. (1999), Lane (2003)].
  - This has been observed in some EMEs, particularly for commodity-rich countries, like Mexico, where a large portion of government revenues still rely on commodity prices (some countries have implemented measures to tackle this problem).

- Fiscal Policy in EMEs
  - Even though standard economic theory suggests that fiscal policy should be countercyclical, in practice some governments seemed to follow pro-cyclical policies [Talvi and Vegh (2005), Gavin and Perotti (1997), Stein et al. (1999), Lane (2003)].
  - This has been observed in some EMEs, particularly for commodity-rich countries, like Mexico, where a large portion of government revenues still rely on commodity prices (some countries have implemented measures to tackle this problem).
    - When commodity prices are high, governments might have more revenues and spend more.

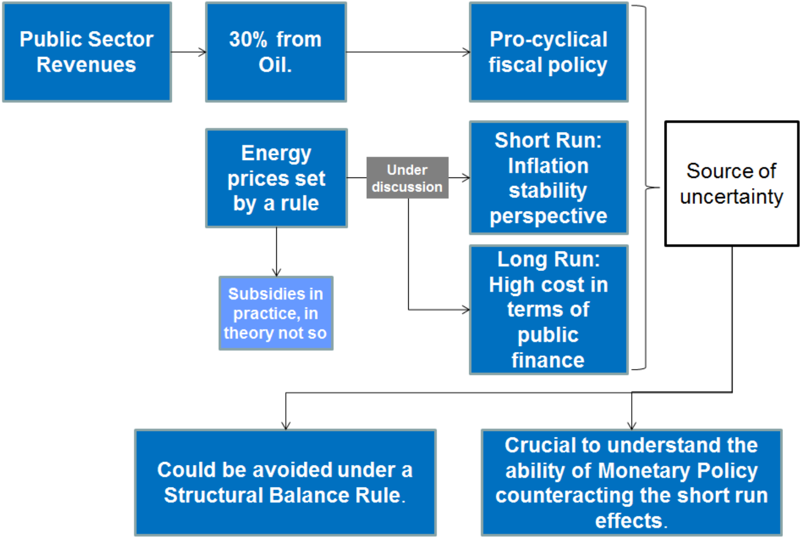
- Fiscal Policy in EMEs
  - Even though standard economic theory suggests that fiscal policy should be countercyclical, in practice some governments seemed to follow pro-cyclical policies [Talvi and Vegh (2005), Gavin and Perotti (1997), Stein et al. (1999), Lane (2003)].
  - This has been observed in some EMEs, particularly for commodity-rich countries, like Mexico, where a large portion of government revenues still rely on commodity prices (some countries have implemented measures to tackle this problem).
    - When commodity prices are high, governments might have more revenues and spend more.
    - Commodity prices are generally very volatile. Thus overall revenues become volatile as well.

- Fiscal Policy in EMEs
  - Even though standard economic theory suggests that fiscal policy should be countercyclical, in practice some governments seemed to follow pro-cyclical policies [Talvi and Vegh (2005), Gavin and Perotti (1997), Stein et al. (1999), Lane (2003)].
  - This has been observed in some EMEs, particularly for commodity-rich countries, like Mexico, where a large portion of government revenues still rely on commodity prices (some countries have implemented measures to tackle this problem).
    - When commodity prices are high, governments might have more revenues and spend more.
    - Commodity prices are generally very volatile. Thus overall revenues become volatile as well.
    - As a result: An important share of public expenditure is determined by a highly volatile source of revenues, such as oil prices in Mexico.

- Fiscal Policy in EMEs
  - Even though standard economic theory suggests that fiscal policy should be countercyclical, in practice some governments seemed to follow pro-cyclical policies [Talvi and Vegh (2005), Gavin and Perotti (1997), Stein et al. (1999), Lane (2003)].
  - This has been observed in some EMEs, particularly for commodity-rich countries, like Mexico, where a large portion of government revenues still rely on commodity prices (some countries have implemented measures to tackle this problem).
    - When commodity prices are high, governments might have more revenues and spend more.
    - Commodity prices are generally very volatile. Thus overall revenues become volatile as well.
    - As a result: An important share of public expenditure is determined by a highly volatile source of revenues, such as oil prices in Mexico.
    - This volatility is transmitted to other macroeconomic variables.

Introduction

Mexico:



Introduction

- What we do?
  - We develop a SOE semi structural macroeconomic model and estimate it for Mexico.
  - We incorporate the effect of oil prices on public finances.
  - With optimal monetary policy, we evaluate the impact of two different fiscal policy rules:
    1. Balanced budget rule.
    2. Structural-balance rule.

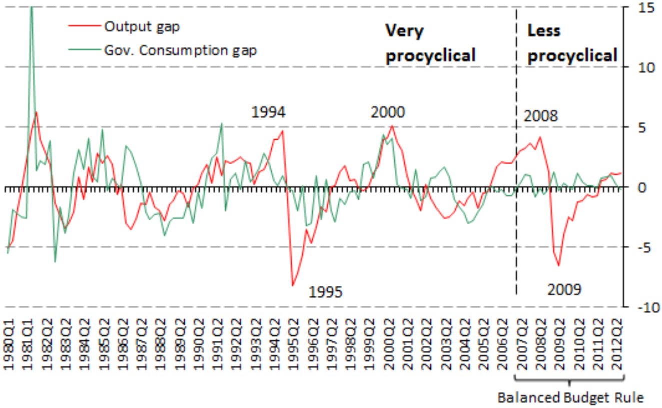
Introduction

- Main questions
  - How would different budget rules shape the way oil price shocks affect the Mexican economy?
  - How do different rules perform under a more flexible energy pricing rule?
    - In particular under a Balanced Budget Rules vs. a Structural-Balance Rule.
  - How does Monetary Policy react to different shocks under these rules?

- Results
  - Under consumption or inflation shocks, both rules generate practically the same effect.
  - When oil price shocks occur, higher macroeconomic stability is achieved and the monetary authority reacts less aggressively under the structural balance rule.

The Mexican Case

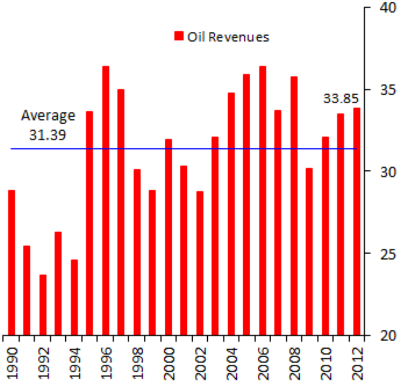
GDP and Government Consumption
Cycle Components
(%)



Source: INEGI.

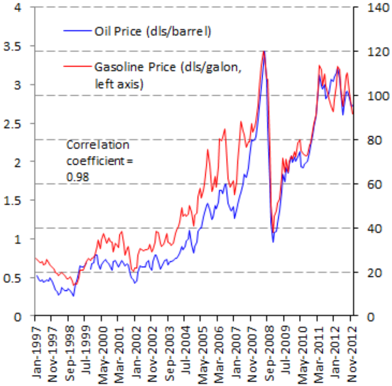
The Mexican Case

Oil Revenues
(% of total fiscal revenues)



Source: SHCP.

International Market Price
(In US dollars)



Source: Bloomberg and Energy Information Administration .

Model: An Overview

- We develop a standard semistructural small open economy neokeynesian model.
- Aggregate supply is modeled by a New Keynesian Phillips Curve.
- Aggregate demand is determined by its main components:
  - Private consumption: Only a fraction of consumers have access to financial markets. (Ricardian Equivalence is not necessarily fulfilled).
  - Investment and the Trade balance
  - Government spending
- The model incorporates an equation to describe the behavior for the real exchange rate which holds the *Uncovered Interest Rate Parity*
- Under optimal monetary policy rule, we have two different fiscal rules.
- This model considers oil exogenously since its price is determined in international markets.
- We estimate it for Mexican data from 2002Q1 to 2012Q3.

Model (Aggregate Demand)

- Consumption (with access to financial markets):

$$c_t^{FM} = \alpha_0 + \alpha_1 c_{t-1}^{FM} + \alpha_2 E_t[c_{t+1}^{FM}] + \alpha_3 (R_t - E_t[\Delta p_{t+1}]) + \upsilon_{c,t},$$

- Consumption (without access to financial markets):

$$c_t^{NFM} = (x_t - t_t^{tax}) + \upsilon_{c,t},$$

- Private Investment:

$$in_t = \vartheta_0 + \vartheta_1 in_{t-1} + \vartheta_2 E_t[in_{t+1}] + \vartheta_3 (R_t - E_t[\Delta p_{t+1}]) + \upsilon_{in,t},$$

- Exports:

$$ex_t = \delta_0 + \delta_1 ex_{t-1} + \delta_2 E_t[ex_{t+1}] + \delta_3 q_t + \delta_4 x_t^{US} + \upsilon_{ex,t},$$

- Imports:

$$im_t = \gamma_0 + \gamma_1 im_{t-1} + \gamma_2 E_t[im_{t+1}] + \gamma_3 q_t + \gamma_4 x + \upsilon_{im,t},$$

Model

- New Keynesian Phillips Curve

$$\pi_t^C = a_1 \pi_{t-1}^C + a_2 E_t[\pi_{t+1}^C] + a_3 x_t + \alpha_4(\Delta ner_t + \pi_t^{US}) + \upsilon_{\pi,t},$$

- Real Exchange Rate

$$rer_t = c_0 rer_{t-1} + c_1(E_t[rer_{t+1}] + (r_t^{US} - r_t)).$$

- Monetary Policy Rule: Minimize Loss Function

$$L = E_t \left\{ \sum_{j=0}^{\infty} \varphi^j [(\alpha_\pi(\pi_{t+j} - \pi^*)^2 + \alpha_x x_{t+j}^2 + \alpha_i(i_{t+j} - i_{t+j-1})^2] \right\}$$

Model: Fiscal Policy

Government spending: subject to fiscal rules that determine how fiscal policy responds to exogenous shocks.

1. Balanced Budget Rule:

$$BA_t = T_t - (R_{t-1} + \Psi(\exp(B_{t-1} - b) - 1))B_{t-1} - G_t,$$

2. Structural Balance Rule:

$$Bs_t = BA_t - \widetilde{T}_t = T_t - \widetilde{T}_t - G_t - (R_{t-1} + \Psi(\exp(B_{t-1} - b) - 1))B_{t-1}$$

where the cyclical component $\widetilde{T}_t$ is

$$\widetilde{T}_t = \varphi_1 \tau [Y_t - Y_{ref}] + (1 - \varphi_1)[P_t^{oil} - P_{ref}^{oil}]Y_t^{oil}$$

1. Introduction
2. The Mexican Case
3. Model
4. **Results**
5. Conclusions

Results

- We simulated stochastic shocks for 1000 periods allowing the optimal monetary policy rule for each case to adjust endogenously. We repeat this 3000 times obtaining the average standard deviations across repetitions.

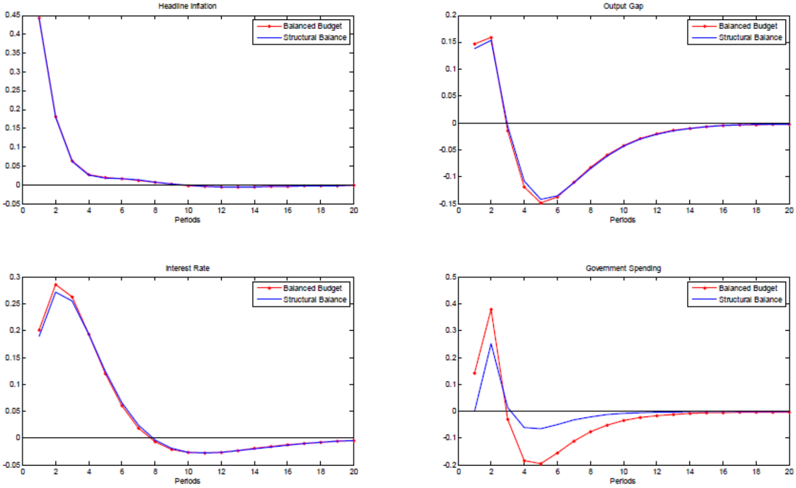
Table: Evaluation of Standard Deviations under Different Fiscal Rules

	Structural Balance Rule	Balanced Budget
Government Spending	$\boxed{3.99}$	$\boxed{16.31}$
Headline Inflation	1.65	1.69
Output Gap	14.48	15.47
Consumption	4.16	4.18
Nominal Interest Rate	5.18	5.31
Investment	19.16	19.34
Real Exchange Rate	1.72	1.75

Take-away: All macroeconomic variables have smaller variance under the Structural Balance-Rule

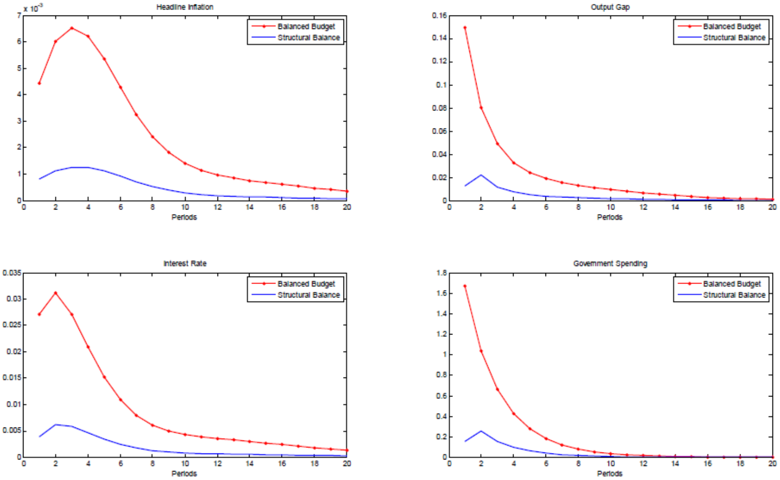
Results: Impulse Response

Non-Core Inflation Shock

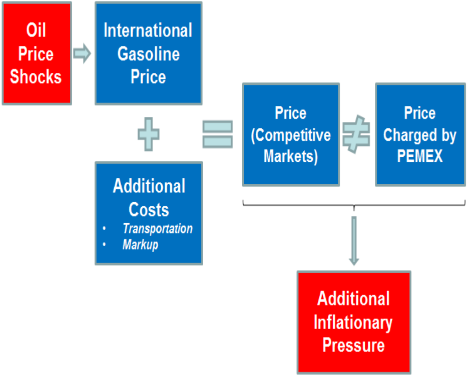


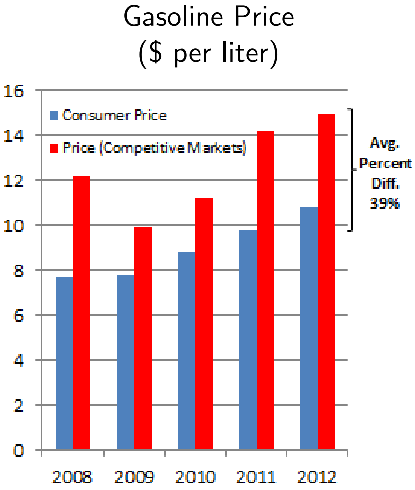
Results: Impulse Response

Oil Price Shock



Results: Inflation and Oil Prices

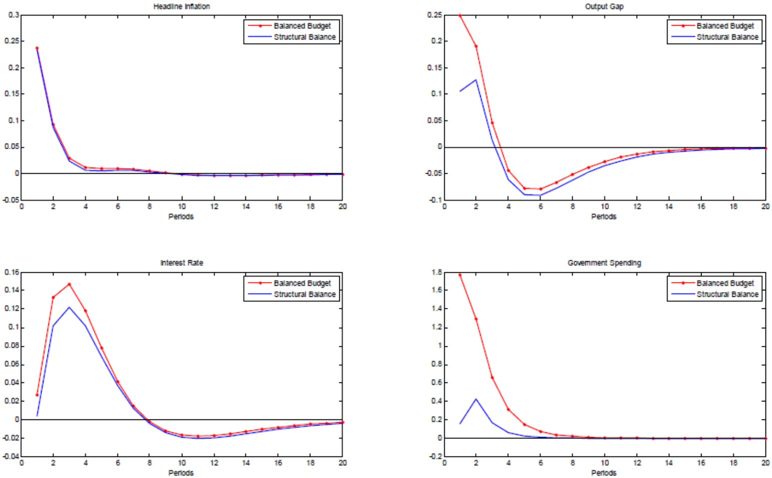




Source: Energy Information Administration and PEMEX.

Results: Inflation and Oil Prices

Oil Price and Non-Core Inflation Shock



Conclusions

- In this paper we develop a small open economy macroeconomic model, and estimate it for Mexico.
  - We incorporate the effect of oil prices on public finances.
  - Assuming monetary policy follows an optimal policy rule, we evaluate the impact of two different fiscal policy rules:
    1. Balanced budget rule.
    2. Structural-balance rule.
- We find that when the economy faces inflation or consumption shocks, both rules generate practically the same effect.
- However, when oil price shocks occur, the monetary authority reacts less aggressively and higher macroeconomic stability is achieved under the Structural-balance rule.
- These results are even more relevant with the recent proposals to flexibilize the energy pricing policy.

THANK YOU

Appendix

References

- Gavin, M. and R. Perotti (1997), "Fiscal Policy in Latin America." NBER Macroeconomics Annual.
- Lane, P., (2003), "The Cyclical Behavior of Fiscal Policy: Evidence from the OECD." Journal of Public Economics, Vol. 87, pp. 2661-2675.
- Stein, E. A. Grisanti, and E. Talvi (1999), "Institutional Arrangements and Fiscal Performance: The Latin American Experience." In Poterba and von Hagen 1999.
- Talvi, E. and C. A. Végh (2005), "Tax Base Variability and Procyclical Fiscal Policy in Developing Countries." Journal of Development Economics 78 (1): 156-190.

Appendix: Estimations

- New Phillips Curve
  $\pi_t^c = 0.520\pi_{t-1}^c + \underset{(0.066)}{0.475} E_t[\pi_{t+1}^s] + \underset{(0.004)}{0.009} x_t + \underset{(0.003)}{0.005}(\Delta e_t + \pi_t^*)$
  *Generalized Method of Moments. Instrument specification: π_{t-2}^c to π_{t-4}^c, x_t to x_{t-1}, Δe_t to Δe_{t-3} and π_t^* to π_{t-4}^*.
  Standard deviation in parenthesis. P-value of J is 0.964.

- Real Exchange Rate Equation
  $rert_t = \underset{(0.055)}{0.487} rert_{t-1} + 0.513\left[E_t[rert_{t+1}] + \frac{1}{400}(r_t^* - r_t)\right]$
  *Generalized Method of Moments. Instrument specification: rer_{t-1}, r_{t-1} and r_{t-3}^*
  Standard deviation in parenthesis. P-value of J is 0.412.

Appendix: Estimations

- Private Consumption
  $$c_t^{FM} = \underset{(0.127)}{0.272}\, c_{t-1}^{FM} + \underset{(0.128)}{0.811}\, E_t[c_{t+1}^{FM}] - \underset{(0.040)}{0.075}\, r_{t-1}$$
  *Generalized Method of Moments. Instrument specification: c_{t-1}^{FM} to c_{t-3}^{FM}, i_{t-3} to i_{t-4} and π_{t-1}^{e} to π_{t-2}^{e}.

  Standard deviation in parenthesis. P-value of J is 0.857.

- Investment
  $$in_t = \underset{(0.964)}{1.744} + \underset{(0.071)}{0.552}\, in_{t-1} + \underset{(0.078)}{0.473}\, E_t[in_{t+1}] - \underset{(0.259)}{0.453}\, r_{t-1} + \underset{(0.122)}{0.228}\, x^*$$
  *Generalized Method of Moments. Instrument specification: in_{t-1} to in_{t-4}, i_{t-3} to i_{t-4}, π_{t-1}^{e} to π_{t-3}^{e} and x_{t-2}^{*} to x_{t-4}^{*}
  Standard deviation in parenthesis. P-value of J is 0.722.

Appendix: Estimations

- Exports

  $$ex_t = \underset{(0.020)}{0.549}\, ex_{t-1} + \underset{(0.033)}{0.450}\, E_t[ex_{t+1}] + \underset{(0.025)}{0.113}\, rer_t + \underset{(0.024)}{0.077}\, x^*_{t-1}$$

  *Generalized Method of Moments. Instrument specification: ex_{t-1} to ex_{t-4}, rer_t *to* rer_{t-4}, x^*_{t-2} *to* x^*_{t-4}, $dlic_t$ to $dlic_{t-4}$.

  Standard deviation in parenthesis. P-value of J is 0.815.

- Imports

  $$im_t = \underset{(0.037)}{33.479} + \underset{(0.037)}{0.198}\, im_{t-1} + \underset{(0.033)}{0.207}\, E_t[im_{t+1}] - \underset{(2.705)}{7.481}\, q_t + \underset{(0.148)}{1.881}\, x_t$$

  *Generalized Method of Moments. Instrument specification: im_{t-4}, x_t to x_{t-4}, rer_t to rer_{t-3} and π^{imp}_{t-2} *to* π^{imp}_{t-4}.
  Standard deviation in parenthesis. P-value of J is 0.764.

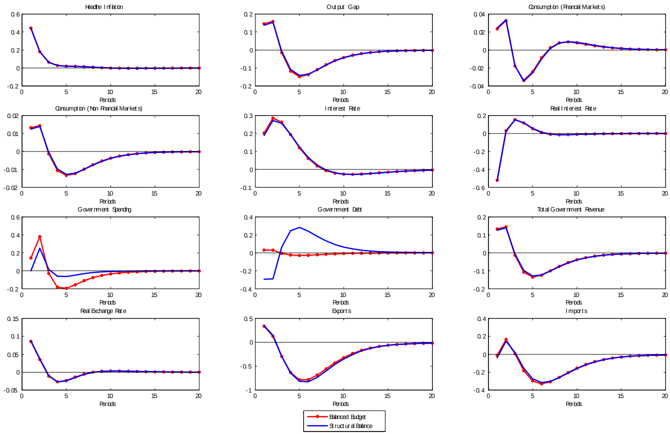
Appendix: Estimations

- Changes in Inventories
  $$inven_t = \underset{(0.138)}{0.286} inven_{t-1} + \mu_{ex_t}$$
  *Least Squares Method. R^2 0.082

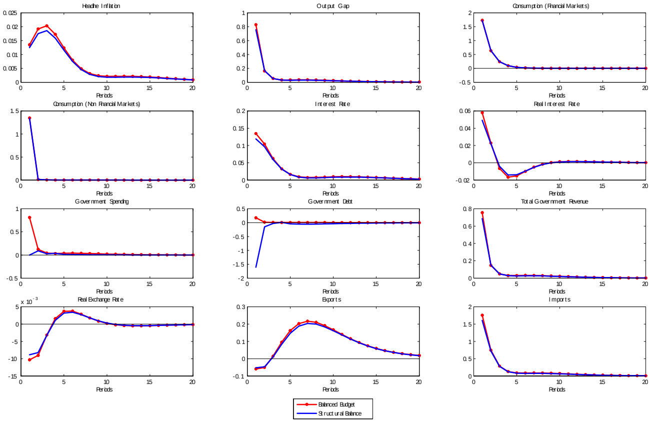
- Non-Core Inflation
  $$\pi_t^{NC} = \underset{(0.112)}{0.524} \pi_{t-1}^{NC} + \mu_{\pi_t^{NS}}$$
  *Least Squares Method. R^2 0-0.762.
- Oil Price Gap
  $$Poil_t = \underset{(0.156)}{0.643} Poil_{t-1} + \mu_{ppet_t}$$
  *Least Squares Method. R^2 0.428.

- Oil Production
  $$Yoil_t = \underset{(0.073)}{0.814} Yoil_{t-1} + \mu_{xpet_t}$$
  *Least Squares Method. R^2 0.66

Non-Core Inflation

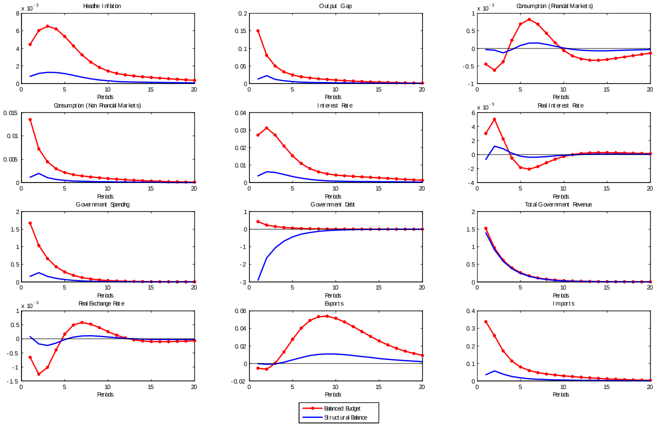


Consumption



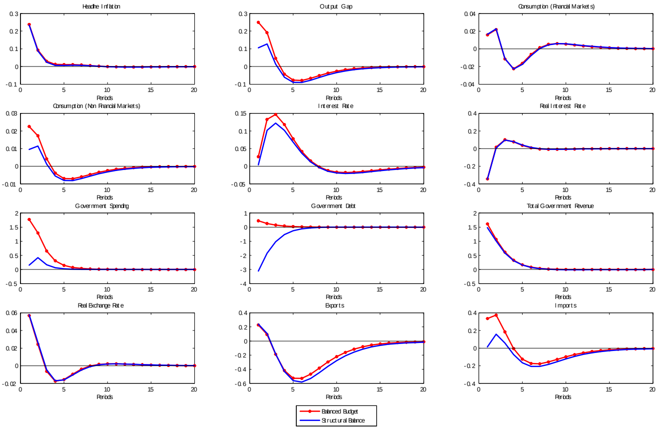
Appendix: Additional IRFS

Oil Price

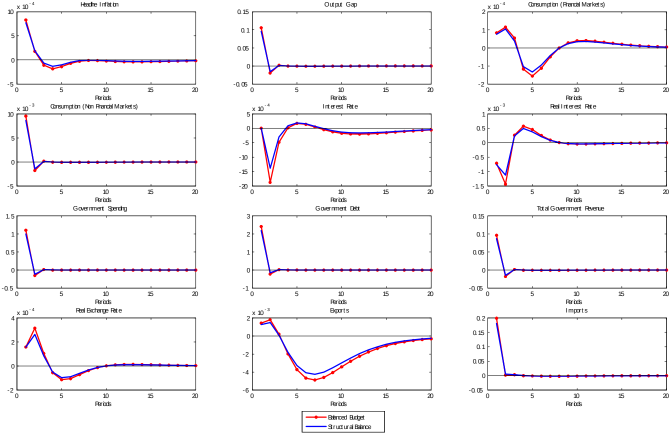


Appendix: Additional IRFS

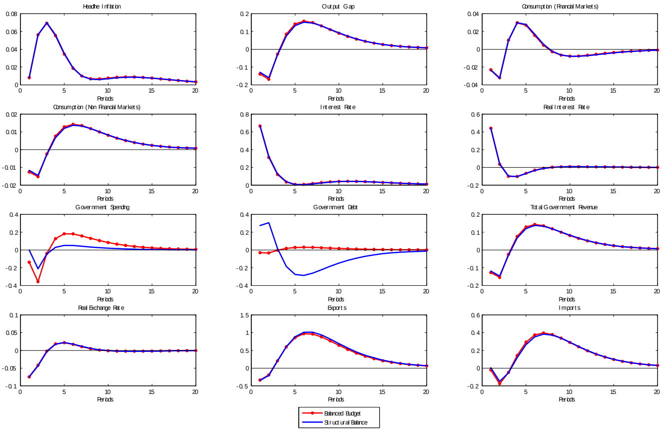
Oil Price and Inflation



Government Consumption



Real Interest Rate



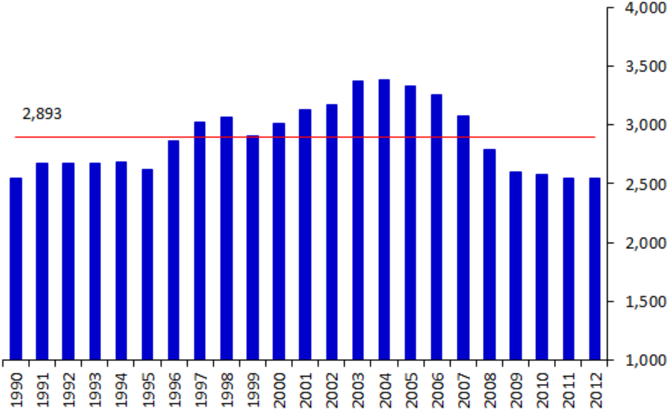
Source: .

Additional

- In practice, governments seem to follow pro-cyclical fiscal policies. Particularly for commodity-rich countries, government revenues are largely influenced by the volatility of commodity prices.
- This is the case of Mexico, where more than 30 percent of the public sector's revenues come from oil, and, energy prices are set by a rule determined by the government.
- Even though the energy pricing rule may be convenient from the inflation stability perspective in the short run, it could imply high costs in terms of public finances.
- This important source of uncertainty for inflation is an open issue and still a challenge from the monetary policy perspective.
- The actions undertaken in the recent past can lead to better results if the authority considers additional elements to isolate the effects of cyclical elements in macroeconomic decisions.

Additional

Mexican Crude Oil Production
(Barrels per day)



Source: .