Policy mix in a small open economy with commodity prices

Marine C. André[1], Alberto Armijo[1], Sebastián Medina[1] and Jamel Sandoval[1]

XXV Meeting of the Central Bank Researchers Network

[1]Banco de México, Dirección General de Investigación Económica
Disclaimer: The views and conclusions here presented are exclusively the responsibility of the authors and do not necessarily reflect those of Banco de México

October 30th, 2020

Presentation structure

Global introduction

- The Global Financial Crisis and lately, the economic crisis due to Covid-19 have generated large shocks in the economy.
- These large shocks may have severe effects on the economy if not correctly addressed by both fiscal and monetary institutions.
- We focus our interest on studying the policy-mix consequences for a small open emerging economy, such as Mexico.
- Emerging market economies (EMEs) are more sensitive to large shocks.
  - Financial markets that are less liquid, are more sensible to an increase in oil price (Chatziantoniou 2014).[1]

[1] Through hedging oil prices may smooth shocks in the short run, we focus on the medium term.

Global introduction

- The Global Financial Crisis and lately, the economic crisis due to Covid-19 have generated large shocks in the economy.
- These large shocks may have severe effects on the economy if not correctly addressed by both fiscal and monetary institutions.
- We focus our interest on studying the policy-mix consequences for a small open emerging economy, such as Mexico.
- Emerging market economies (EMEs) are more sensitive to large shocks.
    - Financial markets that are less liquid, are more sensible to an increase in oil price (Chatziantoniou 2014).[1]
    - The sensitivity of tax revenue to economic activity, due to the oil-prices volatility, is higher in EMEs exporting commodities (Corsetti et. al 2011).

[1] Through hedging oil prices may smooth shocks in the short run, we focus on the medium term.

- The Global Financial Crisis and lately, the economic crisis due to Covid-19 have generated large shocks in the economy.
- These large shocks may have severe effects on the economy if not correctly addressed by both fiscal and monetary institutions.
- We focus our interest on studying the policy-mix consequences for a small open emerging economy, such as Mexico.
- Emerging market economies (EMEs) are more sensitive to large shocks.
    - Financial markets that are less liquid, are more sensible to an increase in oil price (Chatziantoniou 2014).[1]
    - The sensitivity of tax revenue to economic activity, due to the oil-prices volatility, is higher in EMEs exporting commodities (Corsetti et. al 2011).
    - Large fiscal imbalances may affect exchange rates through a risk premium channel (Giorgianni 1997).

[1] Through hedging oil prices may smooth shocks in the short run, we focus on the medium term.

- Two possible combination of policies (Leeper 1991, 2016):
  1. active monetary policy and passive fiscal policy;
  2. passive monetary policy and active fiscal policy.
- Default is extremely likely to happen if these mix of policies are active (Leeper 1991, 2016, Uribe 2006, Bi 2012).

Introduction: EMEs, Shocks and Policy

- Two possible combination of policies (Leeper 1991, 2016):
  1. active monetary policy and passive fiscal policy;
  2. passive monetary policy and active fiscal policy.
- Default is extremely likely to happen if these mix of policies are active (Leeper 1991, 2016, Uribe 2006, Bi 2012).
- Hence, there ought to be an even deeper need of studying interaction between fiscal and monetary policy in emerging economies (Aktas et al. 2010).

Introduction: Policy interaction

- This article analyzes the **interaction between monetary policy and fiscal policy for a small open economy that relies on exporting commodities**.
  - We model how changes in the benchmark interest rate impact fiscal variables, as well as how monetary policy reacts to changes in the fiscal stance.
  - The main channel through which these policies interact is the risk premium, which is endogenously determined.
- We study the different transmission channels for many shocks: public spending, risk premium, oil prices, domestic currency depreciation, interest rate.

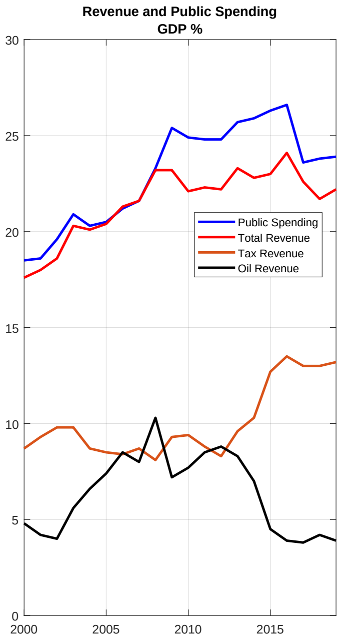
Introduction: Main policy lessons

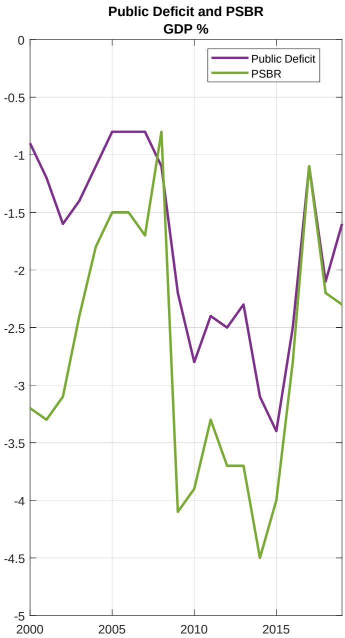
- Including a fiscal block to a standard monetary semi-structural model implies changes in how the monetary authority reacts to different kind of shocks, particularly to an oil price shock.
- Monetary policy reacts countercyclically to most fiscal related shocks, including an oil-price or exchange rate shock, whereas it reacts procyclically in presence of a risk premium shock.
  - Oil price shock: changes in public revenues have a stronger effect on economic activity than either, the exchange rate and risk premium mechanisms.
  - Risk premium shock: Inflationary pressures from currency depreciation are stronger than the effects of the implied decrease in the economic activity.

Important facts: Mexico at a glance

- We use a semi-structural model calibrated for Mexico using data from 2001 to 2017.
  - Total exports of Mexican economy represented almost 40% of GDP in 2019, of which 17 % are commodities.
  - Government owns the main firm allowed to exploit oil (PEMEX). From 1990 to 2019, oil revenues represented around 6% GDP and 28% of government revenue.
- After the Great Financial Crisis and Covid-19 related shocks. . .
  - Public revenues and debt linked to oil industry have been negatively affected, due to the sharp fall in oil prices.
  - The downgrade of PEMEX's debt rating, thus increasing the country risk premium.

Public finance in Mexico





The model: 3 Blocks

The model consists of three blocks

- An exogenous external sector models the US economy and international oil prices as VAR processes.
- A fiscal policy block models the fiscal deficit that depends on:
  - Economic activity.
  - State-owned oil company whose debt and revenue enters in public accounts.
  - The dynamics of public debt, both domestic and foreign components.
  - A fiscal rule is assumed whereby the deficit, as a percentage of GDP, has an upper bound.
- A monetary policy block:
  - A Taylor rule, including an inflation target, disciplines the response of the central bank to both the fiscal block and exogenous shocks.

The model: Fiscal Block - Revenue

Built upon the public finances framework in Mexico.

- Public sector revenue (τ_t) is composed of: tax revenue (τ_t^{tax}), oil revenue (τ_t^{oil}), government agencies and business' revenues (τ_t^{ab}), and other type of revenue (τ_t^{others}).
- Tax revenue depends on economic activity (x_t). Oil revenues depend on WTI price in US dollars (wti_t), the real exchange rate (s_t), and the oil production platform (x_t^{oil}).

$$\tau_t^{tax} = \upsilon_1 x_t + \varepsilon_t^{tax} \tag{1}$$

$$\tau_t^{oil} = \lambda_1 wti_t + \lambda_2 x_t^{oil} + \lambda_3 s_t + \varepsilon_t^{oil} \tag{2}$$

with υ_1 the average share of income collected by the government. Parameters in (2) capture the structure through which PEMEX contributes to public revenue.[2] ε_t^{tax}, and ε_t^{oil} are exogenous shocks.

[2] Mexico has been a net oil-importer since 2014. For instance in 2019, it reached a deficit of 21 000 millions of dollars in oil.

The model: Fiscal Block - Debt

- The government debt b_t is divided into a domestic, b_t^d, and a foreign, b_t^f, components. It evolves according to the public sector budget constraint.

$$b_t = b_t^d + b_t^f; \quad \text{where:} \tag{3}$$

$$b_t = \kappa_1 b_{t-1}^d + \mu_1 b_{t-1}^f + \mu_2 s_t + (\mu_3 + \kappa_2)\, psbr_t + \varepsilon_t^{B^d} + \varepsilon_t^{B^f} \tag{4}$$

μ_2 is the sensitivity of the foreign debt to real exchange rate, μ_3 and κ_2 the proportion that each debt finance the actual deficit ($psbr_t$), being measured by the Public Sector Borrowing Requirements (PSBR).

[3] The PSBR target is set at 2.5% of GDP in 2019 for example, 2.6 % in 2020.

The model: Fiscal Block - Debt

- The government debt b_t is divided into a domestic, b_t^d, and a foreign, b_t^f, components. It evolves according to the public sector budget constraint.

$$b_t = b_t^d + b_t^f; \quad \text{where:} \tag{3}$$

$$b_t = \kappa_1 b_{t-1}^d + \mu_1 b_{t-1}^f + \mu_2 s_t + (\mu_3 + \kappa_2)\, psbr_t + \varepsilon_t^{B^d} + \varepsilon_t^{B^f} \tag{4}$$

μ_2 is the sensitivity of the foreign debt to real exchange rate, μ_3 and κ_2 the proportion that each debt finance the actual deficit ($psbr_t$), being measured by the Public Sector Borrowing Requirements (PSBR).

- PSBR is the widest measure of the public deficit:[3]

$$psbr_t = d_t + FC_t + \varepsilon_t^{PSBR} \tag{5}$$

by considering the primary deficit (d_t), the public debt service (FC_t), including a exogenous shock ε_t^{PSBR}.

[3] The PSBR target is set at 2.5% of GDP in 2019 for example, 2.6 % in 2020.

- The fiscal rule works through primary public spending g_t.

$$g_t = \psi_1 g_{t-1} - (1-\psi_1)\,\psi_2 psbr_t + \varepsilon_t^g \tag{6}$$

(6) aims to stabilize the PSBR at its equilibrium level. The government gradually stabilizes its accounts since it seeks to smooth changes in spending, as alternatives are costly (e.g. fiscal reform requires a change in the regulations).

The model: Fiscal Block - Policy Rule

- The fiscal rule works through primary public spending g_t.

$$g_t = \psi_1 g_{t-1} - (1 - \psi_1)\, \psi_2 psbr_t + \varepsilon_t^g \tag{6}$$

(6) aims to stabilize the PSBR at its equilibrium level. The government gradually stabilizes its accounts since it seeks to smooth changes in spending, as alternatives are costly (e.g. fiscal reform requires a change in the regulations).

- The country risk premium Υ_t is influenced by fiscal and monetary blocks.

$$\Upsilon_t = \xi_1 \Upsilon_{t-1} + \xi_2 \mathbb{E}_t\left(\Upsilon_{t+1}\right) + \xi_3 psbr_t + \varepsilon_t^{\Upsilon}. \tag{7}$$

We use EMBI-G index for Υ_t that is the Emerging Market Bond Index Global elaborated by JP Morgan. It includes PEMEX debt.

The monetary block follows a DSGE-VAR structure (DelNegro and Schorfheide 2006).

- The IS equation is given by:

$$\begin{aligned} x_t = &\alpha_1 x_{t-1} + \alpha_2 \mathbb{E}_t(x_{t+1}) - \alpha_3 r_t + \alpha_4 s_t + \alpha_5 g_t^p - \alpha_6 \tau_t \\ &- \alpha_7 \Upsilon_t + \alpha_8 x_t^{US} + \varepsilon_t^x \end{aligned} \tag{8}$$

The monetary block follows a DSGE-VAR structure (DelNegro and Schorfheide 2006).

- The IS equation is given by:

$$\begin{aligned} x_t = & \alpha_1 x_{t-1} + \alpha_2 \mathbb{E}_t(x_{t+1}) - \alpha_3 r_t + \alpha_4 s_t + \alpha_5 g_t^p - \alpha_6 \tau_t \\ & - \alpha_7 \Upsilon_t + \alpha_8 x_t^{US} + \varepsilon_t^x \end{aligned} \tag{8}$$

- The Phillips Curve with backward and forward looking components is:

$$\pi_t = \beta_1 \pi_{t-1} + (1 - \beta_1) \mathbb{E}_t (\pi_{t+1}) + \beta_2 x_t + \beta_3 s_t + \varepsilon_t^\pi \tag{9}$$

where ε_t^x and ε_t^π are exogenous shocks.

- The real exchange rate evolution is conditioned upon an UIP condition:

$$s_t = (1-\gamma_1)\, s_{t-1} + \gamma_1 \mathbb{E}_t\left(s_{t+1}\right) - \gamma_2 r_t + \gamma_3 r_t^{US} + \gamma_4 \Upsilon_t + \varepsilon_t^s \quad (10)$$

- The real exchange rate evolution is conditioned upon an UIP condition:

$$s_t = (1-\gamma_1)\, s_{t-1} + \gamma_1 \mathbb{E}_t \left(s_{t+1}\right) - \gamma_2 r_t + \gamma_3 r_t^{US} + \gamma_4 \Upsilon_t + \varepsilon_t^s \quad (10)$$

- The central bank sets the nominal policy interest rate, i_t, through a Taylor Rule:

$$i_t = \rho_\pi i_{t-1} + \delta_1 \pi_t^g + \delta_2 x_t + \varepsilon_t^i \quad (11)$$

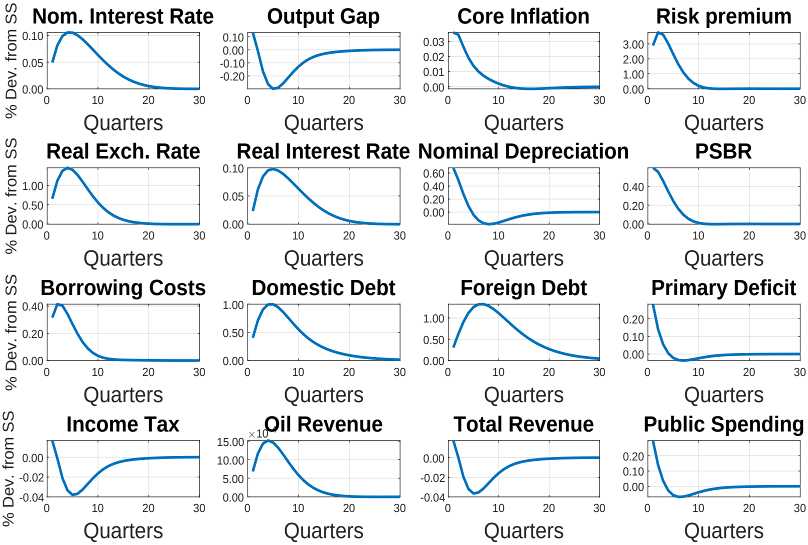
where the rule has a forward-looking component of inflation, given that the monetary policy is conducted with a time lag. The inflation gap, π_t^g, is defined by the expected inflation gap and the current level of inflation:

$$\pi_t^g = \rho_{\pi^g} \mathbb{E}_t \left(\pi_{t+1}^g\right) + \pi_t \quad (12)$$

The inflation gap depends on the difference between current inflation and the central bank objective.

- In order to capture the model mechanisms, we analyze impulse response functions. Therefore, we choose to study separately the effects of higher public spending, a decrease in oil price and an increase in risk-premium shock.
- For the monetary block, we examine the effects of domestic currency depreciation, and an increase in the policy interest rate.

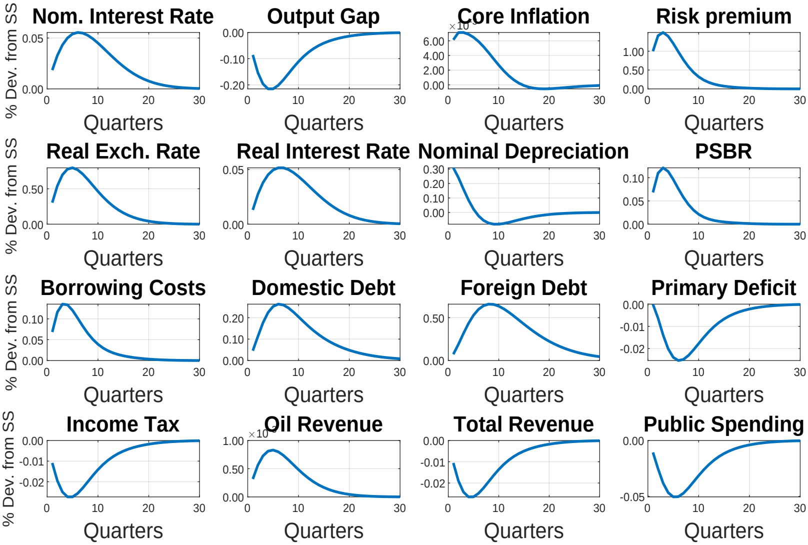
Model mechanisms: Positive Public Spending shock



Model mechanisms: Positive Public Spending Shock

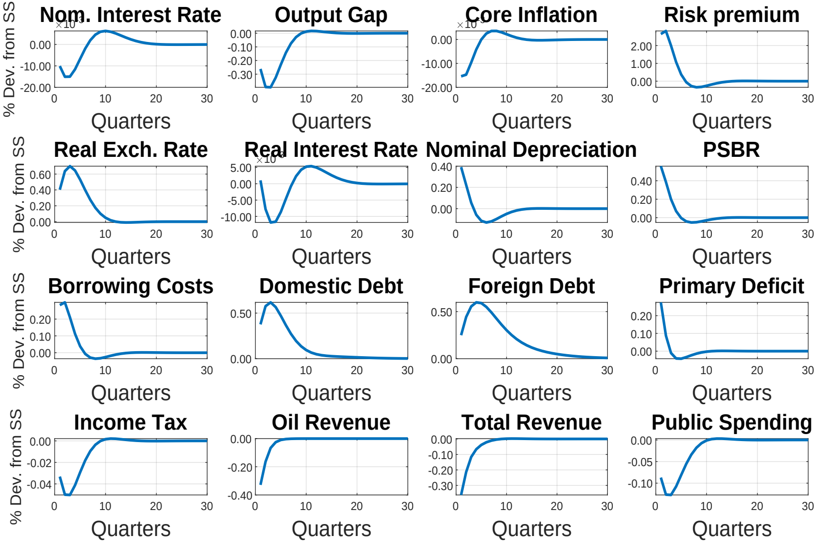
- Inflationary pressures are driven by the depreciation and the increase in the output gap.
  - Increases demand at the cost of worsening both the primary deficit and the PSBR.
  - Increases country risk premium and the nominal exchange rate depreciates.
- Monetary authority increases short-term nominal interest rate to anchor inflation expectations and stabilize output gap.

Model mechanisms: Positive Country Risk Premium Shock



- Traduced into a negative demand shock and an exchange rate depreciation.
- To achieve fiscal target, public spending should decrease so that primary surplus could be reached.
- The central bank increases short-term nominal interest rate to anchor inflation expectations.

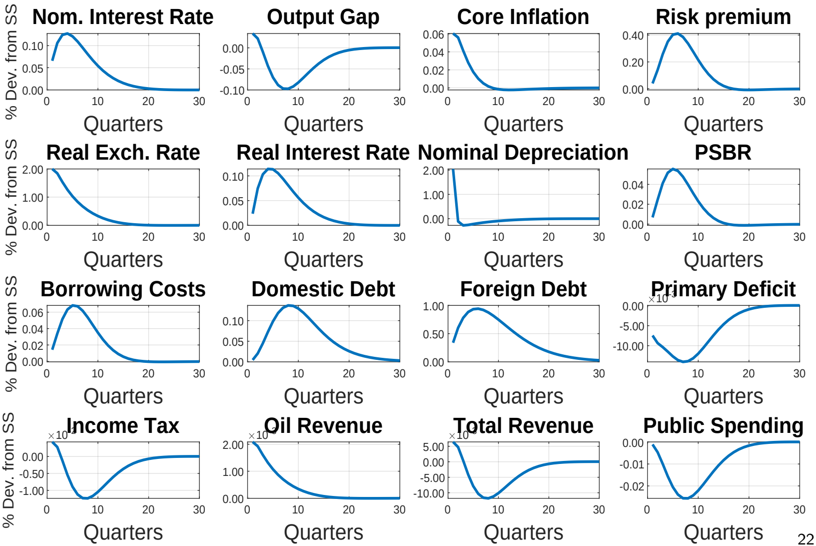
Model mechanisms: Negative Oil Price Shock



Model mechanisms: Negative Oil Price Shock

- Decreases public sector revenues and therefore increases the risk premium, and depreciates the exchange rate.
- Fiscal policy should be restrictive, reducing economic activity.
- Inflation decreases, given the dominating effect of lower public revenues, compared to the inflationary effect of the currency depreciation.
- Central bank reacts reducing short-term nominal interest rate.

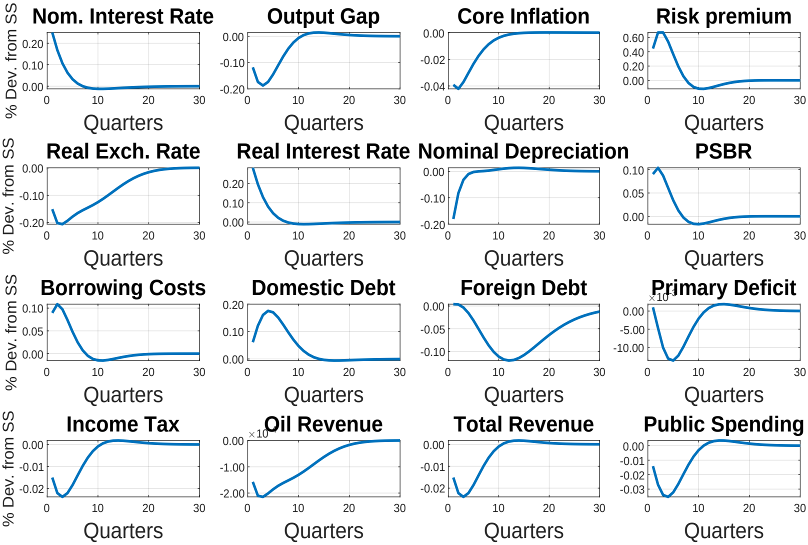
Model mechanisms: Domestic Currency Depreciation Shock



Model mechanisms: Domestic Currency Depreciation Shock

- Stimulates aggregate demand due to an increase in net exports (price competitiveness).
- Monetary policy tightens to accommodate the shock.
- The latter increases PSBR. Therefore, government spending decreases to achieve the fiscal target.

Model mechanisms: Positive Monetary Policy Shock



Model mechanisms: Positive Monetary Policy Shock

- Through the UIP condition, domestic currency appreciates.
- Monetary conditions tightening reduces output gap and inflationary pressures.
- The latter reduces tax collection and increases borrowing costs which worsen public deficit, augmenting risk premium.
- Fiscal authority decreases public spending inducing a reduction in the deficit to accommodate this shock.

Note that monetary policy shocks affect fiscal policy stance and vice-versa, suggesting there is a cost in setting a fiscal policy while considering its impact on monetary policy and conversely.

Main takeaways

- Monetary policy counter-cyclically reacts to oil-price and exchange rate shocks, while for a country risk premium shock, monetary policy reacts pro-cyclically.
- For an oil-price shock, variations in public revenues moves positively with economic activity, being the strongest transmission channel in our model for determining inflation.
- After a country risk-premium shock, inflationary pressures due to the currency depreciation dominate the deflationary consequences from the lower economic activity.

Possible extensions

- A plausible extension would be to generate forecasts of the variables in levels.

- Another extension would be estimating the model via Bayesian techniques with data from 2003 to 2019, as well as a historical shock decomposition analysis.