# THE INTERDEPENDENCE OF FISCAL AND MONETARY POLICY

## THE CASE OF GUATEMALA

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# CONTENIDO

- Introduction
- Background
- Objective
- The degree of fiscal dominance and central bank independence
- Fiscal deficits and inflation
- Conclusion

# INTRODUCTION

- Guatemala's prudent fiscal policy has led to one of the lowest fiscal deficit and public debt as percentage of GDP in the Latin American region during the last two decades. Also, the monetary policy framework has been strengthened by legal ammendments (constitutional ban on finance the government spending by the Central Bank from 1994) and by the implementation of an inflation targeting regime.

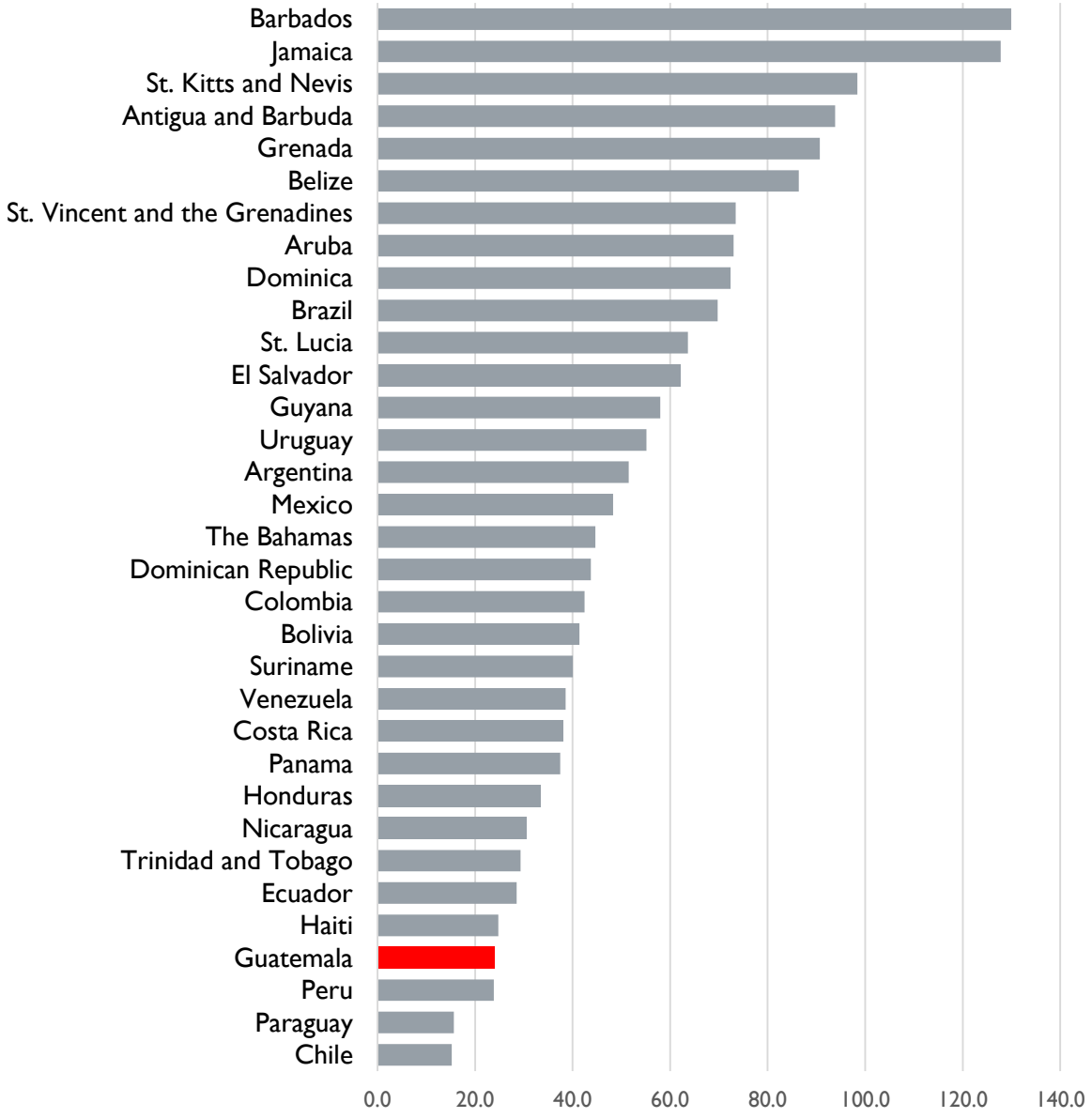
- The literature has extensevely explored the role of high and persistent fiscal deficit and/or public debt as driving factors of inflation but also the recognition of the lack of clarity of such relationship when inflation is low has been aknowledged. Therefore, empirical work on the relationship between monetary and fiscal policies in economies with diferent levels of inflation and institutional settings, as of de Rosende (2007) and empirical work on the long run relationship between inflation and fiscal deficit, as in Catao and Terrones (2003), intend to shed light when the relationship is not obvious.

- This document follows those empirical works to approach the monetary-fiscal policy relationship in Guatemala. Although the debt and deficit indicators in the country are in tolerable levels, the quantitative assesment becomes crucial for policy making.

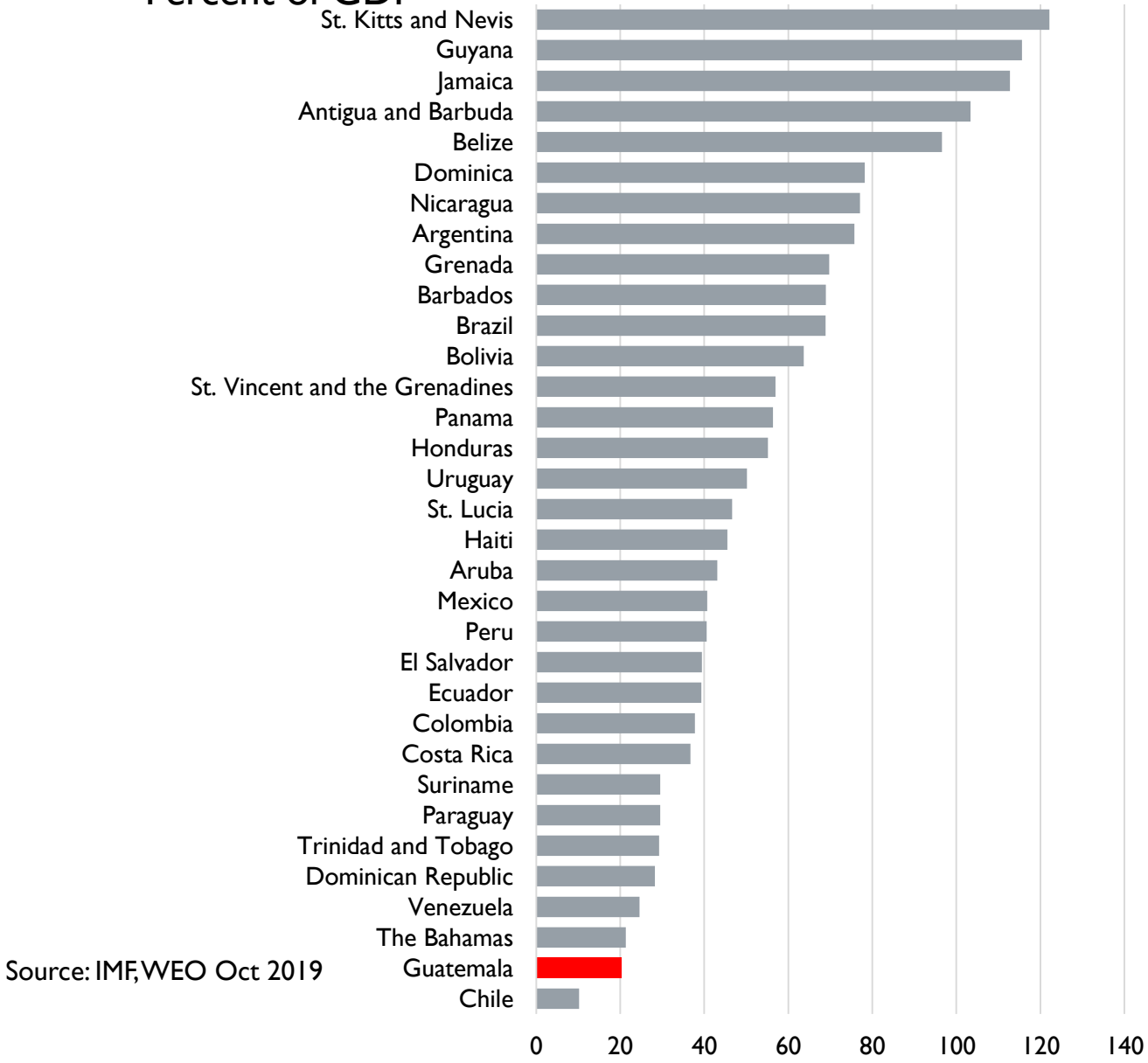
# BACKGROUND

## PUBLIC DEBT, FISCAL DÉFICIT AND INFLATION

## Gross debt of General Government. Average 1998 – 2008
Percent of GDP

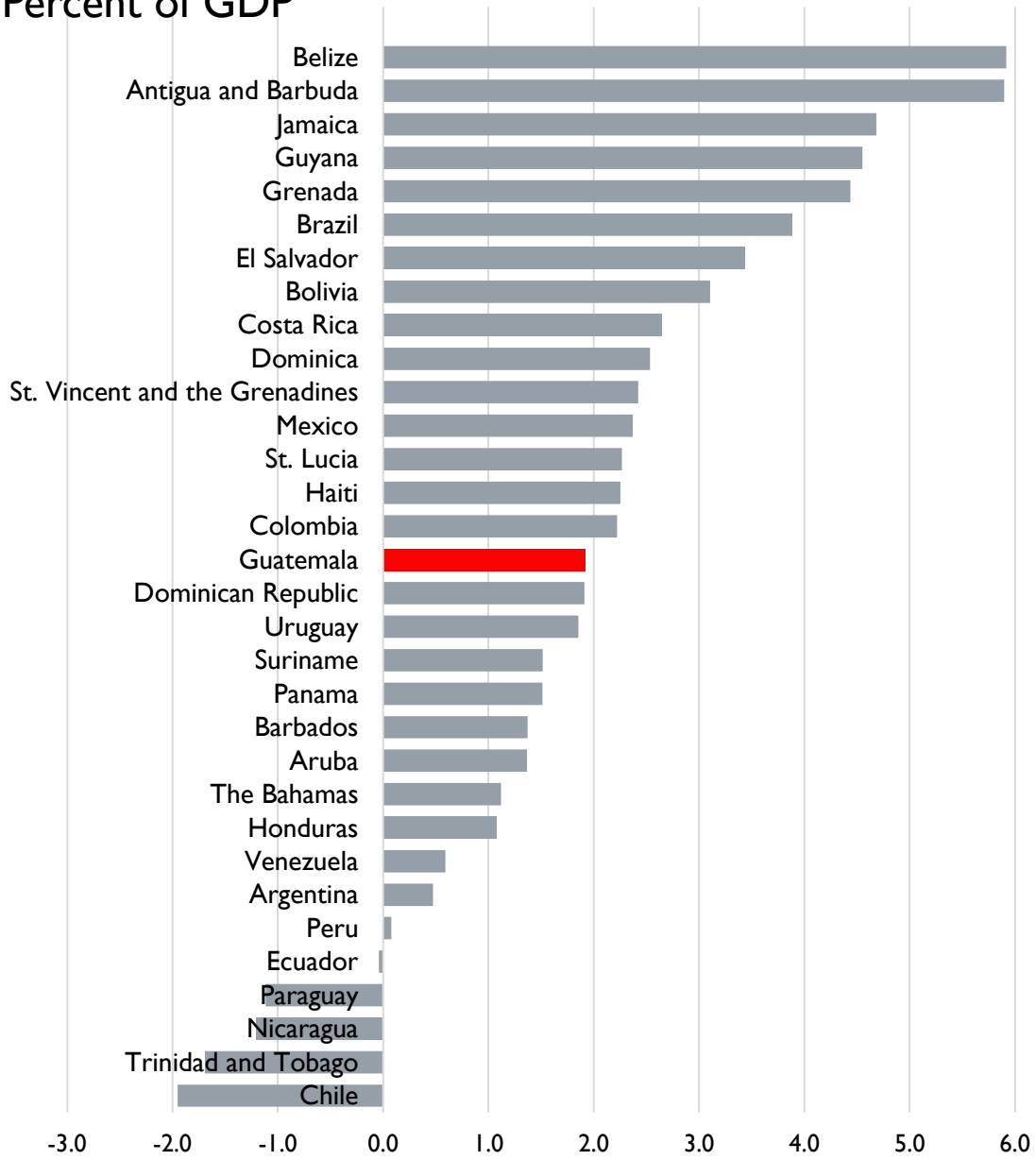



## Gross debt of General Government. Average 2008 – 2018
Percent of GDP

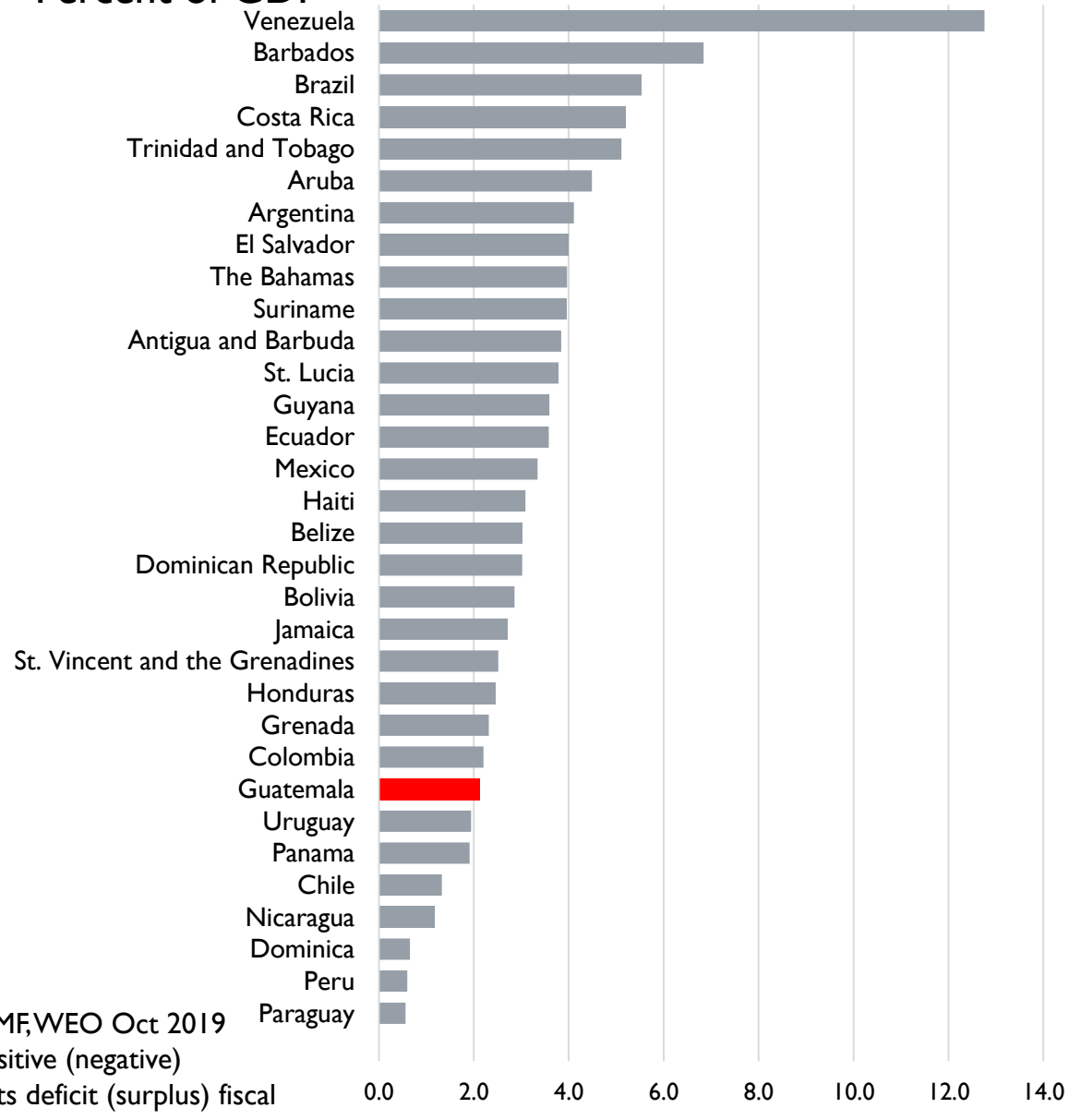



Source: IMF, WEO Oct 2019

## Fiscal déficit of General Government. Average 1998 – 2008
Percent of GDP

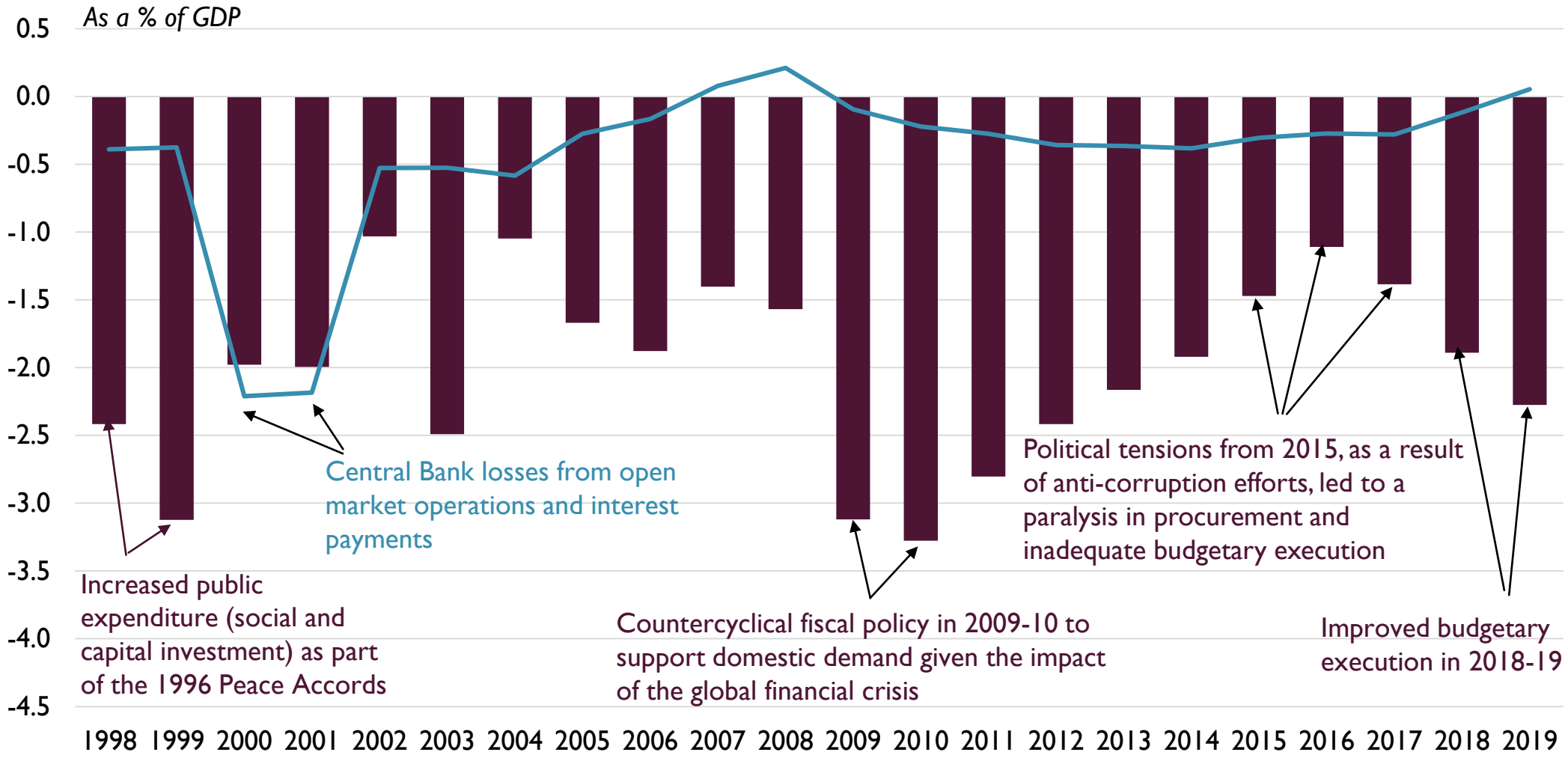



## Fiscal déficit of General Government. Average 2008 – 2018
Percent of GDP



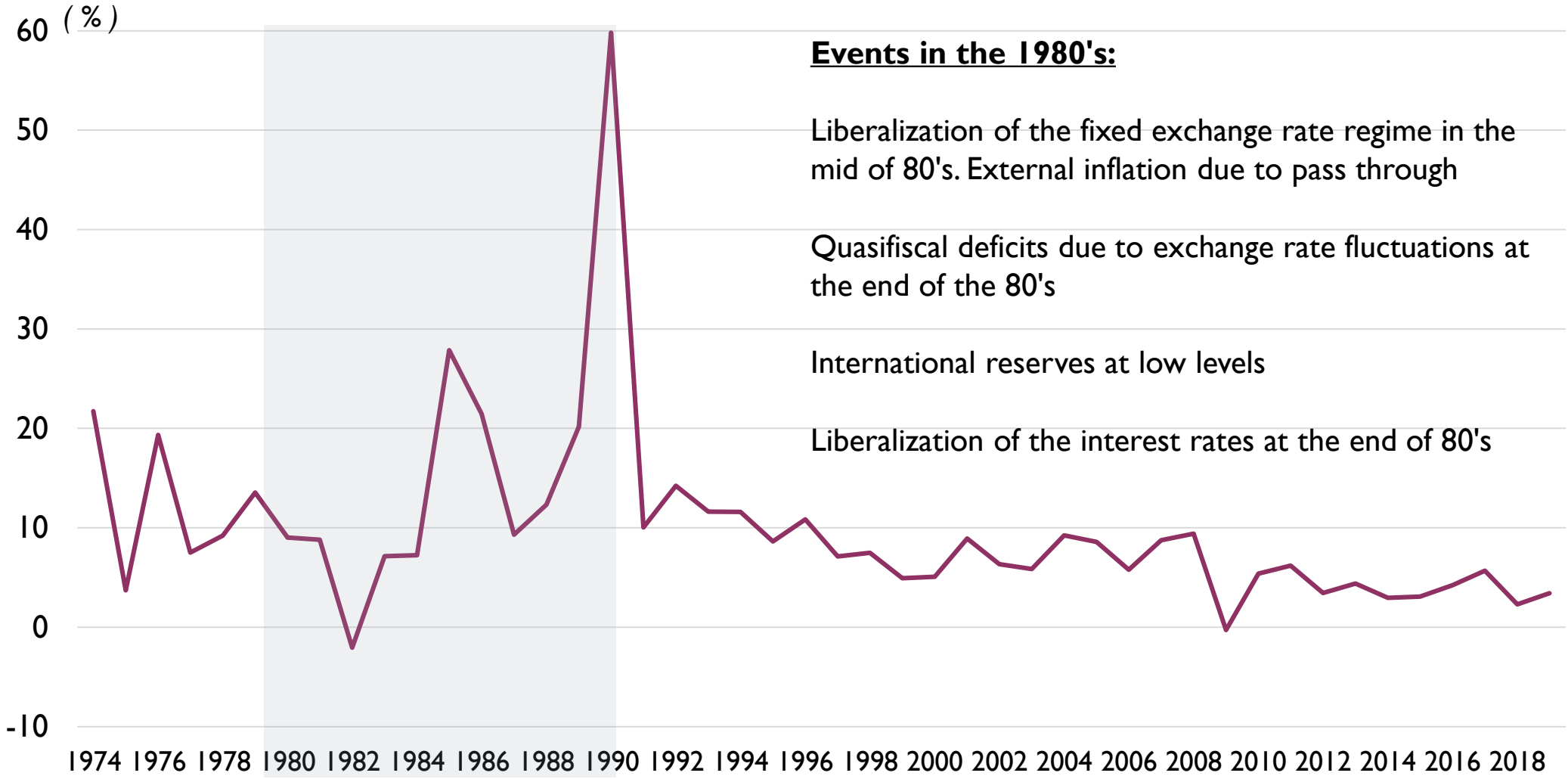

Source: IMF, WEO Oct 2019
Note: Positive (negative) represents deficit (surplus) fiscal

# Guatemala: Fiscal and quasi-fiscal déficits
# 1998 - 2019




Source: Banco de Guatemala

# Guatemala: Inflation
# 1974 - 2019




**Events in the 1980's:**

Liberalization of the fixed exchange rate regime in the mid of 80's. External inflation due to pass through

Quasifiscal deficits due to exchange rate fluctuations at the end of the 80's

International reserves at low levels

Liberalization of the interest rates at the end of 80's

Source: Banco de Guatemala

# OBJECTIVE

- Although Guatemala has proved to have a prudent fiscal policy in terms of debt and deficit, this research intends to quantify how fiscal policy is affecting monetary policy and whether the dynamics of debt and fiscal deficit contribute  to determine the inflation rate in Guatemala.

- First, the degree of fiscal dominance and central bank independece is analyzed following de Resende (2007) and his empirical work using an Dynamic Ordinary Least Squares (DOLS).

- Once the big picture is drawn, the Autorregresive Distributed Lag (ARDL) techniche is used to analyze the fiscal deficit and inflation relationship, following the work in Catao and Terrones (2003).

# DEGREE OF FISCAL DOMINANCE AND CENTRAL BANK INDEPENDENCE

# METHODOLOGY

- De Rosende (2007)'s work on the interdependence between fiscal and monetary policies:
  - **Private sector.** In each period, consumers choose consumption ($c_t$), labor ($n_t$), and next-period holdings of capital ($k_t$), money ($m_t$) and nominal one-period government debt ($b_t$).

$$u\left(c_t, {}^{m_t}/_{p_t}, 1 - n_t\right)$$

$$\text{s.t.} \qquad c_t + \frac{m_t}{p_t} + \frac{b_t}{p_t} + k_t = w_t n_t + r_t k_{t-1} + \frac{m_{t-1}}{\pi_t p_{t-1}} + i_{t-1}\frac{b_{t-1}}{\pi_t p_{t-1}} - \tau_t$$

Where $\tau_t$ is a lump-sum tax, $\pi_t = p_t/p_{t-1}$ is the gross inflation rate, $i_{t-1}$ is the gross nominal interest rate on government debt which is set in period $t_{-1}$ and paid in period t, $w_t$ is the wage rate, and $r_t$ is the gross return on capital between periods t-1 and t.

  - **Government.** In every period, the government spends an exogenous amount of resources Gt. Government expenditures may be financed by levying lump-sum taxes ($\tau_t$), by issuing money ($M_t$), and y increasing public debt ($B_t$).

$$G_t + (i_{t-1} - 1)\frac{B_{T-1}}{p_t} = \tau_t + \frac{(M_t - M_{t-1})}{p_t} + \frac{(B_t - B_{t-1})}{p_t}$$

# METHODOLOGY

- **Equilibrium.** After optimization, de Rosende (2007) obtaines the equiation that describes the aggregate price level as a function of consumption and of the stocks of money and debt:

$$p_t = \frac{(1-\beta)[M_t + (1-\delta)B_{t]}}{\gamma c_t}$$

- For the econometric strategy, de Rosende (2007) rewrites the previous equation to obtain estimates of **δ, the parameter that measures the degree of interdependence between fiscal and monetary policies**

$$M_t = \frac{\gamma}{(1-\beta)} C_t - (1-\delta)B_t \qquad \text{where } C_t \equiv p_t c_t$$

- Thus, for the empirical work:

$$\boldsymbol{M_t = \alpha_0 + \alpha_1 C_t + \alpha_2 B_t + e_t}$$

- δ would be identified from the coefficient on the stock of debt: $\alpha_2 = -(1-\delta)$
- Two extreme cases: $\delta = 1$ it means no fiscal dominance (or equivalentely, there is central bank independence); $\delta = 0$ it means there is fiscal dominance (or equivalentely, no central bank independence).

# MODEL SPECIFICATION

- The dynamic ordinary least squares (DOLS) method allows the estimation of the cointegrating vector (Mt, Bt and Ct).

$$\boldsymbol{M_t = \alpha_0 + \alpha_1 C_t + \alpha_2 B_t + \sum_{s=-p}^{q} \varphi_{1,s} \Delta C_{t-s} + \sum_{s=-p}^{q} \varphi_{2,s} \Delta B_{t-s} + e_t}$$

- Where $M_t$=Monetary base (M1) $C_t$=Household consumption expenditure; $B_t$=General government gross debt; $\alpha_0$= intercept; $\alpha_j$ for j=1,2 are constant coefficients; $e_t$=disturbance term; $\varphi_{j,s}$ for j=1,2 and $s = -p, -p + 1, \dots, q - 1, q$ are constant coefficients.

# DATA

| Variable | Sample | Description | Source |
|---|---|---|---|
| Monetary base | 1980-2019 | Annual, nominal in quetzales, per-capita data | Banco de Guatemala |
| Household consumption expenditure | 1980-2019 | Annual, nominal in quetzales, per-capita data | Banco de Guatemala and International Financial Statistics |
| General government gross debt (internal + external) | 1980-2019 | Annual, nominal in quetzales, per-capita data | Ministry of Finance and Banco de Guatemala |
| Population | 1980-2019 | Estimates of total population as of 1 of July of the year indicated. In millions | United Nations, World Population Prospects, 2019 |

# RESULTS

- **Stationarity.** Mt, Ct and Bt are non stationary variables, acording to ADF unit root test (Ho: The variable has a unit root)

| Variable | lags | t-stat | p-value |
|---|---|---|---|
| Ct | 0 | -2.58 | 0.2912 |
| Mt | 0 | 2.73 | 1.0000 |
| Bt | 0 | 0.17 | 0.9969 |

*Notes:*

*(1) ADF test equations include a constant and a linear trend*

*(2) Lag length based on AIC criterion*

- **Cointegration.** Mt, Ct, and Bt are cointegrated according to the Engle-Granger cointegrations test (Ho: Series are not cointegrated).

| Lag length selection criteria | lags | t-stat | p-value |
|---|---|---|---|
| AIC | 5 | -4.58 | 0.0144 |
| SIC | 5 | -4.58 | 0.0144 |
| MAIC | 0 | -1.17 | 0.9497 |

# RESULTS

**DOLS Estimation of Structural Parameters**

| Lag and lead method | $\alpha_1$ | $\alpha_2$ | $\delta$ | |
|---|---|---|---|---|
| | | | point estimate | 95% conf. Interval |
| Fixed (lead=4 and lag=4) | | | | |
| estimate | 0.091 | 0.146 | 1.146 | [ 1.052 , 1.240 ] |
| t-statistic | 6.128 | 3.139 | | |
| p-value | 0.000 | 0.011 | | |
| AIC (lead=3 and lag=4) | | | | |
| estimate | 0.079 | 0.228 | 1.228 | [ 1.091 , 1.366 ] |
| t-statistic | 3.572 | 3.358 | | |
| p-value | 0.003 | 0.005 | | |
| SIC (lead=3 and lag=0) | | | | |
| estimate | 0.097 | 0.126 | 1.126 | [ 1.027 , 1.225 ] |
| t-statistic | 6.086 | 2.565 | | |
| p-value | 0.000 | 0.017 | | |
| HQC (lead=3 and lag=4) | | | | |
| estimate | 0.079 | 0.228 | 1.228 | [ 1.091 , 1.366 ] |
| t-statistic | 3.572 | 3.358 | | |
| p-value | 0.003 | 0.005 | | |

# FISCAL DEFICIT AND INFLATION

# METHODOLOGY

- Catao and Terrones (2003)'s work on the relationship between fiscal deficit and inflation:
- **Household.** The representative household maximizes $\sum_{t=0}^{\infty} \beta' u(c_t, l_t)$ s.t. $c_t + \frac{b_{t+1}^p}{R_t^*} + \frac{m_{t+1}}{p_t} = y_t - \tau_t + b_t^p + \frac{m_t}{p_t}$
- **Government.** The government budget constraint $\frac{b_{t+1}^g}{R_t^*} = \tau_t + b_t^g - g_t + \frac{M_{t+1} - M_t}{p_t}$
- **Equilibrium.** After optimization, Catao and Terrones (2003) obtain the equation that describes the long run relationship between the rate of inflation as a proportion to the ratio of gross-of-interest government deficit to the average stock of narrow money during the period:

$$\frac{\pi}{1+\pi} = \frac{p[g - \tau + b^g \frac{(R-1)}{R}]}{M}$$

- Thus, for the empirial work

$$\boldsymbol{\pi = \psi \frac{(G - T)}{M}}$$

Where $(G - T)$ is the nominal budget deficit and $\psi$ is the semi-elasticity parameter to be estimated.

# METHODOLOGY

- An auto-regressive distributed lag (ARDL) structure is used where dependent and independent variables enter the right-hand side with lags of order p and q, respectevely:

$$\pi_t = \mu_t + \sum_{j=1}^{p} \lambda_j \, \pi_{t-j} + \sum_{l=0}^{q} \delta'_{i,l} x_{i,t-l} + \varepsilon_{i,t}$$

Where $\pi_t$ stands for the observed inflation; $\mu_t$ represents fixed effects; and $x_{i,t}$ is a (kx1) vector of explanatory variables which includes $\psi$, the coefficient on $\frac{(G-T)}{M}$; $\lambda_j$ are scalars and $\delta_{i,l}$ are(kx1) coefficient vectors.

- The previous equation can be re-parameterized and written in terms of a linear combination of variables in levels and first diferences

$$\Delta \boldsymbol{\pi_t} = \boldsymbol{\mu_t} + \boldsymbol{\phi_t}\left[\boldsymbol{\pi_{t-1}} - \boldsymbol{\theta'_i x_{i,t}}\right] + \sum_{\boldsymbol{j=1}}^{\boldsymbol{p-1}} \boldsymbol{\lambda_j^*} \Delta \boldsymbol{\pi_{t-j}} + \sum_{\boldsymbol{l=0}}^{\boldsymbol{q-1}} \boldsymbol{\delta_{i,l}^{*\prime}} \Delta \boldsymbol{x_{i,t-l}^*} + \boldsymbol{\varepsilon_t}$$

Where $\theta$ defines the long-run equilibrium relationship between the variables involved and $\phi$ the speed with which inflation adjust toward its long-run equilibrium following a given change in $x_{i,t}$.

# DATA

| Variable | Sample | Description | Source |
|---|---|---|---|
| Domestic inflation | 1990Q1 - 2020Q1 | Quarterly, y-o-y variation of the CPI, the last month of the quarter | National Institute of Statistics (INE) and Banco de Guatemala |
| Government deficit | 1990Q1 - 2020Q1 | Quarterly, nominal in quetzales, sum of the three months of the quarter | Ministry of Finance and Banco de Guatemala |
| M1 | 1990Q1 - 2020Q1 | Quarterly, nominal in quetzales, average of the three months of the quarter | Banco de Guatemala |
| Oil price | 1990Q1 - 2020Q1 | Quarterly, West Texas Intermediate, spot price FOB, dollars per barrel, average of the three months of the quarter | US Energy Information Administration |
| Foreign exchange rate | 1991Q2 - 2020Q1 | Quarterly, Quetzales per US Dollar, buy and sell weight rate average, average of the quarter | Banco de Guatemala |
| US inflation | 1990Q1 - 2020Q1 | Quarterly, y-o-y variation of the US CPI, the last month of the quarter | US Bureau of Labor Statistics |

# RESULTS

- **Model selection method**. Starting with a max number of lags of the dependent variable (p) and the independent variable (q) = 8. AIC, SIC, HQ, ARS criteria used in the selection. It was chosen AIC with p=3 and q=0 (given the bounds test and error correction term that will be explained below).

$$infl = c + infl_{-1} + infl_{-2} + infl_{-3} + \frac{def}{m1} + oil + fx + infl^{us}$$

where

- $infl =$ inflation
- $\frac{def}{m1} =$ fiscal deficit as a ratio of M1
- $oil =$ oil price
- $fx =$ foreign exchange rate
- $infl^{us} =$ US inflation

# RESULTS

- **Checking long-run relationship.** Using the F-bounds test. If F-stat < I(0) cannot reject the Ho; if F-stat > I(1) reject the Ho; if I(0)<F-stat<I(1) indetermined.

**F-Bounds test**

Ho: No long-run relationship

| F-Statistic | Significance | I(0) | I(1) |
|---|---|---|---|
| 9.001253 | 10% | 2.2 | 3.09 |
| | 5% | 2.56 | 3.49 |
| | 1% | 3.29 | 4.37 |

There is a long-run (cointegrating) relationship between the variables.

- **Estimation of the coefficients of the long-run equilibrium and the error correction form.**

$$d(infl) = d(infl_{-1}) + d(infl_{-2}) + ect_{-1}$$

Where ect = error correction term

- The long-run coefficient of def/M1(12.6) is higher than the found by Catao and Terrones (2003) for the average of developing countries (1.40).However, the def/M1coefficient is not statistically significant.

- The long-run coefficient of the US inflation is statistically significant and with the expected sign. However, the long run coefficient of oil and fx is not statistically significant or does not have the expected sign.

- The error correction term (ect) is statistically significant and has the correct sign: it means that a deviation from the long-run equilibrium in inflaton is corrected by 35%. This is below the 53% average for developing countries found by Catao and Terrones (2003).

## ARDL model estimations

| Variable | ARDL (3,0,0,0,0) | Long-run coefficients | Error Correction Model |
|---|---|---|---|
| $infl_{-1}$ | 0.590558***<br>[0.091773] | | |
| $infl_{-2}$ | 0.219403**<br>[0.106956] | | |
| $infl_{-3}$ | -0.161128*<br>[0.084244] | | |
| def/m1 | 4.424252<br>[4.715252] | 12.59871<br>[13.52716] | |
| oil | -0.004948<br>[0.005607] | -0.014091<br>[0.015755] | |
| fx | -0.453001*<br>[0.258484] | -1.289987**<br>[0.639234] | |
| $infl^{us}$ | 0.773281***<br>[0.131661] | 2.202032***<br>[0.462329] | |
| constant | 4.213713**<br>[2.100438] | 11.99917**<br>[4.783204] | |
| $d(infl_{-1})$ | | | -0.058275<br>[0.078045] |
| $d(infl(_{-2})$ | | | 0.161128**<br>[0.077472] |
| ect | | | -0.351167***<br>[0.046633] |

## Robustness: Long-run equilibrium relationship

| | Model: | AIC(3,0,0,0,0) | SIC (4,0,3,0) | ARS (5,3,4) | SIC (1,0,0) | AIC (3,0,0,0) | AIC (4,2,0,1,1) | SIC (1,0,0,0,0) | SIC (1,0,1,0,4) | AIC (1,0,1,0,4) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sample: | 1993Q2-2020Q1 | 1993Q2-2020Q1 | 1992Q2-2020Q1 | 1992Q2-2020Q1 | 1992Q2-2020Q1 | 2005Q1-2020Q1 | 1993Q3-2020Q1 | 1991-2019 | 1992-2019 |
| a | def/m1 | 12.59871 | 0.419573 | 0.660795 | 21.65629 | 23.52916 | 86.12897*** | 44.04442** | 9.297641* | 10.11303 |
| b | oil | -0.014091 | -0.025522 | -0.049478** | | -0.035689** | 0.002207 | | -0.023229* | |
| c | fx | -1.289987** | -1.69356** | | | | 5.553974** | | -0.534138 | |
| d | influs | 2.202032*** | | | 3.091987*** | 2.870686*** | 1.775862*** | 2.797935*** | 2.744838*** | 4.678007*** |
| e | oilv | | | | | | | -0.011623 | | -0.059926* |
| f | fxv | | | | | | | 0.18046* | | 0.027007 |

*Note: The numbers in parenthesis for the models mean ($p, q_a, q_b, q_c, q_d, q_e, q_f$): p número of lags of dependent variable, q number of lags of independent variable a,b,c,d,e or f. oilv = y-o-y variation of oil price; fxv = y-o-y variation of foreign exchange rate*

- The variable "influs" was consistently significant with the expected sign in diferente samples and frecuencies.
- The variable "deficit/M1" was statistically significant in few samples only altough with a high coefficient.
- The rest of variables were not allways consistently significant neither did they have the expected sign

# CONCLUSION

- Given that $\delta > 1$, the econometric technique suggests that there is no fiscal dominance (or equivalentely, there is monetary independency) in Guatemala. This means, that the fiscal authority backs fully all outstanding debt. Since increases in current or future taxes are limited, the more feasible way is the reduction in current or future expenditures.
- The punctual value of $\delta$ goes from 1.16 to 1.23 (depending on the lag and lead selection criteria) , similar to those of some advanced economies found by de Rosende (2007). The 95% confidence interval confirm that the lower bound is not less than 1.
- The ARDL econometric techniche does not provide strong evidence of a long-run relationship between inflation and the fiscal deficit. Similarly, the oil price and exchange rate relationship changes depending on the sample. Conversely, the US inflation was statistically significant and with the expected sign throughout all the samples and model especifications.
- The lack of a statistical significance in the long-run relationship between the fiscal deficit and inflation can be explained by the central bank independence in the sense that the debt plays only a minor role in the determination of the price level.

# REFERENCES


- Catao, Luis and Marco E. Terrones. 2003. Fiscal Déficits and Inflation. IMF Working Paper WP/03/65. Research Department. April

- De Resende, Carlos. 2007. Cross-Country Estimates of the Degree of Fiscal Dominance and Central Bank Independence. Bank of Canada Working Paper 2007-36. International Department. June.

# THANKS FOR YOUR ATTENTION!