Investigating the Government Revenue-Expenditure Nexus: empirical evidence for the Free State province in a multivariate model

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Outline

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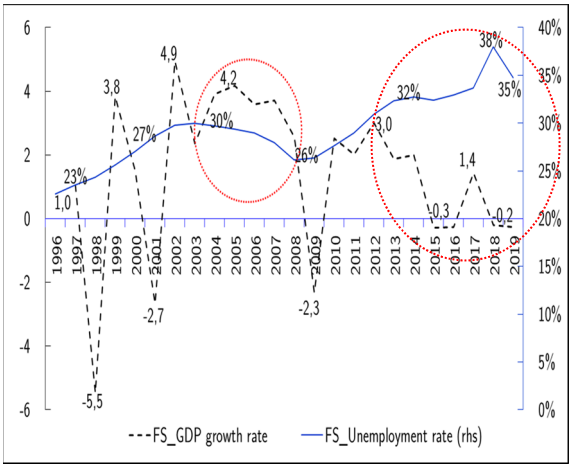
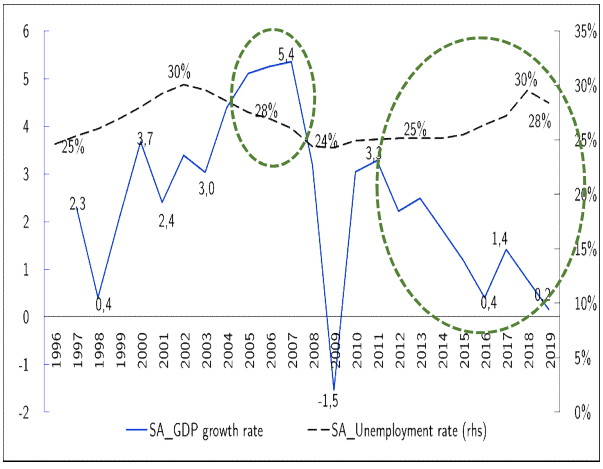
- Conclusions (with some policy recommendation)

Motivation

- Usually, the Provincial Equitable Share (PES) is the largest (or main) source of revenue (over 70%) for the Free State (FS) province. Other components consist of 'Own revenue', and earmarked grants.
- But, the prevailing severely weak economic growth, expanding fiscal deficit, growing demand for quality public services, high unemployment, rising poverty and inequality rate, puts immense pressure on the fiscus, particularly at the provincial level.
- Given the structure provincial envelope, a feasible alternative in the short-term, is to raise the fraction share of the "own revenue", which is about 3%.
- To meet the ever-increasing demand for public goods, provincial government needs to generate 'own revenue', the norm for the FS Provincial government (FSPG) is to raise charges/levies on tax receipts, e.g., motor vehicle licenses, casino taxes, horse racing taxes and liquor taxes.
- The question remains does the above fiscal measure optimal or ineffective? Does it have unintended impact on macroeconomic indicators, e.g., economic growth and inflation or not? The answers to these question remains an empirical issue.

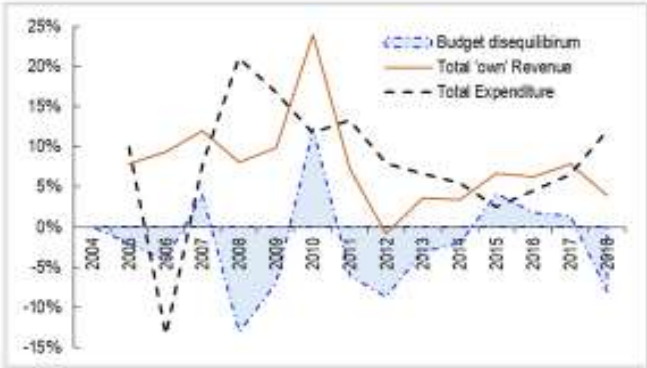
Fig.1: Evolution of real GDP and Unemployment growth rates in FS & SA, 1990-2019





Data source: StatsSA, IHS Markit Regional eXplorer (ReX). Author's estimation

What does this study investigate?



Source: In-Year-Monitoring (FS Provincial Treasury database), Estimates of Provincial Revenue and Expenditure (National Treasury's provincial financial database), Own illustration.

Figure 3. Historical trend of total revenue, total government expenditure and budget disequilibrium (ratio of GDP) for the Free State province.

What does this study investigate?

- Is there any empirical link between revenue, expenditure and economic activity level (or output growth)?
- Can fluctuations be attributed to external (national) or domestic (structural) constraints or developments?
- What are the possible determinants of 'own revenue' performance in FS?
- Our work builds on the recent study by Kavase and Phiri (2018) focusing on South African provinces, who found no evidence of long-run or short-run links between government revenue and expenditure for the Free State Province, but concludes that fiscal sustainability is attainable in some provinces (such as Eastern Cape, Northern Cape and Free-State) in both the long-run and short-run, if government expenditure increases, but a reduction in government expenditure would lead to fiscal sustainability in most of the provinces (which include Western Cape, North West, Gauteng, Mpumalanga and Limpopo).

Literature: Theoretical background

In the vast literature in public finance, the relationship between government revenue (GR) and government exoenditure (GE) hinges on four main theories

1. **Fiscal Synchronisation hypothesis**
   - ✓ Simultaneous decision to tax and spend.
   - ✓ Government size (or spending) determines the welfare-maximising choice of each voters (Meltzer & Richard, 1981). Quantity & quality of public services provided reflects preferences of the community
   - ✓ Empirically, causality runs in both direction. Given the interdependencies between GE & GR, government must be cautious on cutting spending, raising taxes or using either options; it can lead to an ambiguous or insignificant effect on fiscal situations.
2. **Institutional Separation hypothesis**
   - ✓ GE & GR are independent.
   - ✓ Empirically, no intertemporal causality between public spending and revenue.
   - ✓ Lack of causal link can be ascribed to, e.g., conflict among political groups due to divergent interest and agendas (Hoover & Sheffrin, 1992; Drazen, 2001)

Theoretical background…contd.

3. Spend-and-Tax hypothesis

- ✓ Support fiscal deficit: government spend first and impose tax afterwards.
- ✓ Spending restrain is required to reduce budget deficit and reducing expenditure should be the optimal solution to the current deficit (Peacock and Wiseman, 1979)
- ✓ Susceptible to fiscal ratchet effect
- ✓ Empirically, causality runs from GE to GR (or tax).

4. Tax-and-Spend hypothesis

- ✓ Higher taxes leads to larger budget deficit instead of correcting deficits as posited by the spend-tax theory (Friedman, 1978).
- ✓ Raising taxes to cut budget deficits leads to increase in government spending. Thus deficit reduction requires lower taxes
- ✓ Empirically, a positive relationship between tax and public spending exists, and causality runs from tax to expenditure.

- In contrast, other proponents of the tax-spend theory argued that raising taxes is a panacea to solve budget deficit problems (Buchanan & Wagner, 1977).
  - ✓ Higher tax and lower public spending will reduce fiscal deficit.
  - ✓ Empirically, a negative relationship between tax and public spending is expected.

Literature: Empirical Evidence

- Studies exploring GE–GR nexus in South Africa have produced mixed results. Similar inquiry on provincial economies in South Africa is missing.
- Using different econometric techniques (which includes VECM, ARDL, Toda-Yamamoto, 2-step Engle-Granger, MTAR and TAR techniques), data frequency and sample period, a number of studies have found evidence for:
  - ✓ Bi-directional causality between government revenue and expenditure supporting Fiscal synchronization theory in South Africa (see, e.g., Phiri 2019; Baharumshah et al. 2016; Ndarihiwe & Gupta, 2010; Ghartey, 2010; Lusiyan & Thorton, 2007; Kavase & Phiri, 2018)
  - ✓ Institutional separation hypothesis– no evidence of long-run causality between GE & GR (Kavase & Phiri, 2018; Narayan & Narayan, 2006).
  - ✓ Spend-tax hypothesis (see, e.g., Chang et al.2002)

Literature: Empirical Evidence

- Finally, Kavase and Phiri (2018) focused on South African provinces. Using an ARDL model, they examine the government revenue–expenditure nexus across nine provinces (or states), over the period 2000–2016. They found differentiated effects of the strict fiscal stance to finance growing expenditure by raising taxes (increased revenue collection) on provincial budgets, in both the long-run and short-run. They conclude that fiscal sustainability is attainable in some provinces (such as Eastern Cape, Northern Cape and Free-State) in both the long-run and short-run, if government expenditure increases, but a reduction in government expenditure would lead to fiscal sustainability in most of the provinces (which include Western Cape, North West, Gauteng, Mpumalanga and Limpopo).

The Data

- Total government revenue & expenditure sourced from FS Provincial Treasury's In-Year-Monitoring (IYM) database, National Treasury (NT) provincial database & inter-governmental framework (IGFR) publications.
- Nominal gross domestic product-regional (GDPR) @constant prices, (2010=100) for FS, obtained from Regional eXplorer database (IHS Global markit).
- CPI (2010=100) retrieved from Statistics South Africa
- Time-series are seasonally adjusted using ARIMA-X13 procedure (for robustness also used TRAMO-SEATS) & nominal series are adjusted for inflation to obtain real series.
- Real series of government revenue (GR) & expenditure are rescaled to ration of real GDP—capture effects of growth in the provincial economy (Zapf & Payne, 2009) given the reliant of fiscal variables on the economic activity level (Narayan & Narayan, 2006).
- Establish the stationarity properties of each series applying Phillip & Perron (1988), Zivot-Andrews (1992), and Bai & Perron (2003) unit root tests. The last two tests were used to identify possible structural breaks in data, obviating model misspecification.
- Estimated multivariate models consists of quarterly series for the FS Province spanning 2004Q2 to 2018Q1.

Model Specification & Empirical Methodology

- Consider 2 linear multivariate functional model expressed as:

$$\left.\begin{aligned} \ln GR_t &= \lambda_0 + \lambda_1 \ln GE_t + \lambda_2 Y_t + \lambda_3 \pi_t + \delta g_{1t} + \delta d_{2t} + \varepsilon_{1t} \quad (1) \\ \ln GE_t &= \gamma_0 + \gamma_1 \ln GR_t + \gamma_2 Y_t + \gamma_3 \pi_t + \delta g_{3t} + \delta d_{4t} + \varepsilon_{2t} \quad (2) \end{aligned}\right\} \quad \varepsilon_{1t,2t} \sim N(0,\sigma)$$

- In Eqs. 1&2, real GDP (Y) and inflation (π) are control variables to avoid spurious causality & to obviate the 'omitted variable' bias inherent to bi-variate model.

(1) Vector Error Correction Modelling (VECM) Approach

- Estimate the Eqs.(1) & (2) as a VAR (1,2) model, using AIC to select optimal lag length
- Applied a VAR-based Johansen-reduced rank cointegration test. Identify cointegrating space, affirming the presence of long-run relationships among variables using trace and maximum eigenvalues statistics.
- Found evidence of cointegration, re-estimate Eqs.(1) & (2) as VECM models, in the form:

$$\Delta \ln GR_t = \alpha_0 + \sum_{i=1}^{h_1} \alpha_{1i} \Delta \ln GR_{t-1} + \sum_{i=1}^{h_2} \alpha_{2i} \Delta \ln GE_{t-1} + \sum_{i=1}^{h_3} \alpha_{3i} \Delta \ln Y_{t-1} + \sum_{i=1}^{h_4} \alpha_{4i} \Delta \ln \pi_{t-1} + \theta \ln ECM_{1t-1} + u_{1t} \quad (3)$$

$$\Delta \ln GE_t = \beta_0 + \sum_{i=1}^{k_1} \beta_{1i} \Delta \ln GE_{t-1} + \sum_{i=1}^{k_2} \beta_{2i} \Delta \ln GR_{t-1} + \sum_{i=1}^{k_3} \beta_{3i} \Delta \ln Y_{t-1} + \sum_{i=1}^{k_4} \beta_{4i} \Delta \ln \pi_{t-1} + \phi \ln ECM_{2t-1} + v_{2t} \quad (4)$$

$$\{u_{1t}; v_{2t} \sim N(0,\sigma)\}$$

Methodology & Model Specification

(2) Toda-Yamamoto (MWALD)—non-Granger causality Approach

- Requires no pre-testing for the presence of unit roots in time-series.
- Augment standard VAR (k) in levels with $(k+d_{\max})^{th}$ order of integration. Here, k=optimal lag length selected by AIC, and dmax = variables treated endogenously
- Direction of causality is determined by carrying out an F-statistic (MWALD) test for linear or dmax nonlinear restrictions on the first k VAR parameters. The application of the usual *F*-statistic test has asymptotic distribution for a valid inference
- For our application, we modelled the following SUR regressions:

$$\ln GR_t = \alpha_0 + \sum_{i=1}^{k+d\max} \alpha_i \ln GR_{t-i} + \sum_{i=1}^{k+d\max} \beta_i \ln GE_{t-i} + \sum_{i=1}^{k+d\max} \varphi_i \ln Y_{t-i} + \sum_{i=1}^{k+d\max} \vartheta_i \pi_{t-1} + \varepsilon_{1t} \quad (5)$$

$$\Delta \ln GE_t = \gamma_0 + \sum_{i=1}^{k+d\max} \lambda_i \ln GE_{t-i} + \sum_{i=1}^{k+d\max} \Omega_i \ln GR_{t-i} + \sum_{i=1}^{k+d\max} \Lambda_i \ln Y_{t-i} + \sum_{i=1}^{k+d\max} \eta_i \pi_{t-1} + \varepsilon_{2t} \quad (6)$$

$$\Delta \ln Y_t = \mu_0 + \sum_{i=1}^{k+d\max} \mu_i \ln Y_{t-i} + \sum_{i=1}^{k+d\max} \Gamma_i \ln GR_{t-i} + \sum_{i=1}^{k+d\max} \varpi_i \ln GE_{t-i} + \sum_{i=1}^{k+d\max} \Pi_i \pi_{t-1} + \varepsilon_{3t} \quad (7)$$

$$\Delta \ln \pi_t = \psi_0 + \sum_{i=1}^{k+d\max} \psi_i \ln \pi_{t-1} + \sum_{i=1}^{k+d\max} \Theta_i \ln GR_{t-i} + \sum_{i=1}^{k+d\max} \Phi_i \ln GE_{t-i} + \sum_{i=1}^{k+d\max} \theta_i \pi_{t-1} + \varepsilon_{4t} \quad (8)$$

Empirical Results

- ZA, PP & BP unit root tests confirm variables as $I(1)$ stationary
- Evidence of structural breaks in data coinciding with significant domestic (e.g., ongoing strict fiscal consolidation strategy) & global events (e.g., 2007/08 global economy crisis). Thus, add qualitative dummy variables in computed VECM.
- Cointegration analysis indicates the presence of long-run relationship in the constructed VEC models encapsulating the GR & GE equations.
  - ✓ Highly significant & negative one-lagged error correction (EC) terms in the GR & GE individual VEC models affirms existence of a long-run relationship between the exogenous variable and (some of) the endogenous variables.
  - ✓ Evidence of cointegration suggests possible intertemporal causative process running interactively in one direction (unidirectional) or both directions (bi-directional, i.e., feedback effect).

Cointegration test

Table 2. Optimal lag selection for the cointegration test based on information criteria.

Lag length	LogL	LR	FPE	AIC	SC	HQ
0	462.811	NA	0.000	-17.993	-17.841	-17.935
1	841.789	683.647	0.000	-32.227	-31.469	-31.938
2	903.672	101.925*	1.99e-20*	-34.026*	-32.662*	-33.505*
3	909.313	8.405	3.08e-20	-33.620	-31.650	-32.867
4	916.589	9.703	4.61e-20	-33.278	-30.702	-32.294
5	928.623	14.157	5.96e-20	-33.122	-29.941	-31.907

Notes: (*) indicates lag order selected by the criterion. LR, FPE, AIC, SC and HQ denote sequentially modified LR test statistic (each test at 5% level); Final prediction error; Akaike information criterion; Schwarz information criterion; and Hannan-Quinn information criterion, respectively.

Table 3. Results of Johansen (unrestricted) cointegration rank tests.

H_0	H_1	Test statistics	Critical Values (95%)	p-value
		Trace Statistics		
$r = 0$	$r = 1$	48.555	47.856	0.042
$r < 1$	$r = 2$	19.543	29.797	0.454**
$r \leq 2$	$r = 3$	7.305	15.494	0.542
		Maximum Eigenvalue Statistics		
$r = 0$	$r = 1$	29.0114	27.584	0.032
$r < 1$	$r = 2$	12.239	21.131	0.524**
$r \leq 2$	$r = 3$	7.216	14.264	0.463

Notes: *p*-values based on MacKinnon-Haug-Michelis (1999). *, **, *** denote 1%, 5% and 10% statistically significance levels, respectively.

Results: VEC models for GR & GE

- EC terms are statistically significant at 5% level, confirming the existence of a long-run relationship.
- Overall, the reversion of the models to a long-run equilibrium (i.e. steady state) following a economy perturbation (or external shock) is relatively slow. It takes much longer for disequilibrium between GE&GR to be corrected in the GR model (at 11%) compared to the GR model
- Significant dummy variables (at 5% significant level) shows that external shocks strongly affect economic activity level, revenue generation & total government expenditure (e.g., Covid-19), at the provincial level.
- Policymakers in FS needs to monitor global & national events to develop effective risk-coping mechanism that ensures economic growth & own revenue generation.
- Relevant diagnostic tests (bottom panel) shows that the estimated VEC models are well-specified to explain the GR-GE nexus in FS (high adjusted R-squared), devoid of normal errors (JB statistic), serial correlation (BG LM test), and heteroscedacity (ARCH test),.

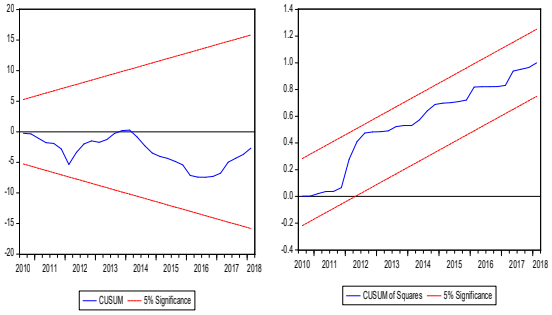
VECM 1: $F(GR\|GE)$			**VECM 2:** $F(GE\|GR)$		
	$\Delta \ln GR$	*p*-values		$\Delta \ln GE$	*p*-values
α_0	0.0001 [0.508]	0.000*	β_0	-0.003 [-4.238]	0.000*
$\phi \ln ECM_{2t-1}$	-0.256 [-4.125]	0.000*	$\theta \ln ECM_{1t-1}$	-0.107 [-2.991]	0.005*
$\Delta \ln GR_{t-4}$	-0.2556 [-1.839]	0.039**	$\Delta \ln GR_{t-1}$	-0.331 [-1.870]	0.071***
$\Delta \ln GE_{t-1}$	0.271 [1.995]	0.054**	$\Delta \ln GE_{t-1}$	0.464 [3.229]	0.003*
$\Delta \ln Y_{t-4}$	-0.056 [-2.387]	0.023**	$\Delta \ln GE_{t-4}$	-0.641 [-5.037]	0.000*
$\Delta \ln \pi_{t-3}$	0.001 [2.192]	0.036**	δ_{1t} (xdum01)	0.005 [4.716]	0.000*
δ_{5t} (xdum02)	0.001*	0.000*	δ_{2t} (dd4)	0.005 [6.651]	0.000*
δ_{6t} (dd4)	0.000*	0.044**	δ_{3t} (dfcon)	0.005 [4.142]	0.000*

Post-estimation diagnostic tests	**VECM 1**	**VECM 2**
F-statistic	9.331(0.000)*	14.829 (0.000)**
Adjusted $\overline{R}^2$	0.759	0.846
Jarque-Bera	3.975 (0.136)	4.978 (0.082)
BG Serial Correlation LM	2.603 (0.272)	2.062 (0.363)
ARCH	2.355 (0.124)	0.088 (0.765)
Breusch-Pagan-Godfrey	27.695 (0.186)	9.137 (0.995)

Notes: *, **, *** denotes 1%, 5% and 10% significance level respectively. α_0 and β_0 are constant parameters, *t*-statistics in [ ] parenthesis, and *p*-values in ( ) parenthesis with asymptotic values $Obs * R^2 \sim \chi^2$.

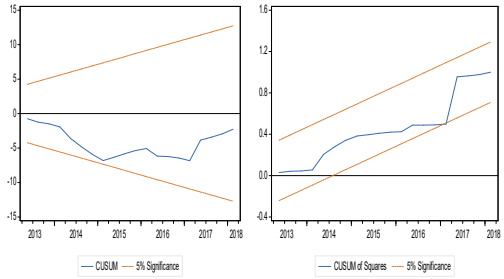
Dynamic stability of the VECM models & parameter constancy test

Figure 4. Graphical display of the dynamic stability test for $F(GR|GE)$ model



Notes: The CUSUM parameter (and variance) stability test assess the robustness of the specified model. This graph shows that both parameters and variance of the model are stable under both cumulative sum (CUSUM) and CUSUM of the square tests, at a 5% significance level.

Figure 5. Graphical display of the dynamic stability test for $F(GE|GR)$ model



Notes: See Figure 4.

Short-run causality test: Estimated VEC models

- Applied the standard WALD (or *F*-test) to identify the exact nature & direction of the intertemporal causative process among variables.

Table 5. $F-$statistic test results for Granger causality in the estimated vector error correction models.

Estimated VECM	$F(GR\|GE)$	$F(GE\|GR)$	
Variables	$\Delta \ln GR$	$\Delta \ln GE$	Direction of causality
$\Delta \ln GR_{t-1}$	–	3.498 (0.071)*	$GR \rightarrow GE$
$\Delta \ln GE_{t-1}$	3.998 (0.054)**	–	$GE \rightarrow GR$
$\Delta \ln Y_{t-2}$	5.699 (0.023)**	–	$Y \rightarrow GR$
$\Delta \ln \pi_{t-4}$	4.805 (0.036)**	–	$\pi \rightarrow GR$

Notes: *, **, *** denote 1%, 5% and 10% statistically significance level respectively. *p*-values in ( ) parenthesis

- GR-VEC model: real GE, real GDP, and inflation independently, and jointly Granger-causes GR in the long-run. These macro-variables appear as determinants of government revenue –generating capacity at the provincial level.
- Evidence in both the GE & GR VEC models, indicates the existence of a bi-directional causality between GE & GR consistent with fiscal synchronization hypothesis for FS province, keeping inline with reported evidence for South Africa (see, e.g., Phiri, 2019, Baharumshah et al. 2016; Ghartey, 2010)

Empirical Results (2): Toda-Yamamoto Approach

Table 6. Results of the T-Y non-Granger (MWALD) causality test.

	$F-$statistic value	*p*-value	Long-run causality
$GR \rightarrow GE$	10.728	0.2181	No
$GE \rightarrow GR$	14.681	0.065*	Yes
$GR \rightarrow Y$	3.986	0.858	No
$Y \rightarrow GR$	14.648	0.066*	Yes
$GE \rightarrow Y$	12.907	0.115	No
$Y \rightarrow GE$	5.942	0.354	No
$\pi \rightarrow$GE	30.500	0.000*	Yes
$GR \rightarrow \pi$	7.344	0.049	No
$\pi \rightarrow GR$	15.765	0.045**	Yes
$\pi \rightarrow Y$	17.121	0.028*	Yes
$GE \rightarrow \pi$	14.005	0.081*	Yes
$Y \rightarrow \pi$	8.834	0.356	No

Notes: *, **, *** denote 1%, 5% and 10% statistically significance levels, respectively. *p*-values in ( ) parenthesis. Optimal lag (of 9) is selected using log-likelihood ratio, LR, AIC, FPR, SC and HQ information criteria. All residuals were checked for white noise using several misspecification tests.

Empirical result: Toda-Yamamoto Approach contd)

- Overall, the T-Y non-Granger causality analysis suggest:
  - ✓ The existence of a long-run (unidirectional causality) running from GR to GE, for the FS province.
  - ✓ Significant unidirectional causality running from real GDP to both GR & GE, confirming the widely accepted notion in public finance that fiscal variables are dependent on the level of economic activity (Narayan and Narayan, 2006).
  - ✓ Provides concrete support for fiscal synchronization hypothesis, underscoring the dynamics of government revenue–expenditure nexus in the long-run and short-run, for the Free State province. This finding is consistent with those reported in the extant empirical literature for developed and developing countries (see, e.g., Al-zeaud (2015) for Jordan; Elyasi and Rahimi (2012) for Iran; and Chang et al. (2002) for Canada).

Conclusion & Policy recommendation

- Overall, our empirical results reveals a bi-directional causality driving the GE–GR nexus in the FS province, implying that FSPG can alleviate fiscal pressures and/or budget constraints linked to budget deficit by raising taxes (i.e., surcharges and levies) to generate 'own revenue', and/or simultaneously cut government expenditure.
  - ✓ FSPG through its Provincial Treasury should adopt, and enforce stringent fiscal measures to implement credible budget and eradicate fruitless expenditure that increases fiscal imbalance, a surge in total government expenditure, and fiscal debt (at the national level).
- Further empirical evidence reveals that provincial government revenue and expenditure are dependent on the economic growth and inflation in the FS province.
  - ✓ Policymakers and fiscal authorities should consider the implications of raising government revenue (via tax imposition) and/or expenditure, particularly on economic activity level in the province.
  - ✓ Policymakers need to consider an accommodative fiscal measures that raises generated revenue & simultaneously stimulates economic activity level, for example, by lowering taxes or phasing out certain surcharges and levies.

Thank You

Question Session

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