The Interaction of Monetary and Fiscal Policy: Evidence from Belize

Authors: Candice Soutar and Rumile Arana

18 June 2020
Overview

- Motivation & Background
- Literature Review
- Methodology & Data
- Preliminary Results
Section 1: Motivation & Background
The Central Bank Act (rev. 2011) enshrined monetary policy activities as one of the Bank’s primary objectives.

It lists the goal of monetary policy is to:

- Foster monetary stability, especially stability of the exchange rate
- Promote credit and exchange conditions conducive to the growth of the economy of Belize

Monetary policy targets commercial banks’ liquidity through the Bank’s management of the monetary base (reserve balances).

Adjustments through the manipulation of reserve requirements are expected to affect credit growth, money supply, international reserves and GDP.

There have been fifteen monetary policy changes made between 1990 and 2010, with the following results in the pertinent variables:

- Loan growth (60%), statutory liquidity (60%), and cash liquidity (86%), gross reserves (47%) and GDP growth (25%).

<table>
<thead>
<tr>
<th>Date</th>
<th>Policy Variable Change:</th>
<th>Expected change in:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statutory Liquidity</td>
<td>Cash Liquidity</td>
</tr>
<tr>
<td>1991Q3</td>
<td>28 to 25</td>
<td>7 to 6</td>
</tr>
<tr>
<td>1992Q4</td>
<td>25 to 27</td>
<td>6 to 7</td>
</tr>
<tr>
<td>1993Q4</td>
<td>27 to 28</td>
<td>n.a.</td>
</tr>
<tr>
<td>1995Q1</td>
<td>28 to 24</td>
<td>7 to 5</td>
</tr>
<tr>
<td>1995Q4</td>
<td>24 to 26</td>
<td>5 to 7</td>
</tr>
<tr>
<td>1998Q4</td>
<td>26 to 24</td>
<td>7 to 5</td>
</tr>
<tr>
<td>2000Q2</td>
<td>n.a.</td>
<td>5 to 3</td>
</tr>
<tr>
<td>2001Q1</td>
<td>n.a.</td>
<td>3 to 4</td>
</tr>
<tr>
<td>2002Q4</td>
<td>n.a.</td>
<td>4 to 6</td>
</tr>
<tr>
<td>2004Q2</td>
<td>24 to 19</td>
<td>n.a.</td>
</tr>
<tr>
<td>2004Q4</td>
<td>19 to 20</td>
<td>6 to 7</td>
</tr>
<tr>
<td>2005Q2</td>
<td>20 to 21</td>
<td>7 to 8</td>
</tr>
<tr>
<td>2006Q1</td>
<td>21 to 22</td>
<td>8 to 9</td>
</tr>
<tr>
<td>2006Q3</td>
<td>22 to 23</td>
<td>9 to 10</td>
</tr>
<tr>
<td>2010Q2</td>
<td>n.a.</td>
<td>10 to 8.5</td>
</tr>
</tbody>
</table>

Monetary Policy Changes & Impact on Observed Variables (1990 – 2010)
Of note in these instances of expansionary monetary policy:

- Loan growth and that of gross foreign reserves respond according to expectations.
- Fiscal activities after the expansionary change in monetary policy counter the policy measures.
- GDP growth follows the fiscal path.
- When contractionary policies are undertaken, the aforementioned variables respond in an opposite manner.

Growth In variables Before and After Expansionary Monetary Policy (1990 - 2010)

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP Growth</td>
<td>4.8%</td>
<td>-1.2%</td>
</tr>
<tr>
<td>Loan Growth</td>
<td>2.7%</td>
<td>6.0%</td>
</tr>
<tr>
<td>Gross Reserves</td>
<td>3.7%</td>
<td>-9.3%</td>
</tr>
<tr>
<td>Current Expenditure</td>
<td>4.5%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Capital Expenditure</td>
<td>-15.0%</td>
<td>-5.6%</td>
</tr>
</tbody>
</table>
Historical Review... Fiscal Policy

- Belize has struggled with maintaining strong fiscal positions since its independence given the following:
  - Belize's low and declining trend output growth (Halving of average growth between 2000 and 2019),
  - The country's near-maxed tax capacity (Roberts et al, 2018)
  - Fairly large public sector with its corresponding outlay costs.
- The fiscal deficit has averaged 3.7% of GDP over the past five years.

![Belize's Overall Fiscal Balance to GDP vs GDP Growth (1990 – 2019)](chart.png)
Recurring fiscal deficits have led to an increased accumulation of debt.

Initially the growth in public liabilities was through the external market however in the past five years the domestic market has become more significant.

Given the need for public sector outlays recent Fiscal adjustment has mainly come through three external debt restructurings (2006, 2013, 2017).

At 2019-end, total public sector debt remained stubbornly high at 99.7% of GDP.
Why is this Important…

- The fiscal authorities have been more “dominant” than the Central Bank in the Belizean economy given:
  - Legal provisions enshrined in the Central Bank of Belize Act that has opened a window for quasi-fiscal activities and potential government influence
  - The size and required expenditure to sustain the activities of the public sector
  - The impact of fiscal activities outweigh monetary policy in its impact on economic growth (Soutar, 2019; Arana, 2019)
- The activities of the fiscal authority is a very important issue in an economy with increasing public sector liabilities and persistent fiscal imbalances
- Fiscal dominance in the Belizean economy has been acknowledged, but has never been empirically assessed for the country
Section II: Literature Review
Sargent and Wallace (1981) describe monetary-fiscal standoff as a coordination game between fiscal and monetary authorities. If the central bank moves first, they can impose discipline on the fiscal authority (Monetary Dominant) and if the fiscal authority makes the first move the opposite is true and the economy can be deemed fiscally dominant.

Aiyagari and Gertler (1985) put forward a two-period overlapping generations model to explain how fiscal and monetary interdependence ultimately affects the ability of monetary policy to control inflation. In a Ricardian regime, government sets taxes to fully back debt; and in a non-Ricardian a portion of that debt has to be backed by the monetary authorities’ inflationary-prompting money creation.

Leeper (1991) describes this non-Ricardian situation as one where an active fiscal policy exists while a passive monetary policy occurs concurrently.
## Selected Studies and Results

<table>
<thead>
<tr>
<th>Author</th>
<th>Market Studied</th>
<th>Time Period</th>
<th>Methodology &amp; Main Variables</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlos De Resende (2007)</td>
<td>OECD (18) &amp; Developing Nations (20)</td>
<td>(A) 1950 - 2004</td>
<td>Panel Dynamic Ordinary Least Squares (OLS) on money supply, household consumption and debt</td>
<td>Fiscal Dominance is more common in Developing Countries than in the OECD Nations. Debt plays a minor role in price determination</td>
</tr>
<tr>
<td>Henning Bohn (1998)</td>
<td>United States</td>
<td>(A) 1916 - 1995</td>
<td>OLS on primary budget surplus, temporary budget spending, business cycle indicator and debt</td>
<td>US Primary surplus reacts positively to debt-GDP ratio showing that the fiscal authorities are satisfying the intertemporal budget constraint</td>
</tr>
<tr>
<td>Luis Catao and Marco Terrones (2003)</td>
<td>107 Countries</td>
<td>(A) 1960 - 2001</td>
<td>ARDL pooled mean group estimator on inflation, money supply, overall budget balance, openness and oil prices</td>
<td>Fiscal deficits are positively associated with inflation in high-inflation and developing country with a weaker results among advanced economies</td>
</tr>
<tr>
<td>Edda Zoli (2005)</td>
<td>Emerging Markets (8)</td>
<td>(Q) and (M) 1990 - 2005</td>
<td>VAR between primary balance to GDP ratio and debt to GDP; OLS on nominal interest rate, inflation, output gap, primary balance noinal exchange rate ; Event studies</td>
<td>Mixed results for fiscal dominance hypothesis using VAR methodology. No sign of fiscal policy impacting the monetary policy reaction function. In the event studies, it has been shown that fiscal policy has an impact on sovereign spreads and exchange rates</td>
</tr>
<tr>
<td>Antonio Afonso, Jose Alves and Raquel Balhote (2019)</td>
<td>European Union (28)</td>
<td>(A) 1970 -2015</td>
<td>Panel OLS fixed Effects, Two staged least squares estimation on current account primary balance, debt, output gap, interest rate, inflation, monet supply and real effective exchange rate</td>
<td>Primary balance increase when debt levels increase; monetary authorities assume a larger role in economic stabilization in periods of higher debt accumulation</td>
</tr>
</tbody>
</table>
Section III: Methodology & Data
Main variables utilized in assessing the relationship between monetary and fiscal policy (degree of fiscal dominance) include:

- Primary Balance to GDP
- Debt to GDP Ratio
- Remainder of the data were used for monetary & fiscal policy reaction function and in identifying the impact of fiscal policy on the macroeconomy
- A quarterly time series was employed from 1986Q1 to 2019Q4
- Variables underwent a logarithmic transformation or in the case of primary balance (negative values) were normalized to GDP

<table>
<thead>
<tr>
<th>Variables</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserve Cash Ratio</td>
<td>Required cash reserves as a percentage of deposit liabilities</td>
<td>Central Bank of Belize</td>
</tr>
<tr>
<td>Debt to GDP Ratio</td>
<td>Outstanding Debt Stock as a percentage of Nominal GDP</td>
<td>Ministry of Finance &amp; Statistical Institute of Belize</td>
</tr>
<tr>
<td>Primary Balance to GDP Ratio</td>
<td>Central Government Primary Balance as a percentage of Nominal GDP</td>
<td>Ministry of Finance &amp; Statistical Institute of Belize</td>
</tr>
<tr>
<td>Overall Balance to GDP Ratio</td>
<td>Central Government Overall Balance as a percentage of Nominal GDP</td>
<td>Ministry of Finance &amp; Statistical Institute of Belize</td>
</tr>
<tr>
<td>Inflation</td>
<td>Percentage change in Consumer Price Index (2011 = 100)</td>
<td>Statistical Institute of Belize</td>
</tr>
<tr>
<td>Money Supply (M2)</td>
<td>Narrow money plus quasi money balances</td>
<td>Central Bank of Belize Statistical Digest</td>
</tr>
<tr>
<td>Import Prices</td>
<td>US Export Price Index (2000 = 100)</td>
<td>FRED Database</td>
</tr>
<tr>
<td>Oil Prices</td>
<td>WTI oil spot prices in USD/barrel</td>
<td>US Energy Information Administration (EIA)</td>
</tr>
<tr>
<td>Output Gap</td>
<td>GDP as a percentage of potential GDP</td>
<td>Statistical Institute of Belize</td>
</tr>
<tr>
<td>Private Sector Credit</td>
<td>Net credit to the private sector</td>
<td>Statistical Institute of Belize</td>
</tr>
<tr>
<td>Consumption</td>
<td>Household private consumption</td>
<td>Statistical Institute of Belize</td>
</tr>
<tr>
<td>Foreign Reserves</td>
<td>Net Foreign Asset position of the Central Bank of Belize</td>
<td>Central Bank of Belize Statistical Digest</td>
</tr>
<tr>
<td>Temporary Government Spending</td>
<td>Central Government capital expenditure</td>
<td>Ministry of Finance</td>
</tr>
<tr>
<td>Central Bank Financing</td>
<td>Central Bank credit to Central Government</td>
<td>Central Bank of Belize Statistical Digest</td>
</tr>
</tbody>
</table>
Deterioration in the Overall Fiscal Balance has been associated with higher GDP ...

... the picture is even clearer when examining fiscal outlays.
Fiscal Policy Impact (continued)

However Central Bank financing seems to have an inflationary impact...

... and is further associated with a deterioration of the NFA position as well.

![Chart](image-url)
Monetary Policy and The Belizean Economy

Changes in Reserve cash have been associated with increased economic growth…

…and expansionary changes in fiscal policy are associated with increasing excess cash.

![Graph showing the relationship between changes in GDP and changes in Reserve Cash.](image)

![Graph showing the relationship between changes in Excess Cash and changes in Primary Surplus.](image)
Establishing Fiscal Dominance: ARDL & VAR Approach

**ARDL Estimations**

- Using the De Resende (2007) methodology the authors estimated the degree of fiscal dominance by calculating the fraction of outstanding debt, $k$, backed by current and future primary surpluses
  
  $$M2 = \beta_0 + \beta_1 \times \text{Consumption}_{t-1} + \beta_2 \times \text{Debt to GDP}_{t-1} + \mu$$
  
  Where $\beta_2 = -(1 - k)$

- Applying the methodology of Afonso et al (2019) the authors estimated fiscal and monetary policy reaction functions
  
  $$\text{PBal} = \beta_0 + \beta_1 \times \text{PBal}_{t-1} + \beta_2 \times \text{CapEx}_{t-1} + \beta_3 \times \text{Gap}_{t-1} + \beta_4 \times \text{Debt to GDP}_{t-1} + \mu$$

  $$\text{RCR} = \beta_0 + \beta_1 \times \text{RCR}_{t-1} + \beta_2 \times \text{Gap}_{t-1} + \beta_3 \times \text{M2}_{t-1} + \beta_4 \times \text{FRes}_{t-1} + \mu$$

**VAR Estimation**

- Drawing on the methodology of Bali (2005) a VAR model was estimated to test if Central Government’s primary balance responds to changes in their liabilities and vice versa
  
  $$\Delta \text{PBal}_t = \beta_0 + \sum \beta_1 \times \Delta \text{PBal}_{t-1} + \sum \beta_2 \times \Delta \text{Debt to GDP}_{t-1} + \mu$$

  $$\Delta \text{Debt}_t = \alpha_0 + \sum \alpha_1 \times \Delta \text{PBal}_{t-1} + \sum \alpha_2 \times \Delta \text{Debt to GDP}_{t-1} + \varepsilon$$
Impact of Fiscal Policy: ARDL Approach

ARDL Estimations

- Drawing on the methodology of Catao and Terrones (2003) and Hendry (1995) the impact of fiscal policy on inflation was investigated:

  \[ \text{Infl} = \beta_0 + \beta_1 * \text{CenBankFin}_{-i} + \beta_2 * \text{M2}_{-i} + \beta_3 * \text{FiscalBal}_{-i} + \beta_4 * \text{Oil}_{-i} + \beta_5 * \text{Agri}_{-i} + \beta_6 * \text{US}_\text{exp}_\text{index}_{-i} + \beta_7 * \text{T_Bill_rate}_{-i} + \beta_8 * \text{Output_gap}_{-i} + \mu \]

- Applying the methodology of Branch and Jordan (2005), the authors investigate the impact of fiscal policy on international reserves

  \[ \text{NFA} = \beta_0 + \beta_1 * \text{Cred}_{-i} + \beta_2 * \text{GDP}_{-i} + \beta_3 * \text{PB}_{-i} + \beta_4 * \text{RCR}_{-i} + \beta_5 * \text{QM}_{-i} + \mu \]
Section IV: Preliminary Results
Fiscal Dominance: De Resende

Long Run Estimation Results of the De Resende Model

Dependent Variable - Money Supply (M2)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D_DGDP</td>
<td>-0.346395</td>
<td>0.194054</td>
<td>-1.785048</td>
<td>0.0825</td>
</tr>
<tr>
<td>LCON</td>
<td>1.050879</td>
<td>0.124866</td>
<td>8.416078</td>
<td>0.0000</td>
</tr>
<tr>
<td>C</td>
<td>8.075520</td>
<td>0.786885</td>
<td>10.26265</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

EC = LM2 - (-0.3464*D_DGDP + 1.0509*LCON + 8.0755)

F-Bounds Test

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>Signif.</th>
<th>l(0)</th>
<th>l(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
<td>5.835373</td>
<td>10%</td>
<td>2.63</td>
<td>3.35</td>
</tr>
<tr>
<td>k</td>
<td>2</td>
<td>5%</td>
<td>3.1</td>
<td>3.87</td>
</tr>
<tr>
<td></td>
<td>2.5%</td>
<td>3.55</td>
<td>4.38</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1%</td>
<td>4.13</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Actual Sample Size</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finite Sample: n=50</td>
<td>10%</td>
<td>2.788</td>
<td>3.513</td>
<td></td>
</tr>
<tr>
<td>5%</td>
<td>3.368</td>
<td>4.178</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1%</td>
<td>4.695</td>
<td>5.758</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finite Sample: n=45</td>
<td>10%</td>
<td>2.788</td>
<td>3.54</td>
<td></td>
</tr>
<tr>
<td>5%</td>
<td>3.368</td>
<td>4.203</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1%</td>
<td>4.8</td>
<td>5.725</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ARDL Results

- Evidence of fiscal dominance established between 2007 and 2019…
  - \( k = 1 - 0.346395 = 0.653605 \)
- Prior to this period, the fiscal authorities were able to source external debt, hence there wasn’t a large percentage of domestic debt from the Central Bank
- The bounds test indicates that there is a cointegrating relationship between the variables
- The error correction terms is negative and significant in the short run model
- Diagnostic checks were carried out and indicate a stable model as well
- DOLS estimation provides robustness check of results
Fiscal Dominance: VAR Approach

Results of Bivariate VAR Impulse Response Function

Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of D(PB) to D(PB)

Response of D(PB) to D(D_DGDP)

Response of D(D_DGDP) to D(PB)

Response of D(D_DGDP) to D(D_DGDP)

VAR Stability Assessment

Inverse Roots of AR Characteristic Polynomial

-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
-1.0
-0.5
0.0
0.5
1.0
-1
0
1
# Fiscal Policy Response Function: ARDL

## Long Run Estimation of Fiscal Policy Response Function:
### Dependent Variable - Primary Balance to GDP

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D_DGDP</td>
<td>0.020637</td>
<td>0.014209</td>
<td>1.452457</td>
<td>0.1542</td>
</tr>
<tr>
<td>LCAP</td>
<td>-0.010304</td>
<td>0.003205</td>
<td>-3.215333</td>
<td>0.0026</td>
</tr>
<tr>
<td>LFRES</td>
<td>-0.003583</td>
<td>0.004169</td>
<td>-0.859452</td>
<td>0.3952</td>
</tr>
<tr>
<td>LRCR</td>
<td>-0.016504</td>
<td>0.022497</td>
<td>-0.733587</td>
<td>0.4675</td>
</tr>
<tr>
<td>C</td>
<td>-0.032528</td>
<td>0.032015</td>
<td>-1.016022</td>
<td>0.3157</td>
</tr>
</tbody>
</table>

\[
EC = PB - (0.0206\times D_{D\text{GDP}} - 0.0103\times LCAP - 0.0036\times LFRES - 0.0165\times LRCR - 0.0325)
\]

### F-Bounds Test

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>Value</th>
<th>Signif.</th>
<th>I(0)</th>
<th>I(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymptotic: n=1000 F-statistic</td>
<td>10.05166</td>
<td>10%</td>
<td>2.2</td>
<td>3.09</td>
</tr>
<tr>
<td>4</td>
<td>5%</td>
<td>2.56</td>
<td>3.49</td>
<td></td>
</tr>
<tr>
<td>2.5%</td>
<td>2.88</td>
<td>3.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1%</td>
<td>3.29</td>
<td>4.37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Actual Sample Size

<table>
<thead>
<tr>
<th></th>
<th>56</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finite Sample: n=60</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>2.323</td>
</tr>
<tr>
<td>5%</td>
<td>2.743</td>
</tr>
<tr>
<td>1%</td>
<td>3.71</td>
</tr>
<tr>
<td>Finite Sample: n=55</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>2.345</td>
</tr>
<tr>
<td>5%</td>
<td>2.763</td>
</tr>
<tr>
<td>1%</td>
<td>3.738</td>
</tr>
</tbody>
</table>

## Short Run Estimation of Fiscal Policy Response Function:
### Dependent Variable - \( \Delta \) Primary Balance to GDP

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(PB(-1))</td>
<td>0.272704</td>
<td>0.116541</td>
<td>2.339978</td>
<td>0.0244</td>
</tr>
<tr>
<td>D(PB(-2))</td>
<td>0.091940</td>
<td>0.105140</td>
<td>0.874449</td>
<td>0.3871</td>
</tr>
<tr>
<td>D(PB(-3))</td>
<td>0.219643</td>
<td>0.081753</td>
<td>2.686681</td>
<td>0.0105</td>
</tr>
<tr>
<td>D(D_DGDP)</td>
<td>-0.068828</td>
<td>0.027873</td>
<td>-2.462151</td>
<td>0.0182</td>
</tr>
<tr>
<td>D(D_DGDP(-1))</td>
<td>-0.072394</td>
<td>0.030146</td>
<td>-2.401472</td>
<td>0.0211</td>
</tr>
<tr>
<td>D(D_DGDP(-2))</td>
<td>-0.049244</td>
<td>0.030861</td>
<td>-1.595679</td>
<td>0.1184</td>
</tr>
<tr>
<td>D(D_DGDP(-3))</td>
<td>0.068806</td>
<td>0.030797</td>
<td>2.234215</td>
<td>0.0311</td>
</tr>
<tr>
<td>D(LFRES)</td>
<td>0.041455</td>
<td>0.007948</td>
<td>5.215481</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(LFRES(-1))</td>
<td>0.022537</td>
<td>0.007493</td>
<td>3.007776</td>
<td>0.0045</td>
</tr>
<tr>
<td>D(LFRES(-2))</td>
<td>0.018333</td>
<td>0.006374</td>
<td>2.876154</td>
<td>0.0064</td>
</tr>
<tr>
<td>CointEq(-1)*</td>
<td>-1.228763</td>
<td>0.149175</td>
<td>-8.237031</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

### ECM Regression

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(PB(-1))</td>
<td>0.272704</td>
<td>0.116541</td>
<td>2.339978</td>
<td>0.0244</td>
</tr>
<tr>
<td>D(PB(-2))</td>
<td>0.091940</td>
<td>0.105140</td>
<td>0.874449</td>
<td>0.3871</td>
</tr>
<tr>
<td>D(PB(-3))</td>
<td>0.219643</td>
<td>0.081753</td>
<td>2.686681</td>
<td>0.0105</td>
</tr>
<tr>
<td>D(D_DGDP)</td>
<td>-0.068828</td>
<td>0.027873</td>
<td>-2.462151</td>
<td>0.0182</td>
</tr>
<tr>
<td>D(D_DGDP(-1))</td>
<td>-0.072394</td>
<td>0.030146</td>
<td>-2.401472</td>
<td>0.0211</td>
</tr>
<tr>
<td>D(D_DGDP(-2))</td>
<td>-0.049244</td>
<td>0.030861</td>
<td>-1.595679</td>
<td>0.1184</td>
</tr>
<tr>
<td>D(D_DGDP(-3))</td>
<td>0.068806</td>
<td>0.030797</td>
<td>2.234215</td>
<td>0.0311</td>
</tr>
<tr>
<td>D(LFRES)</td>
<td>0.041455</td>
<td>0.007948</td>
<td>5.215481</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(LFRES(-1))</td>
<td>0.022537</td>
<td>0.007493</td>
<td>3.007776</td>
<td>0.0045</td>
</tr>
<tr>
<td>D(LFRES(-2))</td>
<td>0.018333</td>
<td>0.006374</td>
<td>2.876154</td>
<td>0.0064</td>
</tr>
<tr>
<td>CointEq(-1)*</td>
<td>-1.228763</td>
<td>0.149175</td>
<td>-8.237031</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

### Summary Statistics

- **R-squared**: 0.872824
- **Adjusted R-squared**: 0.844563
- **S.E. of regression**: 0.001171
- **Sum squared resid**: 222.2432
- **Log likelihood**: 2.073606
Monetary Policy Response Function: ARDL

Long Run Estimation of Monetary Policy Response Function: Dependent Variable – Reserve Cash Ratio

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>N_FR_GDP</td>
<td>-0.735027</td>
<td>0.122837</td>
<td>-5.983766</td>
<td>0.0000</td>
</tr>
<tr>
<td>LM2</td>
<td>0.901667</td>
<td>0.104347</td>
<td>8.641078</td>
<td>0.0000</td>
</tr>
<tr>
<td>GAP</td>
<td>-7.082021</td>
<td>4.019417</td>
<td>-1.761952</td>
<td>0.0898</td>
</tr>
<tr>
<td>PB</td>
<td>11.37528</td>
<td>3.937189</td>
<td>2.889187</td>
<td>0.0077</td>
</tr>
<tr>
<td>C</td>
<td>-11.83378</td>
<td>1.221055</td>
<td>-9.691439</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

EC = LRCR - (-0.7350*N_FR_GDP + 0.9017*LM2 -7.0820*GAP + 11.3753*PB -11.8338)

F-Bounds Test
Null Hypothesis: No levels relationship

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>Value</th>
<th>Signif.</th>
<th>I(0)</th>
<th>I(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymptotic: n=1000</td>
<td>7.554338</td>
<td>2.2</td>
<td>3.09</td>
<td></td>
</tr>
<tr>
<td>k = 4</td>
<td>10%</td>
<td>2.56</td>
<td>3.49</td>
<td></td>
</tr>
<tr>
<td>2.5%</td>
<td>2.88</td>
<td>3.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1%</td>
<td>3.29</td>
<td>4.37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Actual Sample Size = 48

Short Run Estimation of Monetary Policy Response Function: Dependent Variable - ∆ Reserve Cash Ratio

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(LRCR(-1))</td>
<td>0.119978</td>
<td>0.099690</td>
<td>1.203512</td>
<td>0.2396</td>
</tr>
<tr>
<td>D(LRCR(-2))</td>
<td>0.227895</td>
<td>0.099777</td>
<td>2.284038</td>
<td>0.0308</td>
</tr>
<tr>
<td>D(N_FR_GDP)</td>
<td>-0.016773</td>
<td>0.052076</td>
<td>-0.322092</td>
<td>0.7500</td>
</tr>
<tr>
<td>D(N_FR_GDP(-1))</td>
<td>0.327799</td>
<td>0.062605</td>
<td>5.236010</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(N_FR_GDP(-2))</td>
<td>0.223630</td>
<td>0.053229</td>
<td>4.201319</td>
<td>0.0003</td>
</tr>
<tr>
<td>D(LM2)</td>
<td>-0.888646</td>
<td>0.482356</td>
<td>-1.842306</td>
<td>0.0769</td>
</tr>
<tr>
<td>D(LM2(-1))</td>
<td>-3.095153</td>
<td>0.521789</td>
<td>-5.931811</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(LM2(-2))</td>
<td>-0.357016</td>
<td>0.521995</td>
<td>-0.683944</td>
<td>0.5001</td>
</tr>
<tr>
<td>D(LM2(-3))</td>
<td>-0.981123</td>
<td>0.490356</td>
<td>-2.008393</td>
<td>0.0560</td>
</tr>
<tr>
<td>D(GAP)</td>
<td>-1.646478</td>
<td>0.304849</td>
<td>-5.400691</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(GAP(-1))</td>
<td>1.844221</td>
<td>0.307683</td>
<td>5.937096</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(PB)</td>
<td>1.264814</td>
<td>0.371666</td>
<td>3.019620</td>
<td>0.0044</td>
</tr>
<tr>
<td>D(PB(-1))</td>
<td>-5.741261</td>
<td>1.491342</td>
<td>-3.849729</td>
<td>0.0007</td>
</tr>
<tr>
<td>D(PB(-2))</td>
<td>-3.731374</td>
<td>1.380410</td>
<td>-2.703091</td>
<td>0.0119</td>
</tr>
<tr>
<td>D(PB(-3))</td>
<td>-2.298977</td>
<td>1.128051</td>
<td>-2.038008</td>
<td>0.0518</td>
</tr>
<tr>
<td>DUMMY</td>
<td>0.058919</td>
<td>0.030831</td>
<td>1.911051</td>
<td>0.0671</td>
</tr>
<tr>
<td>CoIntEq(-1)*</td>
<td>-0.539956</td>
<td>0.073450</td>
<td>-7.351365</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared = 0.741101
Adjusted R-squared = 0.607476
Mean dependent var = 0.011055
S.D. dependent var = 0.115359
S.E. of regression = 0.072274
Schwarz criterion = -1.482860
Log likelihood = 68.49385
Hannan-Quinn criter. = -1.895135
Durbin-Watson stat = 2.229184
### ARDL Estimation of Inflation Dynamics

**Dependent Variable – Change in CPI**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCRED</td>
<td>-1.2730</td>
<td>1.5606</td>
<td>-0.8157</td>
<td>0.4202</td>
</tr>
<tr>
<td>LGDP_SA</td>
<td>-0.6057</td>
<td>1.8380</td>
<td>-0.3295</td>
<td>0.7437</td>
</tr>
<tr>
<td>PB</td>
<td>21.9966</td>
<td>5.9585</td>
<td>3.6916</td>
<td>0.0008</td>
</tr>
<tr>
<td>LRCR</td>
<td>-0.6900</td>
<td>0.3037</td>
<td>-2.2724</td>
<td>0.0293</td>
</tr>
<tr>
<td>LQM</td>
<td>3.4148</td>
<td>0.8400</td>
<td>4.0651</td>
<td>0.0003</td>
</tr>
<tr>
<td>C</td>
<td>-21.5900</td>
<td>3.2808</td>
<td>-6.5806</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Fiscal Impact on Inflation & Reserves

**Levels Equation**

Case 2: Restricted Constant and No Trend

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCBL</td>
<td>0.0353</td>
<td>0.0141</td>
<td>2.51</td>
<td>0.0166</td>
</tr>
<tr>
<td>M2_GDP</td>
<td>0.1625</td>
<td>0.0362</td>
<td>4.48</td>
<td>0.0001</td>
</tr>
<tr>
<td>LWTI</td>
<td>0.0870</td>
<td>0.0251</td>
<td>3.47</td>
<td>0.0013</td>
</tr>
<tr>
<td>LTRATE</td>
<td>-0.0684</td>
<td>0.0140</td>
<td>-4.87</td>
<td>0.0000</td>
</tr>
<tr>
<td>LIM_IN</td>
<td>0.2949</td>
<td>0.1054</td>
<td>2.79</td>
<td>0.0081</td>
</tr>
<tr>
<td>LAGRIC</td>
<td>-0.0980</td>
<td>0.0387</td>
<td>-2.53</td>
<td>0.0155</td>
</tr>
<tr>
<td>C</td>
<td>1.4658</td>
<td>0.5965</td>
<td>2.45</td>
<td>0.0187</td>
</tr>
</tbody>
</table>

**ARDL Estimation of Foreign Reserves**

**Dependent Variable: Foreign Reserves of Central Bank**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCRED</td>
<td>-1.2730</td>
<td>1.5606</td>
<td>-0.8157</td>
<td>0.4202</td>
</tr>
<tr>
<td>LGDP_SA</td>
<td>-0.6057</td>
<td>1.8380</td>
<td>-0.3295</td>
<td>0.7437</td>
</tr>
<tr>
<td>PB</td>
<td>21.9966</td>
<td>5.9585</td>
<td>3.6916</td>
<td>0.0008</td>
</tr>
<tr>
<td>LRCR</td>
<td>-0.6900</td>
<td>0.3037</td>
<td>-2.2724</td>
<td>0.0293</td>
</tr>
<tr>
<td>LQM</td>
<td>3.4148</td>
<td>0.8400</td>
<td>4.0651</td>
<td>0.0003</td>
</tr>
<tr>
<td>C</td>
<td>-21.5900</td>
<td>3.2808</td>
<td>-6.5806</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Fiscal Impact on Inflation & Reserves

**Levels Equation**

Case 2: Restricted Constant and No Trend

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCBL</td>
<td>0.0353</td>
<td>0.0141</td>
<td>2.51</td>
<td>0.0166</td>
</tr>
<tr>
<td>M2_GDP</td>
<td>0.1625</td>
<td>0.0362</td>
<td>4.48</td>
<td>0.0001</td>
</tr>
<tr>
<td>LWTI</td>
<td>0.0870</td>
<td>0.0251</td>
<td>3.47</td>
<td>0.0013</td>
</tr>
<tr>
<td>LTRATE</td>
<td>-0.0684</td>
<td>0.0140</td>
<td>-4.87</td>
<td>0.0000</td>
</tr>
<tr>
<td>LIM_IN</td>
<td>0.2949</td>
<td>0.1054</td>
<td>2.79</td>
<td>0.0081</td>
</tr>
<tr>
<td>LAGRIC</td>
<td>-0.0980</td>
<td>0.0387</td>
<td>-2.53</td>
<td>0.0155</td>
</tr>
<tr>
<td>C</td>
<td>1.4658</td>
<td>0.5965</td>
<td>2.45</td>
<td>0.0187</td>
</tr>
</tbody>
</table>

**F-Bounds Test**

Null Hypothesis: No levels relationship

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>Value</th>
<th>Signif.</th>
<th>l(0)</th>
<th>l(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
<td>10.20792</td>
<td>10%</td>
<td>1.99</td>
<td>2.94</td>
</tr>
<tr>
<td>k</td>
<td>6</td>
<td>5%</td>
<td>2.27</td>
<td>3.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5%</td>
<td>2.55</td>
<td>3.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1%</td>
<td>2.88</td>
<td>3.99</td>
</tr>
</tbody>
</table>

**Actual Sample Size**

Finite Sample: n=60

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>10%</th>
<th>5%</th>
<th>1%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2.114</td>
<td>2.45</td>
<td>3.293</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.153</td>
<td>3.598</td>
<td>4.615</td>
</tr>
</tbody>
</table>

Finite Sample: n=55

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>10%</th>
<th>5%</th>
<th>1%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2.139</td>
<td>2.49</td>
<td>3.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.204</td>
<td>3.658</td>
<td>4.709</td>
</tr>
</tbody>
</table>

**Actual Sample Size**

Finite Sample: n=55

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>10%</th>
<th>5%</th>
<th>1%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2.226</td>
<td>2.67</td>
<td>3.593</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.241</td>
<td>3.781</td>
<td>4.981</td>
</tr>
</tbody>
</table>

**Actual Sample Size**

Finite Sample: n=55

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>10%</th>
<th>5%</th>
<th>1%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2.259</td>
<td>2.67</td>
<td>3.593</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.264</td>
<td>3.781</td>
<td>4.981</td>
</tr>
</tbody>
</table>
What’s next…

- Refining the analysis of the impact of fiscal policy on the macroeconomy with a focus on international reserves
- Estimating a panel regression model to analyze the impact of fiscal variables on international reserves
- Methods that may improve the robustness of the results
Thank You

CENTRAL BANK
of BELIZE

PO Box 852
Belize City
Belize
Central America

+1 501 233-6194
centralbank.org.bz