Tax Reforms, Structural breaks and Dynamics of Tax Revenue in Fiji

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Tax Reforms, Structural breaks and Dynamics of Tax Revenue in Fiji

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Abstract

Despite implementing several tax reforms and rising tax revenue over the past few years in Fiji, the expenditure plans of the government as announced in the 2017-2018 budget has stimulated discussion on the sustainability of public debt. The main goal of this paper is to investigate the response of tax revenue to external and domestic shocks using annual data for the period 1963-2014. This study uses unit root tests that accounts for endogenous multiple structural breaks and finds that tax revenue in Fiji is a non-stationary process. Thus, shocks to tax revenue are likely to have permanent effects, adverse shocks to tax revenue are likely to be transmitted to other variables/sectors, and the tax revenue is unlikely to return to its trend path aftermath a shock. Reforms that improve the resilience of the tax system and shelter from adverse shocks therefore are warranted.

Keywords
Tax Reforms, Tax Revenue, Structural Breaks, Fiji
1. Background

Following the recent announcements regarding expenditure plans in 2017-2018 budget, there has been increased scrutiny over the government’s expenditure plans, and debate on sustainability of public finance in Fiji. The budget announcement came against the background of already rising public debt levels. In recent years, a number of important tax reforms were undertaken in Fiji in an attempt to improve compliance, revenue collection and support economic growth. These include: reduction of corporate tax rates, changes to income taxable threshold, streamlining and simplification of administration of Pay As You Earn (PAYE) tax, introduction of new taxes such as social responsibility taxes, changes in the Value Added Tax (VAT) and declaration of designated new regions as tax free zones, and introduction of tax incentives relating to small and medium enterprises (SMEs), domestic investment, and foreign investment, and industries such as agriculture, finance, media and tourism, amendments to the Tax Administration Decree and Income Tax Act, etc (Government of Fiji 2007, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017).

In this paper, we investigate the response of tax revenue to shocks, for example, a positive policy shock. Hence, the paper has been motivated by growing concerns over scrutiny over the government’s expenditure plans, sustainability of public finance and recent tax policy reforms. This objective is achieved by applying unit root tests allowing for multiple structural breaks to investigate the unit root behavior of tax revenue in Fiji using annual data from 1963-2014. To the best of my knowledge, there is no empirical study that has examined this topic for Fiji despite increased scrutiny of government spending plans as well as significant tax reforms in recent years. The empirical results in this paper has important implications for understanding the effects
of domestic and externals shocks, transmission of effects of shocks to other related sectors of the economy, scope and effectiveness of tax policy reforms, future econometric modelling and forecasting of tax revenue. We explain each by turn below.

First, our study provides new insights on how different external and internal shocks are likely to impact tax revenue. Understanding whether (internal or external) shocks have permanent or transitory impact on tax revenue will help design appropriate policy measures and ensure tax revenue is kept at a level that can support government’s fiscal ambitions. This issue is quite critical, given growing debate in Fiji regarding sustainability of public finance. If tax revenue is a stationary series, then shocks to tax revenue will have transitory effects and the series will return to its trend path over time (Ozcan 2013, Shahbaz, Khraief, et al. 2014). This implies that positive policy shocks or policy reforms to improve tax revenue will be less effective.

However, if tax revenue is a non-stationary series, shocks to tax revenue will have permanent or persistent effects. This follows that any adverse shock emanating from external or internal source will have permanent or persistent impact on tax revenue. This presents a strong case for policy intervention. On the other hand, a positive policy shock will have positive permanent effects and is likely to improve tax revenue performance (see, Barros, Gil-Alana, and Payne 2013, Lean and Smyth 2014, Shahbaz, Khraief, et al. 2014, Gozgor 2016). The presence of a unit root also indicates that permanent policy changes to raise tax revenue performance are likely to be more appropriate than temporary policy changes (Gozgor 2016). Hence, our finding is of enormous importance for analysing the effects of different types of external and domestic shocks, and formulation and evaluation of tax policy reforms.
Second, understanding the unit root properties of tax revenue is important for gauging how shocks to tax revenue can be transmitted to other sectors of the economy. If tax revenue is non-stationary, shocks to tax revenue are permanent, then the shocks will be transmitted to other related variables in the fiscal sector, and macroeconomy (see, Ozcan 2013, Gozgor 2016, Barros, Gil-Alana, and Payne 2013). As documented by Hendry and Juselius (2000), “variables related to the level of any variable with a stochastic trend will inherit that non-stationary, and transmit it to other variables in turn”. This implies if there is any adverse shock to tax revenue, the shocks will be transmitted to other variables such as government spending, public debt and real GDP.

Third, understanding the unit root properties of tax revenue has important implications for modelling, testing and forecasting its future path (see, Braun 1988). Our results have significant implications for future econometric modelling of tax revenue. Given that understanding the determinants of tax revenue is critical for design for effective measures to raise tax revenue, it is very important that researchers carefully select their choice of econometric methodology. If tax revenue is a stationary variable, then this implies vector autoregressive (VAR) or structural vector autoregressive (SVAR) technique is employed to understand the determinants of tax revenue. The stationarity of series also reduces the chances of obtaining spurious results (Narayan and Narayan 2010). If, the series is found to be non-stationary, applied researchers should exercise extreme with their choice of econometric methodology. In particular, before regressing against other possibly non-stationary determinants of tax revenue on tax revenue, establishing presence of a cointegrating relationship with the help of cointegration tests is
absolutely necessary. This is to avoid spurious regression results, and its misleading policy implications.

Fourth, another value of the present study is that it has implications for forecasting – something that is very essential for formulation of future expenditure plans and ensuring sustainability of public finance. If, for instance, tax revenue is a mean (trend) reverting process, then this implies that series will return to its mean value and the past behavior of tax revenue can be used to generate forecast of tax revenue. In contrast, if tax revenue is non-stationary, then past behavior of tax revenue is of little or no use for forecasting and one would need to look at other variables affecting tax revenue to generate forecast of tax revenue (see, Barros, Gil-Alana, and Payne 2013, Gozgor 2016, Lean and Smyth 2013, Narayan and Narayan 2010, Öztürk and Aslan 2015, Shahbaz, Khraief, et al. 2014, Shahbaz, Tiwari, et al. 2014).

Furthermore, this paper identifies adopts unit root tests that identifies the break dates endogenously. Since there could be several sources of structural break in context of Fiji’s economy, correct identification of break in the data series is important for the sake of adopting a proper specification of econometric models (see, Ewing and Wunnava 2001).

The rest of the paper is structured as follows. Section 2 outlines the data and methodology, while Section 3 discusses the empirical results. Section 4 discusses the conclusion and policy implications.
2. Data and Methodology

Data Source

Tax revenue is measured in millions of Fijian dollars. Tax revenue is denoted as $\ln TR_t$. The data is collected from several World Economic Reports (World Bank 1974, 1970, 1980, 1985), Asian Development Bank’s Key Indicators for Asia and the Pacific, and Reserve Bank of Fiji’s Statistical Annex (Reserve Bank of Fiji 2017, Asian Development Bank 1999). The sample period is restricted to 1963-2014. Figure 1 shows the trend in Fiji’s tax revenue over the period 1963-2014. There is clear evidence of increasing tax revenue over time.

![Tax Revenue](image)

**Figure 1.** The behavior of Fiji’s tax revenue over time (1963-2014)

Methodology

The empirical analysis starts by investigating the order of integration of tax revenue series using Augmented Dickey Fuller (ADF) (Dickey and Fuller 1979) Unit Root Test and Phillip-Perron (Phillips and Perron 1988) Unit Root Test. Given that these unit root tests are well known in the applied econometrics literature, the details of these unit root tests are not provided. The consideration of structural breaks is important for investigating the order of integration of tax revenue series. This is important as the economy undergoes various types of economic and political shocks that may influence the order of integration of variables. In a seminal study,
Perron (1989) pointed that failure to allow for structural breaks can bias the unit root test towards non-rejection of unit root. Hence, this study uses unit root test developed by Zivot and Andrews (1992) and Narayan and Popp (2010) to account for structural break(s) in the series.

**Zivot-Andrew (1992) Unit Root Test**

We account for a single structural break by employing Zivot-Andrew (1992) Unit Root Test. In a seminal study, Sen (2003) has demonstrated that Model C version of the test minimises the loss of power and is relatively superior to Model A. Thus, this study uses Model C version of the Zivot-Andrews (1992) Unit Root Test that allows for a change in both slope and intercept. The null hypothesis is that tax revenue series is an integrated process without a structural break against the alternative hypothesis that tax revenue series is a trend that is stationary with a structural break in the trend function that occurs at an unknown time. The Zivot-Andrews (1992) unit root test is applied by estimating the equation (1) below.

\[
\Delta \ln TR_t = \omega_0 + \varphi_{y,t-1} + \beta T + \delta_i DU_i + \varphi_1 DT_i + \sum_{j=1}^{k} \tau_j \Delta \ln TR_{t-j} + \mu_t
\]

In equation (1), \(\ln TR_t\) is tax revenue series. \(T\) is time trend. \(\omega_0\) represents the constant. \(\Delta\) is the first difference operator, \(\mu_t \sim iid (0, \sigma^2)\), \(t = 1, \ldots, n\). The prime parameter of interest is \(\sigma\). The additional variable \(\Delta \ln TR_{y,t-j}\) is included in equation (1) to allow for serial correlation and ensure that the error term is white noise. \(DU_i\) is an indicator dummy variable for a mean shift occurring at time \(TB\), while \(DT_i\) is the corresponding trending shift variable, where \(DU_i = 1\) and \(DT_i = t - TB\) if \(t > TB\); otherwise 0. We follow Zivot and Andrews (1992) and set the ‘trimming region’ to \([0.15, 0.85]\). The break date is determined by selecting the value of \(TB\) for which the ADF \(t\)-statistic (absolute value of the \(t\)-statistic for \(\sigma\) ) is maximised.
**Narayan and Popp (2010) Unit Root Test**

Next, this study implements Narayan and Popp (2010) Unit Root Test that accounts for multiple structural breaks. In a recent study, Narayan and Popp (2013) examined small sample size and power properties of three unit root tests that allows for multiple structural breaks (see, for instance, Lee and Strazicich 2003, Lumsdaine and Papell 1997, Narayan and Popp 2010). They found that Narayan and Popp (2010) Unit Root Test has a better size, and high power, and identifies break dates more correctly. The Narayan and Popp (2010) Unit Root Test is implemented by estimating the following equations:

**Model 1**

\[
\ln TR_t^{M1} = \rho \ln TR_{t-1} + \lambda_0 + \beta * T + \theta_1 D(T_B')_{1,t} + \theta_2 D(T_B')_{2,t} \\
+ \delta_1 DU'_{1,t-1} + \delta_2 DU'_{2,t-1} + \sum_{j=1}^{k} \beta_j \Delta \ln TR_{t-j} + e_t
\]  

(2)

**Model 2**

\[
\ln TR_t^{M2} = \rho \ln TR_{t-1} + \lambda_1 + \beta * T + \kappa_1 D(T_B')_{1,t} + \kappa_2 D(T_B')_{2,t} \\
+ \delta_1 * DU'_{1,t-1} + \gamma_1 * DT'_{1,t-1} + \gamma_2 * DT'_{2,t-1} + \sum_{j=1}^{k} \beta_j \Delta \ln TR_{t-j} + e_t
\]  

(3)

Model 1 allows for two breaks in the level, while Model 2 allows for two breaks in the level and the slope. In equation (2-3), \( \ln TR_t \) is tax revenue series. We test the unit root null hypothesis of \( \rho = 1 \) against the alternative hypothesis of \( \rho < 1 \). In both models, the \( t \)-statistic of \( \hat{\rho} \) is denoted by \( t_{\hat{\rho}} \). The break dates in the series can be determined by grid search or sequential procedure. However, Narayan and Popp (2010) argue that that breaks are not much different and sequential procedure is less computationally demanding.
3. Results and Discussion

Unit Root Test Results without Breaks

Table 1 reports ADF and Phillips-Perron unit root tests results for tax revenue series for Fiji. Time series plot in Figure 1 indicates tax revenue has increased over time. Hence for the sake of completeness, the tests are conducted including both constant (C) and time trend (T). The test results indicate that the null hypothesis of a unit root is not rejected in levels as the test statistics are not significant. The test statistics for tax revenue in the first difference ($\Delta \ln TR_t$) is significant according to ADF and Phillips-Perron unit root test. The null hypothesis of unit root is only rejected in the first difference. Hence, $\ln TR_t$ is found to be a nonstationary process or I(1) variable.

Table 1. Unit Root Test Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>In levels</th>
<th>In first-difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ADF</td>
<td>Phillips-Perron</td>
</tr>
<tr>
<td></td>
<td>C &amp; T</td>
<td>C &amp; T</td>
</tr>
<tr>
<td>$\ln TR_t$</td>
<td>-1.567 (0.792)</td>
<td>-1.590 (0.783)</td>
</tr>
</tbody>
</table>

Note: The reported values are test-statistics. Figures in bracket are probability values. *** indicates statistical significance at 1 percent level. The unit root tests were conducted in Eviews program.

Unit Root Test Results with Breaks

Table 2 reports the unit root test results allowing for single structural break. The test statistic from Zivot-Andrews (1992) Unit Root Test is -3.895 and is less than the critical value of -4.820 at 10% significance level. Thus, the null hypothesis of a unit root with a structural break in both the intercept and trend is not rejected. However, when the unit root test was conducted with tax revenue expressed in first difference, the Zivot-Andrews test statistic is -6.774, exceeds the
critical value of -5.570 at 1% significance level. Thus, the results from Zivot-Andrews Unit Root Test suggest that tax revenue is a non-stationary process.

### Table 2. Unit Root Tests with Structural Breaks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Zivot-Andrew (1992) Unit-Root Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test-statistics</td>
</tr>
<tr>
<td>$\ln TR_t$</td>
<td>-3.895</td>
</tr>
<tr>
<td>$\Delta \ln TR$</td>
<td>-6.774***</td>
</tr>
</tbody>
</table>

*Note:* *** indicates statistical significance at 1 percent level. The unit root tests were conducted in Eviews. $k$ denotes optimal lag length.

In Table 2, we report the unit root test results based on Clemente-Montañés-Reyes’s (1998) Unit Root Test. The unit root hypothesis is not rejected in levels as the computed test-statistics are statistically insignificant. However, the unit root hypothesis rejected under both cases as the test-statistics is significant at 5 percent significance level. Thus, the unit root test results indicate that tax revenue is a non-stationary variable, $I(1)$.

### Table 3. Unit Root Tests with Multiple Structural Breaks Results

**Panel A : Clemente-Montañés-Reyes unit root test results**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model</th>
<th>Test-statistic</th>
<th>TB1</th>
<th>TB2</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln TR_t$</td>
<td>IO model</td>
<td>-3.142</td>
<td>1969</td>
<td>1986</td>
<td>0</td>
</tr>
<tr>
<td>$\ln TR_t$</td>
<td>AO model</td>
<td>-2.816</td>
<td>1976</td>
<td>1991</td>
<td>0</td>
</tr>
<tr>
<td>$\Delta \ln TR_t$</td>
<td>IO model</td>
<td>-6.243**</td>
<td>1980</td>
<td>2005</td>
<td>0</td>
</tr>
<tr>
<td>$\Delta \ln TR_t$</td>
<td>AO model</td>
<td>-6.302**</td>
<td>1979</td>
<td>2008</td>
<td>0</td>
</tr>
</tbody>
</table>

**Panel B : Narayan and Popp unit root test results**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model</th>
<th>Test-statistic</th>
<th>TB1</th>
<th>TB2</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln TR_t$</td>
<td>Model 1</td>
<td>1.431</td>
<td>1992</td>
<td>2005</td>
<td>4</td>
</tr>
<tr>
<td>$\ln TR_t$</td>
<td>Model 2</td>
<td>-2.067</td>
<td>1986</td>
<td>1999</td>
<td>0</td>
</tr>
<tr>
<td>$\Delta \ln TR_t$</td>
<td>Model 1</td>
<td>-6.465***</td>
<td>1981</td>
<td>1988</td>
<td>0</td>
</tr>
<tr>
<td>$\Delta \ln TR_t$</td>
<td>Model 2</td>
<td>-6.509***</td>
<td>1981</td>
<td>1988</td>
<td>0</td>
</tr>
</tbody>
</table>

*Note:* the reported figures are test-statistics. TB1 denotes first break date; TB2 denotes second break date. The Clemente-Montañés-Reyes unit root test was implemented in Stata. AO (additive outlier) model allows for sudden change in mean; IO (innovational outlier) model allows for gradual change. The critical value at 5% significance level is -5.490. *** indicates statistical significance at 1 percent level; ** indicates statistical significance at 5 percent level. For Narayan and Popp (2010), the reported figures are test-statistics. The critical values for Model 1: 1% (-5.259); 5% (-4.514); 10% (-4.143). The critical values for Model 2: 1% (-5.949); 5% (-5.181); 10% (-4.789). The critical values were extracted from Narayan and Popp (2010). The Narayan and Popp (2010) unit-root test was implemented in Gauss 15.0.
Panel B reports the unit root test results based on Narayan and Popp (2010) Unit Root Test. The computed test-statistics for Narayan and Narayan (2010) unit root test is 1.431 and -2.067, for Model 1 and Model 2, respectively. In both cases, the test statistics are statistically insignificant. Under Model 1, the estimated break dates are 1992 and 2005 that coincides with introduction of Value Added Tax (VAT) and reduction of corporate tax rate in Fiji. Under Model 2, the estimated break dates are 1986 and 1999 that are close to Fiji’s first political coup in 1987 and May 1999 general elections and political coup in 2000. The null hypothesis of a unit root is therefore rejected at 1 percent significance level, once tax revenue series are expressed in the first difference.

Tax revenue is best described as a non-stationary process, implying that shocks are likely to exert permanent impact on tax revenue. The evidence of non-stationarity here indicates that following a shock, tax revenue series does not return to its trend path. This implies that the adverse shocks are likely to have permanent depressive impact and tax revenue is less likely to improve with temporary policy measures. Temporary tax cuts are unlikely to be significant help in changing tax revenue. The evidence of non-stationarity also indicates that an adverse shock to tax revenue is likely to be transmitted to other related sectors of the economy. Policy intervention is therefore required to shelter the tax system from adverse external shocks using permanent policy measures. Our finding also indicates that future studies should carefully select their econometric methodology when modelling tax revenue. Evidence of non-stationary also suggests that past values of tax revenue will be of little use in forecasting future values of tax revenue. Hence, exploring other determinants of tax revenue is important.
4. Conclusion and Policy Implications

Over the last decade, the Fijian government has implemented a number of tax reforms. While tax revenue collections has increased rapidly, the announced expenditure plans in 2017-2018 budget has raised much concern regarding sustainability of public debt in Fiji. An important aspect of examining sustainability of public finance requires understanding the future path of tax revenue, and its response to (domestic and external) shocks. The main goal of this paper was to fill this gap in the literature by undertaking an empirical analysis of tax revenue using a suite of unit root tests allowing for endogenous structural breaks using annual data from 1963-2014. The major finding is that tax revenue is best described as a non-stationary process.

Our finding has important policy and research implications. Our finding implies that adverse shocks to tax revenue are likely to have permanent impact and transmitted to other related sectors of the economy. It follows that different tax-related reforms are bound to have permanent impact on tax revenue in Fiji. Our study has important implications for designing and evaluation of future tax reforms in Fiji. The result here suggests that there is a strong case for the Fijian government to undertake “permanent” rather “temporary” tax revenue reforms to improve revenue collection. For instance, temporary tax cuts will not result permanent changes in tax revenue. However, public education and awareness on a regular basis are likely to be more effective in improving tax revenue.

The findings here also suggest that it will be difficult for the government to sustain public finance in the absence of policy measures to shelter the tax system from adverse economic,
policy or weather-related or other external shocks. With the recent Cyclone Winston in 2016 costing an estimated 30 percent of Fiji’s GDP (International Monetary Fund 2018) and influencing expenditure plan in 2017-2018 (Government of Fiji 2017), climate change is bound to test resilience of tax system and influence the government’s ability to fulfill its expenditure ambitions. This calls for policy reforms to build a resilient tax system.

Another important implication from this study is that future studies on modelling tax revenue in Fiji should exercise caution particularly in their choice of econometric methodology. Since tax revenue is a non-stationary variable, regressing it on another non-stationary variable, in absence of cointegration between the variables would give rise to spurious regression, and produce misleading policy implications. Furthermore, since tax revenue is a non-stationary process, its past behavior is of little importance for forecasting tax revenue. In this case, researchers should consider studying other determinants of tax revenue. In light of changing donor priorities, growing concerns regarding climate change and competition in the foreign markets, Pacific Island Economies need to strengthen their tax system, and as such undertaking a similar study for other countries in the region are likely to be quite insightful on the response of tax revenue following tax-related reforms and other domestic and external shocks.
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References


International Monetary Fund. 2018. 2017 Article IV Consultation with the Republic of Fiji. Washington, D. C. 20431 USA.


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