TAX SMOOTHING HYPOTHESIS: A CASE OF PAKISTAN

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Abstract

Tax Smoothing Hypothesis (TSH) proposes that a government seeks to minimize tax distortions and does not vary tax rates directly with changes in expenditures. Instead expenditures are financed by debt and a constant tax stream is maintained. This thesis explores if TSH holds for Pakistan and finds evidence of Tax Smoothing from 1976-2014 as tax rate series exhibits unit root properties, and the lagged values of tax rates do not influence contemporaneous tax rates changes. Moreover, tax rates are not affected by changes in government expenditures and real GDP growth rate. These results are consistent with the properties of the TSH and explain fiscal imbalances in Pakistan.

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1. Introduction

Tax Smoothing is a theory of optimal public finance which was first developed by Barro (1979). It outlines the factors that influence a choice between public debt and taxation; primarily tax smoothing results when the government chooses to minimize the distortions associated with taxation and evenly spreads these distortions across all time periods. Given the long-run balanced budget constraint, minimization of total costs of taxation means that planned tax rate over time will be constant (Strazicich, 2002, p. 2325). The Tax Smoothing Hypothesis (TSH) also provides a positive theory of government debt management as it develops that given a constant planned tax rate any temporary budget expenditures and temporary deviations of output from their permanent levels are financed by debt, and there is no change in tax rates due to these factors. This theory can be empirically tested because the hypothesis implies that tax rates follow a random-walk behavior as changes in tax rates are unpredictable. Furthermore, due to this behavior of tax rates, lagged information should not be useful in the determination of taxation changes.

This thesis probes if the fiscal patterns of tax revenue, government expenditure, and real output fall under the tax smoothing theory of public debt management for Pakistan from 1976-2014. Pakistan has a long history of running fiscal deficits with tax revenue falling short of the government's expenditures. The study of Pakistan's budget imbalances is important as the large fiscal deficits do not follow periods of high inflation or negative growth in income (Cashin et al., 2003, p. 48). High debt levels in Pakistan are a pressing macroeconomic issue and a rationale for deficits in light of this theory could help in expanding the understanding of debt and taxation patterns of the country. With more detailed information on how taxation and debt are allocated, better solutions to manage high levels of debt could be drawn for the country.

The empirical strategy I employ in this thesis directly tests if tax revenues as a percentage of GDP follow a random-walk by conducting unit root tests. Additionally, to test if lagged values of changes in expenditures, output growth, and taxation have an effect on contemporaneous tax rate determination, this paper also includes autoregressive, and a vector autoregressive model. Previous research on tax smoothing in Pakistan (Padda, 2010; Cashin et al. ,2003) has relied on more indirect means of testing for tax smoothing by checking if budget surplus granger-causes change in government spending as based on the theory budget surplus has some information about the future changes in government expenditures. Moreover, previous research on tax smoothing also relied on a decomposition of temporary and permanent expenditures to analyze if temporary expenditures have no effect on tax determination. However, a problem, with this strategy is the manner in which the decomposition is undertaken. As a result the conclusions on tax smoothing are heavily dependent on the methodology with which the expenditures are split in various components. To overcome this issue, I directly test if tax revenue follows a random walk behavior by employing unit root tests. The unit root tests exhibit low power for the short time series available for the Pakistan; therefore to obtain more robust conclusions lagged changes are used to see if tax smoothing holds for Pakistan.

The results show that for the sample period there is evidence of tax smoothing for Pakistan as I fail to reject the null hypothesis of unit root. The autoregressive estimation and the vector-autoregressive (VAR) model also corroborate these results as tax rates changes are not influenced by the changes in government expenditure or real GDP growth rate. These findings are also consistent with prior literature on Pakistan which also finds evidence of tax smoothing.

The thesis is organized as follows. Section 2 details the theoretical foundations of the tax smoothing hypothesis, followed by literature review on tax smoothing. Section 4 provides an overview of Pakistan's fiscal policies. Data Description is covered in section 5, Section 6 explains the empirical strategy adopted, and Section 7 describes the results. The last section concludes the paper.

2. The Tax Smoothing Hypothesis

The hypothesis was first laid out by Barro (1979); the paper used the tax smoothing hypothesis to develop a theory of optimal financing explaining factors that determine a choice between debt and taxes. The main theme in this seminal paper is that deficits vary instead of tax rates as government expenditures change. Thus stable tax rates are maintained which are not as volatile as the changes in government expenditures.

The model is based on the government's budget equation in which the present value of expenditures and initial public debt is equal to the present value of taxes as specified in equation 1 below:

$$\sum_1^\infty \frac{\mathrm{Gt}}{(1+r)^t} + bo = \sum_1^\infty \frac{\tau_t}{(1+r)^t} \tag{1}$$

where,

G_t = public expenditure net of interest payments on public debt in time period t

τ_t = real tax revenue obtained in time period t

r = real (=nominal) interest rate assuming constant prices (Barro, 1979, p. 942).

Under this set up, with exogenous government expenditures and a fixed initial debt level, the present value of taxation can be determined. The fixed nature of the present value leaves space for the determination of the time pattern of taxes (Barro, 1979, p. 943). The constraint here lays out the mechanisms with which a government finances its expenditures, they are debt and taxes only; and the model does not consider creation or printing of money as a mode of government financing (Barro, 1979, p. 942).

Another aspect considered by Barro (1979) is the costs involved in the collection of taxes, which are termed as "dead weight losses" or "excess burdens". For the given present value of taxes, the present value of the excess burden is determined by tax distribution by type and the timing of taxes. The present value of the given costs is given by:

$$Z = \sum_1^\infty \tau_t f\left(\frac{\tau_t}{Yt}\right) / (1+r)^t \tag{2}$$

where,

Z is the total collection costs of taxes t=1,2,3….∞,

Y_t = Real Income or taxable resources

The basic model does not take into account the composition of taxes by type; instead it just focuses on the timing of taxes (Barro, 1979, p. 943). In each time period the government has a planned series of expenditures G_1, G_2, G_3… which are financed by the anticipated real income values Y_1, Y_2, Y_3…; real interest rate, and the initial stock of public debt b_o (Barro, 1979, p. 944).

Thus the objective of the government is the cost minimization strategy under which the costs are optimally selected. The optimization problem is to choose τ_t t=1,2,3,…. in each time period from equation (2) subject to equation (1). The first order conditions obtained here require that the marginal costs for raising taxes are same in each period (Barro, 1979, p. 944). This planned constancy of τ/Y ratio is the central outcome of the tax smoothing hypothesis. This leads to the first empirically testable implication of the hypothesis that the tax rates follow a random-walk behavior as changes in tax rates are unpredictable. The government sets the taxation rates to minimize the costs of taxation over time. Given the constraint of a balanced budget as specified in equation (1), minimization of excess burden or dead weight loss associated with taxation would result in a constant tax rate over time. The distortions are evenly dispersed across time periods thus any changes in tax rates are unpredictable.

The tax smoothing model was further developed by Atish Ghosh (1995) who built on Barro's model where the government optimized or minimized costs associated with raising revenue by distributing the costs constantly across time periods by having a constant rate of taxation. This extension of the model focuses on the optimal path of budget surplus. Consequently, an optimal budget surplus is equal to the present value of the government expenditures can be compared to the actual budget surplus to see if the taxes are smoothed over time (Ghosh, 1995, p. 1034). The dynamics of taxes are understood indirectly by exploring the relationship between budget deficits or surpluses and the government revenue (Ghosh, 1995, p. 1036). The paper formulates that under tax-smoothing budget surplus or deficit should reflect any changes in the government expenditures which are temporary. The optimization problem sets the present value of changes in government expenditures equal to the budget surplus (Ghosh, 1995, p. 1038). The actual budget surplus is defined as:

$$SUR_t = \tau_t - g_t - (r-n)\, d_t \qquad (3)$$

where,

τ_t= tax rate in time period t,

g_t= ratio between government expenditure and GDP in time period t,

d_t=debt/GDP in time period t,

n= growth of output as a fraction of GDP, and

r= real interest rate constant (Ghosh 1039).

It is compared to the optimal budget surplus defined as:

$$SUR_t^* = \sum_{j=1}^{\infty} R^j E\{\Delta g_{t+j} \mid \Omega_t\} \qquad (4)$$

where,

$E\{\Delta g_{t+j} | \Omega_t\}$ = expectation of change in government expenditure as a fraction of GDP conditional on the information set of government in time period t,

R= (1+n)/ (1+r) (Ghosh, 1995, p. 1039).

These equations result in the second testable implication of the tax smoothing model under which budget surplus should Granger-cause subsequent changes in government expenditure. This is dependent on the information about the future path of government expenditures, the surplus granger-causes Δg_t as long as the government has more information about the changes in g (Ghosh, 1995, p. 1039). The theory developed by Ghosh underscores a specific relationship between budget surplus and government expenditures. Temporary increases in expenditure are financed by budget deficits or lower surplus butt an anticipated future increase in expenditures is financed by increase in taxes this (Ghosh, 1995, p. 1042). A comparison between the actual and optimal budget surpluses could be tested empirically and help determine if the tax-policy adopted follows a tax-smoothing pattern or not.

A third testable implication of the tax smoothing hypothesis is the effect of temporary and permanent expenditures on taxes or deficits. Barro (1979) considered wartime expenditures and depression as the temporary expenditures. He theorizes that the temporary component of government expenditure has no impact on taxes in the current time period (Barro, 1979, p. 948). Further development of the model based on the decomposition of expenditures into permanent and transitory components was undertaken by Sahasakul (1986). Based on this approach government should change taxation in response to just a change in permanent component of government expenditure. To derive a tax equation which can be tested empirically Sahasakul (1986) works with the budget constraint similar to equation (1). He develops a series of average marginal income tax rate which is estimated by the following equation:

$$\tau_t^m = \left(\frac{1}{\theta}\right) g_t + \left(\frac{\rho}{\theta}\right) b_{t-1} + \varepsilon_t \qquad (5)$$

where,

τ_t^m=marginal tax rate,

θ =ratio of optimal tax rate to marginal tax rate,

g_t= real government expenditure/real output,

ρ= real interest rate minus growth rate of real output,

b_{t-1}= ratio of outstanding debt to real output, and

ε_t= white noise error term (Sahasukal, 1986, p. 257).

The government expenditure is then decomposed to a temporary and permanent component. For the analysis the permanent component constitutes defense and non-defense parts. Defense includes real defense purchases and non-defense consists of federal purchases and transfer payments (Sahasukal, 1986, p. 257). The temporary decomposition is the difference between actual and permanent spending ratios (Sahasukal, 1986, p. 259). The model sets out to test if there are any co-movements between temporary government spending and tax rates. The presence of this co-movement constitutes as evidence against tax smoothing.

These models together provide the empirically testable assumptions that can be used to find evidence for tax smoothing. I test the unpredictability of tax rates changes as set forth in the initial model.

3. Literature Review

There are numerous papers testing the tax smoothing hypothesis (TSH) for single countries. Most of the research is centered on the United States and other developed countries and literature on developing countries is not that intensive. In this section the techniques employed to assess TSH are covered, the countries for which the hypothesis is tested, and the variations of the model are also included.

One of the earliest papers which found evidence of tax smoothing for United States was Barro (1979) which also laid the foundation of the theory. Further research on United States includes Ghosh (1995) who developed a model for intertemporal tax smoothing based on optimal fiscal policy where permanent expenditures must be financed by a rise in taxation without an increase in budget deficits. Here the author developed that taxation costs associated with temporary government expenditures must be spread over time so these expenditure shocks are financed by budget deficits. This paper explains the budget deficits in U.S. and Canada at federal government level for the period from 1962-1988 and finds evidence for tax smoothing.

A different methodology to find evidence for TSH was undertaken by Sahasakul (1986); he rejected the hypothesis for United States for the period 1937-82. The strategy focused on a decomposition of expenditures between permanent and temporary components and asserted that under the assumption of uniform taxation; only 'permanent' expenditures should lead to a change in tax rate. The taxation rates involved here are the marginal rates and the author found that in addition to permanent factors the tax rates also respond to other factors including temporary defense purchases, general price level, and time trend. As a result of this response the taxation patterns are said to not be consistent with tax smoothing behavior.

Another paper by Huang and Lin (1993) tested implication that in anticipation of an increase in growth rate national income or a decline in government expenditures, the government will run a budget deficit. They evaluated the tax smoothing hypothesis for U.S. data from 1929-1988 using cross-equation restrictions on a vector auto-regression (model). The methodology focused on log-linearization of the relationship between budget deficits and expected growth rates of government expenditures, and aggregate output. Their results showed that TSH is rejected for the period 1929-1988 but for post-1947 period they find an evidence of TSH.

For local and federal government Strazicich (1997) checked the implication of random walk for tax rates for Canada and United States. Prior to this paper most of the research focused on federal tax rates and was based on consolidated federal government data in the analyses. He found that for United States between 1930-1990 average tax rates results are consistent with tax smoothing for federal government but the hypothesis was rejected for state and local governments. Canadian federal and provincial average tax levels are consistent with tax smoothing from 1927-1990.

To further enhance the model and introduce different types of assets, Aiyagari et al. (2002) studied the model in an incomplete market setting and introduced risk-free government borrowing. Their results showed that the random walk properties of optimal taxation hold under restrictions on preferences and quantity of risk-free securities; without these restrictions on government asset holdings the results fail to hold. Bohn (1990) also build on the deterministic model proposed by Barro (1979) and tested the optimal government tax setting in a stochastic setting by adding risky securities to the model. The proposition tested is that optimal tax rate smooth taxes over time and also over different states. For a given set of exogenous securities, the optimality condition was that the tax rate is uncorrelated with the returns on these securities. For U.S. data, tax smoothing was not rejected based on time paths. However, the tax rates were correlated with return on securities as a result TSH fails to hold for U.S. data. Based on the findings of this paper and the theoretical model developed by the author, the optimal tax policy is intended to minimize distortions related to taxation and it is also aiming to avoid inter-temporal distortions of tax rates as a consequence taxes are smoothed over time and across different states (or different combinations of assets).

Other variations of the model include the paper by Malley et al (2003). Here a general equilibrium model is set up in which a benevolent government chooses a path of distorting income tax rates to finance provision of public services. Due to the general equilibrium setting the theoretical model in addition to constant tax rates across time periods also derives the constancy of output shares of private consumption, private capital, government production series and government consumption over time. However, they do not find empirical support for this theoretical model for 22 OECD countries which they included in their analysis for the period 1960-1996. Another test in the general equilibrium context is undertaken by Angyridis (2008). The paper by focusing on the outcomes from numerical simulations conducts a comparison between balanced budgets vs. tax smoothing optimal budget for a small open economy. The paper concluded that there are significant welfare gains in a scenario when the government is allowed to lend and borrow and is allowed to smooth taxes across time periods instead of the scenario where the government is expected to maintain a balanced budget in all time periods and not incur deficit.

Fisher and Kingston (2004) derive the conditions for tax smoothing in a small open economy. Here instead of the government's loss (cost) function the model builds on the micro-foundations and developed the model with an understanding of the properties of households. They develop the necessary and sufficient conditions under which tax smoothing is optimal or the tax rates exhibit martingale-like behavior, in an environment when households are risk averse, the markets are incomplete and the economy is subject to business cycles.

Reitschuler (2010) found evidence of tax smoothing hypothesis for European countries and also assessed the welfare consequences of the Maastricht-deficit rule. Under the rule the countries had to somewhat give up their fiscal policy discretion and manage deficits up to 3% of GDP. As a result, a government cannot run high deficits in order to smooth taxes over time. His results find evidence of tax smoothing for Germany, Greece, Portugal and the Netherlands but once adjusting for the structural break of Maastricht-deficit rule in 1993 the hypothesis is rejected for all 15 countries in their sample. He found evidence that the introduction of this fiscal policy rule inhibited the government's control over smoothing taxes over time. Sweden's fiscal policy has exhibited most volatility compared to all the OECD countries with no restrictions on budget policy the budget balance displayed high variance. Adler (2006) tests if tax smoothing explains these changes in the fiscal deficits for Sweden. If the hypothesis holds true budget surplus granger causes changes in government expenditure. The empirical evidence failed to reject tax-smoothing for 1952-1999 but for the period 1970-1996 it is rejected. The results of the author indicate that 60% of the volatility of budget surplus can be explained by tax-smoothing.

Jayawickrama and Abeysinghe (2013) established that a random walk is a necessary but not a sufficient condition for tax smoothing. The authors constructed the sufficient conditions for tax smoothing, they derive that these conditions are due to co-integration between future tax rates and current permanent government expenditure. They also established various degrees of smoothing by distinguishing between 'strong-tax smoothing, 'weak-tax smoothing', and 'no-tax smoothing' based on the cointegration parameter. They checked this model on eight OECD countries and concluded that the permanent changes in government expenditures led to changes in tax rate but 'weak-tax smoothing' was also displayed when the tax rates responded to some temporary changes as well.

Serletis and Schorn (1999) test the integration and co-integration properties of the series and apply alternative methodologies to analyze both tax- and revenue-smoothing hypothesis for US, UK, France, and Canada for the sample period from 1950-1994. Their alternative strategies which included single-equation approach, and the multi-equation VAR approach, and their unit root tests provide support for tax-smoothing in the data. Their approach is different as they also incorporate the alternative financing method available to the government through creation of money in the analysis and also suggest optimal seigniorage.

Olekalns (1997) analyzed the implications for three decades of Australian data from 1964-1995 and concluded that the actual surplus was too volatile and not consistent with tax smoothing. Additionally, the paper also accounts for the tax-tilting motivation of the government to support a budget policy, which focuses on inter-temporal transfers of surpluses or deficits that are aligned with the government's incentives to support a deficit in present or transfer it to a future time period. Adjusting for tax-tilting parameter this paper finds systematic differences between actual and optimal budget surpluses.

Most of the research on the topic focuses on single country tests to find evidence for tax smoothing. Strazicich (2002) found evidence of tax smoothing in a panel of nineteen countries by using the central government data from 1955-1988. Pooling time series increases the power of the unit root tests to reject the null hypothesis. Aside from the non-stationarity tests of tax rates series, the paper also examined political and economic variables and their significance in predicting tax rate changes. He found that political variables were not significant for tax smoothing; the political factor analyzed was the level of political cohesiveness of the government.

In comparison to the numerous research papers on developed countries which employ a number of techniques and test the hypothesis for different time periods; work on the developing countries is scant and all of which is focused on single country analysis.

Karakas et al. (2014) look for evidence for the hypothesis for Turkey from 1923 to 2011. Their methodology focused on unit root tests, auto-regression and vector auto-regression models which are applied to tax rates, government expenditures, and real output data. The results obtained by the authors found support for tax smoothing as the tax rate series displayed non-stationarity and also failed to reject the joint insignificance of lagged values of tax rates which supported the assertion that past changes in taxes do not affect the present changes in tax rates. However, their VAR results do not support the model. Similarly, for Indonesia random walk behavior of tax rate was tested by Kurniawan (2011) by employing unit root tests, and tests of predictability of tax rates based on its lagged values, and lags of changes in government expenditure ratio and growth of real output. Their results support the tax smoothing hypothesis for Indonesia from 1969-2008 as the tax rate changes are not predictable. This literature tests the implication that the government smooths the tax rate over time to minimize distortionary costs of taxation over time for a given path of government spending, instead of changing taxes in line with expenditure the government runs a budget deficit and thus tax rate follows a random walk. The methodology that I employ to test TSH for Pakistan is based on the strategy of these two papers.

Cashin, Haque and Olekalns (2003) analyzed the fiscal deficits of Pakistan and test the overall sustainability of the fiscal policy. They use the model prediction that under non-lump sum taxes, the government intends to minimize distortions imposed by the tax policy and the government intends to maintain constant tax rates over time instead of changing the tax rates in each period as the expenditures change. They first tested Barro's (1979) model of tax smoothing to see if evidence for Pakistan is consistent with tax smoothing from 1956-

1995. Their empirical results showed that tax rates in Pakistan follow a random-walk and thus the tax rate would only change due to unanticipated information about future expenditures. They also set out to see if budget surplus granger-causes change in government spending as tax smoothing predicts that budget surplus has some information about the future changes in government expenditure. They found evidence for tax smoothing as the government had budget imbalances (ran deficits) due to expected future changes in government spending. Their premise for concluding that tax smoothing hypothesis exists for Pakistan was the graphical similarity between actual and optimal budget surplus.

Padda (2010) also studied the welfare costs of fiscal policy for Pakistan for the period from 1965-2007. The paper studied the optimal fiscal policy options of taxes, expenditures and public debt. The paper first found evidence of tax-rates' random walk behavior confirming the validity of tax smoothing. In the second stage the paper decomposed the expenditures into permanent and temporary components and tested that the permanent component of the government expenditure rate should move along with the tax rate series for tax smoothing to hold. The cointegration of the two series established a long-run relationship between the permanent expenditure rate and the tax rates. He used an Error Correction Model to find evidence for this relationship and also included transitory component of expenditures and the growth rate of money supply (M1) to control for inflation and seigniorage effects. Their results showed that evidence of tax smoothing in Pakistan is weak and the short-run current taxes are affected by previous period's permanent expenditures but not by previous period's taxes. Thus the permanent expenditure component is not the only factor influencing the tax rates and temporary variables also influence the tax-rates. Based on the strategy employed in this paper the evidence on tax smoothing is weak for Pakistan. To contribute to this literature, I additionally test the hypothesis by evaluating a relationship between tax rates, government expenditure changes, and real GDP growth rate.

4. Pakistan's Fiscal Overview

Pakistan has a long history of running fiscal deficits. From 1965 to 1972 there were many internal disturbances, political tensions, and international conflicts as a result of which defense expenditures increased in Pakistan. The policies in the 1970s were inspired by socialist ideology and consequently there were large-scale nationalizations and public sector investments and Pakistan's fiscal expenditures mounted during this time (Cashin, Haque and Olekalns, 1999, p. 7). In 1971 East Pakistan separated from West Pakistan, now called Bangladesh and Pakistan respectively. After the political transition, Pakistan adopted the 1973 constitution which gave the Federal government power to borrow for the purpose of financing the government expenditures within the limits proscribed by the parliament (Khan, 2003, p. 11). However, in the 1980s the parliament did not actively moderate the limits to control the growing revenue-expenditure gap (Khan, 2003, p. 11). During this time the government had deals with international organizations and there was a great influx of foreign debt in Pakistan. Borrowings increased from 60% in 1990 to 102% by 2000 (Khan, 2003, p. 17). The budgetary imbalances in Pakistan have been an issue as the revenues were not able to cover current expenditures, and debt accumulation since 1990s developed as one of the most pressing economic issues in Pakistan (Kazmi, 2014, p. 82). Pakistan's public debt in 2014 was Rs.15,534 billion about 70% of which was domestic debt and remainder external or foreign debt (Kazmi, 2014, p. 82).

Another trend in the fiscal system in Pakistan has been the lower budget deficits target which the country has to achieve as a requirement for specific conditionality for foreign loans from International Financial Institutions. To meet these targets the country has reduced its development expenditure hampering future growth potential (Kazmi, 2014, p. 89). These trends highlight that the fiscal policy in Pakistan has not been independent of pressure from external groups as well as pressure from lenders in order to meet the debt requirements. This is also clearly evident from the expenditure shares and the change in their compositions; in

1984-1985 development expenditure received a higher share than defense, and debt-servicing ranked third in this list. In comparison for 2014-2015 the highest share of public spending was related to debt servicing, development ranked second, and defense expenditures ranked third (Kazmi, 2014, p. 81).

In order to address the issue of high debt levels Fiscal Responsibility and Debt Limitation (FRDL) Act was introduced in 2005 which stipulated specific conditions for the purpose of maintaining public debt within certain limits (Kazmi, 2015, p. 85). The law was meant to maintain revenue expenditures and revenue receipts so they are in line with each other and that the public debt is under respectable limits. Since the law was introduced till 2014 Pakistan was unable to meet the stipulated conditions which reflect that poor fiscal management is still an unaddressed issue for the country.

5. Data Description

The data series for Pakistan was collected from the Handbook of Statistics on Pakistan Economy 2015, published by the State Bank of Pakistan (SBP). The handbook contains historical data on different areas pertinent to Pakistan's economic performance collected from different Annual Economic Survey of Pakistan.

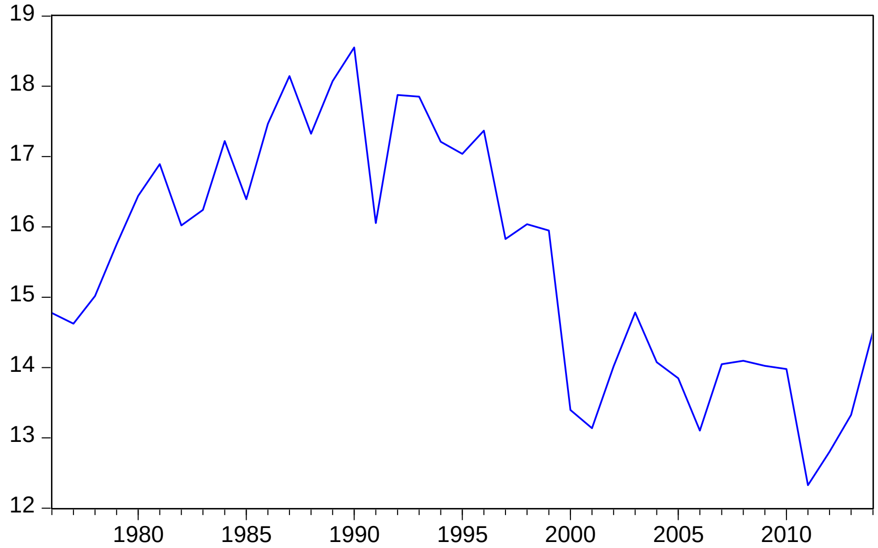
For this analysis of tax smoothing data on tax revenues, government expenditure, and real GDP growth rate is required. According to Kurniawan (2011) tax rate is calculated as central government revenue as a fraction of GDP, expenditure rate is calculated as central government's spending as a fraction of GDP, and the author adjusts nominal GDP by Consumer Price Index for constructing real growth rate series (Kurniawan, 2011, p. 192).

Here instead of the above definitions I use the data only on tax revenue as a fraction of GDP to calculate tax rates. This is because the taxation revenue data included a breakdown of all the revenue receipts of the government and total tax revenue is calculated by adding direct- and indirect- taxes as well as surchages on natural resources natural gas, petroluem, and other natural resources. According to the notes in the handbook direct tax is directly levied on the taxpayer such as income and property tax, while indirect tax is levied on goods and serives (Ahmad et al. 933). The data series was recorded from 1976-2014 and included the consolidated figures for both the central (or federal) government and the provincial governments. The values are denominated in Pakistani Rupees. Descriptive statistics for the data series are displayed in Table 1 and Figure 1 shows the trends in the taxation revenue data series from 1976-2014.

Table 1. Descriptive Statistics (1976-2014)

	Tax Rate (%)	Expenditure (%)	Real GDP Growth Rate (%)
Mean	15.5	22.2	4.9
Median	15.8	22.9	4.7
Maximum	18.5	26.7	9.0
Minimum	12.3	16.9	0.36
Standard Deviation	1.7	3.1	2.02

Figure 1. Trends in Total Tax Revenue as a percentage of GDP (1976 – 2014)



Similarly, for expenditures this paper used the consolidated federal and provincial data, and real GDP growth rate series for the period 1976-2014 is obtained from the handbook. The trends in the series are displayed in the figures 2 amd 3 below.

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Figure 2. Trends in Total Expenditure as a percentage of GDP (1976-2014)

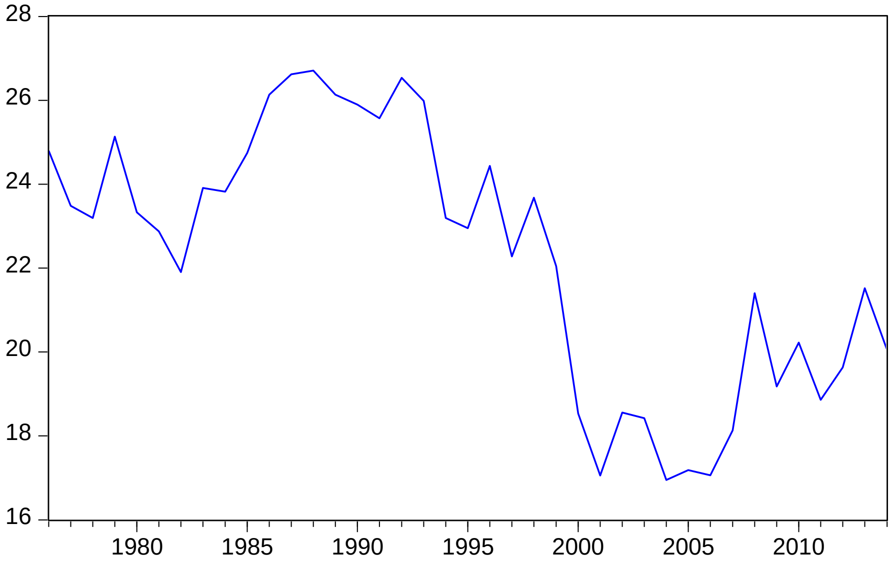
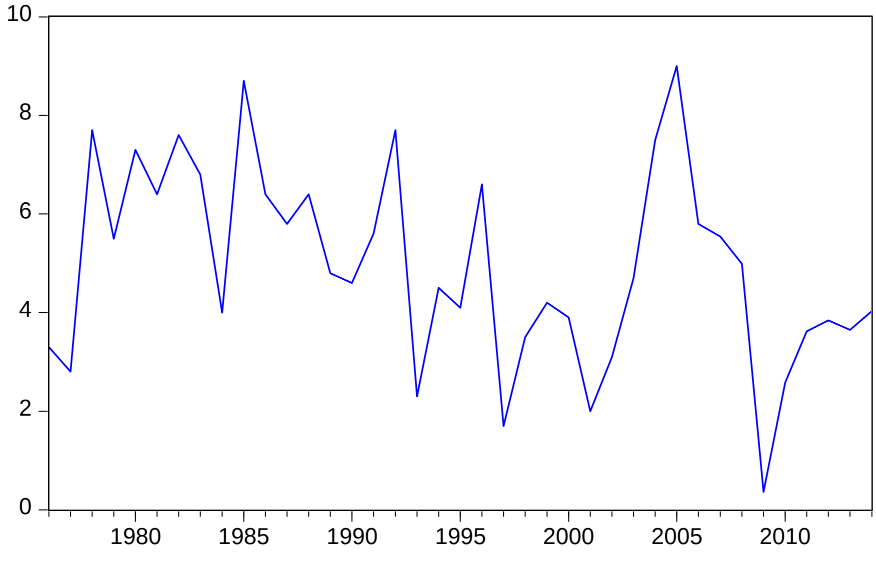


Figure 3. Real GDP Growth Rate (1976-2014)



6. Empirical Strategy

The empirically testable assumptions of tax smoothing were described in section 2 on tax smoothing. This paper will contribute to the literature of tax smoothing on Pakistan by testing the unpredictability of changes in tax rates by using the methodology employed by Kurniawan (2011). The methodology is different as the prior research methods on Pakistan are more indirect means of testing for tax smoothing as they analyze the relationship between government expenditures and surplus. It also focused on the permanent and temporary expenditure components effect on taxation; decomposition of these expenditures is sensitive to the methodology adopted. However, the methodology employed in this paper directly tests the government budget equation and the cost constraint specified by Barro (1979).

The criterion for this form of empirical testing was developed by Barro (1990) when he analyzed the future tax rates, and patterns and unpredictability of taxes. The primary hypothesis tested is that τ_t is constant in all time periods. The constancy of tax rates emerges when the expected future values of real government spending, and output are equal to their mean values conditional on information at time t (Barro, 1990, p. 269). τ_t is derived from the intertemporal budget constraint of the government which is specified in equation (1). The important result from the above model is that in each time period t τ_t is determined such that:

$$E(\tau_{t+i} \mid I_t) = \tau_t \qquad (6)$$

where, i = 1, 2, 3 …

I_t = information at time t (Barro, 1990, p. 269). In the first difference form, the above results mean that changes in tax rates are unpredictable and can be expressed as $E(\tau_{t+i}-\tau_{t+i-1} \mid I_t) = 0$ for t = 1,2,3,….. (Barro, 1990, p. 269).

Kurniawan (2011) tests this random walk implication by using the null hypothesis of a unit root in the tax rate series. This paper will also employ unit root tests including

Augmented Dickey Fuller (ADF), Phillips-Peron (PP) and Kwiatkowski-Philips-Schmidt-Shin (KPSS) on the data for Pakistan.

The unit root tests are important to understand the patterns in a time series whether it is stationary or non-stationary. A time series is stationary if its joint distribution is time invariant, which means the moments of distribution are constant over time and so are the correlations across time periods which stay constant (Mahadeva and Robinson, 2004, p. 6). In practice, however, most macroeconomic series are short as a result testing for the above condition is difficult, so instead covariance stationarity is tested. Under covariance stationarity the mean, variance, and covariance are independent of time. The random-walk series below represents a non-stationary series:

$$x_t = x_{t-1} + \varepsilon_t,\ \varepsilon_t \text{ i.i.d } (0, \sigma^2) \qquad (7)$$

Thus the unit root test checks if the time series is non-stationary and possesses a unit root against the alternative of stationarity based on the test employed (Mahadeva and Robinson, 2004, p. 6).

The Augmented Dickey Fuller Test uses the null hypothesis of unit root against the alternative of stationarity. It also addresses serial correlation by including lagged dependent variables in the test and there are several different methods used to select the optimal number of lags (Mahadeva and Robinson, 2004, p. 20). Philips-Peron is an alternative non-parametric test used for testing unit roots, as a non-parametric test it can be applied to a broad range of problems as it does not assume a functional form of the error process of the variable (Mahadeva and Robinson, 2004, p. 29). KPSS test is employed with the null of stationarity against the alternative hypothesis of the unit root.

One limitation of this method is that unit root tests exhibit low power in small samples that are usually available for macroeconomic series especially for developing countries. Robinson and Mahadeva (2004) explain that power of the test is the probability of rejecting a false null hypothesis when the alternative hypothesis is true. In this case low power means that probability of falsely concluding that the variable has a unit root is higher. A way around this problem is to conduct multiple tests of unit root and if the results are similar then they could lend credence to the hypothesis that the series has a unit root. Moreover, additional tests that do not rely on detecting unit roots could also support the results.

Methodology employed by Kurniawan (2011) also goes beyond unit root tests and employs autoregressive tests for changes in tax rates and also conducts vector autoregressive (VAR) tests to see if output growth and government spending have an important role to play in the determination of tax rates. This paper will also employ similar strategy to assess the tax rates for Pakistan.

To assess if the lagged values of the dependent variable are significant in explaining the tax rates the autoregressive model of tax rates is tested by the equation below as adopted by Kurniawan (2011):

$$\Delta\tau_{t=}\alpha_0 + \Sigma_{i=1}^{k}\alpha_i\Delta\tau_{t-i} + \varepsilon_t \qquad (8)$$

The number of lags is selected using Akaike Information Criteria AIC, which is based on information theory and is used for model selection by specifying the number of parameters involved (Liddle, 2007, p. 1).

The joint significance of the lagged variables is tested with the null hypothesis:

Ho: α_1=α_1=…=α_k= 0 (Kurniawan 192).

The alternative hypothesis is that at least one of lags involved are significant and thus previous period’s tax rate is important in determining the contemporaneous taxation rates, which is the evidence against the tax smoothing hypothesis. An autoregressive model is used to assess if the prior values of the dependent variable are important in the determination of current time period values of the dependent variable (STAT510, 2017, p. 1).

Lastly the vector autoregressive model (VAR) is employed to see if tax rates changes are determined by the lagged values of changes in tax rates ($\Delta\tau_t$) along with changes in government expenditure(Δg_t) and the real output growth rate (γ_t). VAR expresses each variable as a linear form of its past values, as well as the past values of other variables been taken into account and a serially uncorrelated error term (Stock and Watson, 2001, p. 102). The number of lags included in each equation can be determined by different selection methods such as Akaike Information Criteria and Schwartz Criteria. The error terms in the equations are the "surprise" movements in the variables after lagged variables are taken into consideration (Stock and Watson, 2001, p. 102).

The VAR model estimated is:

$$Z_t = \delta + \omega_1 Z_{t-1} + \omega_2 Z_{t-2} + \ldots + \omega_p Z_{t-p} + \mu_t$$

where,

$Z_t = [\Delta\tau_t, \gamma_t, \Delta g_t]$ is the vector of endogenous variables,

ω_i i=1, 2, …, p represents 3-dimensional quadratic coefficient matrices, and

μ_t is the 3-dimensional vector of residual (Kurniawan 192).

The estimation results based on F-statistics and Chi-Squared of Wald coefficient tests are used to determine if changes in tax rates are independent of the previous lags of the changes in tax rates, and the lags of change in government expenditure and real output growth rate. The three methods employed collectively could be construed as evidence in favor or against of tax smoothing for Pakistan.

7. Empirical Results

The results for the unit root tests which were performed with different testing methods are shown in Table 1. The Augmented Dickey Fuller (ADF) and PP Tests used the null hypothesis that the series has a unit root while KPSS test uses the null hypothesis of stationarity in a series. By checking for unit root using different null hypothesis a robust conclusion on series properties can be drawn.

For ADF and PP, the tests included intercept, intercept and a trend, and no intercept or trend. The purpose of including all of these specifications was to ensure that all series properties were assessed before concluding that the series has a unit root. The lag selection was automatic for ADF and was based on AIC with maximum lags up to 9 and for PP the bandwidth was selected automatically using Bartlett kernel, which was 3 (Newey-West automatic). The ADF test failed to reject the null hypothesis of a unit root in the series at 10%, 5%, and 1% level. The PP test failed to reject the null hypothesis of a unit root at all conventional significance levels.

Similarly, KPSS test was conducted with intercept, and with trend and intercept. The bandwidth selection was automatic using Bartlett Kernel and was 4 (Newey-West automatic). The LM statistics for the tests are tabulated in Table 2. For trend and intercept comparing the LM statistic to asymptotic critical values of 0.21 (1%), 0.14 (5%), and 0.11 (10%), the null hypothesis is rejected at 5% and 10% level but at 1% fail to reject the null. For the test with intercept the null hypothesis can be rejected at 10% but fail to reject the null hypothesis at 5% and 1%.

Table 2. Unit Root Test Results Tax Rate (%) (1976-2014)

Augmented Dickey Fuller Test		
	T-statistic	**P-Value**
With Intercept	-1.67	0.43
With Trend and Intercept	-2.68	0.24
None	-0.22	0.59
PP Test		
	T-statistic	**P-Value**
With Intercept	-1.54	0.49
With Trend and Intercept	-2.52	0.31
None	-0.21	0.60
KPSS Test		
	LM Statistic	
With Intercept	0.44	
With Trend and Intercept	0.17	

The results from these tests show that the tax series (tax revenue as a percentage of GDP) exhibits unit root and that the past values of changes in tax rates are not important for predicting the current values of tax rates changes. This confirms that there is evidence of tax smoothing for Pakistan. As previously mentioned unit roots for small samples have low power; in order to draw robust conclusions other methods also assess the patterns of tax changes to analyze if tax rates change with government expenditures.

The first differenced series of tax rates is regressed on the lagged values to check if past values help predict changes in tax rates in the current period. The lagged values should not have an effect on the current period taxes because under tax smoothing the current period tax change is not determined by changes in values of taxes from previous period or by changes in lagged values of other variables. Table 3 shows the results of the auto-regression of the tax series with different number of lags.

Table 3. Tax Rate Auto-Regression (1976-2014)

Coefficient	No of lags in the model		
	Lag 3	Lag 2	Lag 1
α_0	-0.053	-0.039	-0.011
	(-0.323)	(-0.250)	(-0.073)
α_1	-0.260	-0.282	-0.216
	(-1.414)	(-1.645)	(-1.283)
α_2	-0.2478	-0.283	
	(-1.339)	(-1.640)	
α_3	0.109		
	(-0.588)		
Akaike Info Criteria	2.873	2.819	2.816
Schwarz Criteria	3.051	2.951	2.903
F-statistic	1.586	2.178	1.647
Prob(F-statistic)	0.212	0.129	0.207
Note: T-statistics are given in parenthesis			

The results give further information on the predictability of changes in tax rates. The autoregressive model included the first differenced tax series and up to 3 lags were included. All of the variables were individually insignificant at 5% level; consequently, the lags do not have an effect on the determination of current period tax rate changes. The joint insignificance of the variables based on the F-statistic probabilities shows that the tax rates lagged values jointly do not have an effect on the present period tax rates. The model with one lag is the best fit based on the lowest value of the Akaike Information Criteria. Tax smoothing explains that due the government's strategy of optimally allocating tax distortions across time periods, tax rate changes should be unpredictable and should not depend on the previous year's values. As a result tax rates are constant over time and any changes in tax rates are not predictable given the prior information. The auto-regressive results also support this assertion of the tax smoothing hypothesis for Pakistan.

To further test if the lagged values of government expenditures and real output growth rate have an effect on the changes in tax rate changes an unrestricted vector auto-regressive (VAR) model was computed. The results from the estimation are shown in Table 4 which includes one lag of the variables. To arrive at the lag selection, the model was estimated with different number of lags and the model with one lag was selected based on the LM test of VAR Residuals which failed to reject the null hypothesis of serial correlation and led to the conclusion that one lag is sufficient to capture the relationship between the lagged values of the variables in this model. Moreover, the roots lie under one, thus the model also satisfies the stability conditions of the VAR model. The results for the VAR Residual Serial Correlation test, VAR Stability Conditions, and the Wald Test results are included in Appendix A. The Granger Causality or the Block Exogeneity Wald Test checks if expenditure change and real GDP growth rate granger-cause tax rate changes. The chi-square values and the p-values show that the lagged values of expenditure change and real GDP growth rate do not help explain changes in tax rate changes.

The results from these tests show that patterns of tax rate changes are unpredictable as they are not determined by their own lagged values or the lagged values of other explanatory variables specified in the model by Barro (1979). This entails evidence in favor of tax smoothing for Pakistan from 1976-2014.

Table 4. Vector Auto Regression Results (1976-2014)

	TAX_CHANGE	REAL_GDP	EXPENDITURE_CHANGE
TAX_CHANGE(-1)	-0.4025	-0.119	-0.1050
	(0.194)	(0.403)	(0.316)
	[-2.074]	[-0.297]	[-0.332]
REAL_GDP(-1)	0.070	0.306	0.089
	(0.077)	(0.160)	(0.125)
	[0.910]	[1.913]	[0.711]
EXPENDITURE_CHANGE(-1)	0.202	0.353	-0.1270
	(0.123)	(0.255)	(0.201)
	[1.642]	[1.383]	[-0.634]
C	-0.3520	3.507	-0.5570
	(0.416)	(0.866)	(0.681)
	[-0.845]	[4.046]	[-0.817]
R-squared	0.141	0.163	0.038
Adj. R-squared	0.063	0.087	-0.0480
Sum sq. residuals	29.222	126.300	78.019
S.E. equation	0.941	1.956	1.537
F-statistic	1.809	2.147	0.445
Log likelihood	-48.134	-75.213	-66.302
Akaike AIC	2.818	4.281	3.800
Schwarz SC	2.99	4.455	3.974
Mean dependent	-0.003	5.015	-0.092
S.D. dependent	0.972	2.047	1.501
Determinant residuals covariance (dof adj.)	5.841		
Determinant residual covariance	4.144		
Log likelihood	-183.803		
Akaike information criterion	10.583		
Schwarz criterion	11.106		
Note: Standard errors in ( ) & t-statistics in [ ]			

8. Conclusion

This paper aimed to assess if the fiscal patterns in Pakistan are consistent with the tax smoothing hypothesis. The hypothesis is a theory of optimal fiscal management as it lays out the optimal taxation and debt combination required to finance government expenditures. The results of this paper showed that there is evidence of tax smoothing for Pakistan for the sample period. Three different testing procedures were undertaken to assess if this theory holds for Pakistan and the direct analysis of the taxation rates by unit root tests including ADF, PP, and KPSS, auto-regressions of tax rates on its lagged changes, and a vector auto-regressive model all reveal that changes in current period tax rates are not influenced by changes in the lags of taxes, government expenditure, and real output growth rates.

Future research on Pakistan could focus on other facets of fiscal deficits which could enhance the study of Fiscal Management. One way forward is to modify the model and also analyze the political factors that are particularly important in the determination of taxation and debt for developing countries. The inability of developing government to raise revenue due to political and institutional reasons could be influencing the choice of using debt to finance expenditures and including these aspects in the research on tax smoothing for developing countries could pave a way to understand optimal public debt and taxation patterns suited for developing countries.

Appendix A

Table A 1. VAR Stability Conditions

Root	Modulus
0.346436	0.346
-0.284914 - 0.055267i	0.290
-0.284914 + 0.055267i	0.290
No root lies outside the unit circle.	
VAR satisfies the stability condition.	

Table A 2. Residual Serial Correlation

Lags	LM-Stat	P-Value
1	11.145	0.265
2	10.209	0.333
Note: Probability from chi-square with 9 df.		

Table A 3. Wald Tests (1976-2014)

Dependent variable: TAX_CHANGE			
Excluded	Chi-square	df	P-Value
REAL_GDP	0.829	1	0.362
EXPENDITURE _CHANGE	2.697	1	0.100
All	3.701	2	0.157
Dependent variable: REAL_GDP			
Excluded	Chi-square	df	P-Value
TAX_CHANGE	0.088	1	0.766
EXPENDITURE _CHANGE	1.913	1	0.166
All	2.149	2	0.341
Dependent variable: EXPENDITURE_CHANGE			
Excluded	Chi-square	df	P-Value
TAX_CHANGE	0.110	1	0.739
REAL_GDP	0.506	1	0.476
All	0.582	2	0.747

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