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Sustainability Analysis of Bangladesh Government Debt

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ABSTRACT

This paper investigates the sustainability of Bangladesh public debt by calculating the sustainable tax rate and comparing it with the current tax rate. Here, the 'sustainable tax rate' is the tax rate that, if adopted immediately and maintained, would result in the same government debt-to-GDP ratio in 2100 as exists currently. To calculate the sustainable tax rate for Bangladesh, we consider three cases. *Case1*: Government expenditures per person rise until 2050 at an annual rate equal to the average annual rate of growth of real GDP, 2011-2013, and after 2050 remain constant. *Case2*: Government expenditures per person are always proportional to GDP. *Case3*: Government expenditures per person are always proportional to GDP per worker. We calculate the sustainable tax rate for each of the three cases, conditional on the difference between interest rate and economic growth rate. The sustainable tax rate under these various scenarios ranges from 16 percent of GDP to 26 percent. The current Bangladesh tax rate is around 10 percent of GDP. Our estimates of the sustainable tax rate reflect the pending demographic changes in Bangladesh—the aging of the population and the shrinking of the labor force. The main conclusion is that to maintain the sustainability of its debt, the Bangladesh government must increase its revenue substantially.

Key words: Sustainable tax rate, Expenditure forecasting, Public Debt.
JEL Classification Code: H63, J11.

Sustainability Analysis of Bangladesh Government Debt

1. Introduction

We analyze the sustainability of Bangladesh public debt according to Blanchard's debt-sustainability criterion (Blanchard, 1990), which deduces from the government's inter-temporal budget constraint the required overall tax rate needed to stabilize the debt-to-GDP ratio at its current level. This is the same criterion used by Broda and Weinstein (2005) in their analysis of sustainability of Japanese government debt. As it turns out, Bangladesh is facing the same challenges arising from population aging and its implied rising pressures on government spending as Japan. We adapt the Broda and Weinstein method of forecasting Japanese government expenditures to our analysis of Bangladesh.

No forecast of future government spending can be perfectly accurate, so in our calculations of the sustainable tax rate for Bangladesh we consider three cases. Case1: Government expenditures per person rise until 2050 at an annual rate equal to the average annual rate of growth of real GDP, 2011-2013, and after 2050 remain constant. Case2: Government expenditures per person are always proportional to GDP. Case3: Government expenditures per person are always proportional to GDP per worker. We calculate the sustainable tax rate for each of the three cases, conditional on the difference between interest rate and economic growth rate.

In this paper, the sustainable tax rate is defined as the tax rate that, if adopted immediately and maintained, would result in the same government debt-to-GDP ratio in 2100 as exists currently. The Bangladesh sustainable tax rate under the various scenarios we consider ranges from 16 percent of GDP to 26 percent. The current Bangladesh tax rate is around 10 percent of GDP. Our estimates of the sustainable tax rate reflect the pending demographic changes in Bangladesh—the aging of the population and the shrinking of the labor force. The inescapable conclusion is that to maintain the sustainability of its debt, the Bangladesh government must increase its revenue substantially.

This paper contributes to recent literature on debt sustainability in developing countries, and Bangladesh in particular. Analyses of debt sustainability are assessments of the adequacy of a nation's fiscal resources to meet its sovereign debt obligations without its government having to resort to extraordinary measures. As a practical matter,

the World Bank and the IMF have adopted threshold limits for government debt in relation to GDP and other similar statistics. The IMF 'template' for debt sustainability analysis is to ascertain from forecasts of macroeconomic variables whether the thresholds they have set are likely to be breached. For example, the most recent IMF debt sustainability analysis of Bangladesh (International Monetary Fund, 2018) finds that "Over the medium term, debt ratios are projected to remain on a sustainable path…," in other words, below the threshold level for debt-to-GDP which is 35% for low-income countries. Islam and Biswas (2005) and Islam (2008) follow a similar method to that of the IMF, with forecasts of the Bangladesh debt-to-GDP ratio based on simple extrapolation of its recent trajectory and find that the forecast lies below the IMF threshold. Goswami and Hossain (2013) forecast macroeconomic variables for Bangladesh including debt-to-GDP, using an ARIMA specification. They use the model to predict whether the IMF threshold would be breached based on these forecasts and find that it would not be. Medina (2018) estimates a VAR model with recent macroeconomic time-series for Bangladesh and uses the model to simulate the effects on the debt-to-GDP ratio of stochastic shocks to real GDP growth, prices, exchange rates, and interest rates. He concludes that the Bangladesh debt-to-GDP is likely to remain within the IMF threshold.

Studies of debt sustainability that are outside the IMF template—that is, not focused on whether an arbitrary threshold set by the IMF is likely to be breached—follow one of two approaches. The first is analysis of the cointegration relation between government revenue and expenditures as pioneered by Bohm (1998) with US time-series data. The idea is that if revenue and expenditures are cointegrated, then their long-term tendency to move together would mean that a debt spiral is unlikely. To our knowledge, this type of analysis has not been applied to the Bangladesh case, perhaps for lack of enough years of observation without structural breaks. Bohm used two hundred years of data for his analysis of the US.

The other approach to debt sustainability is the one we adopt, comparison of the actual overall tax rate with the tax rate that would stabilize the debt-to-GDP ratio at its current level as first proposed by Blanchard (1990)—what he referred to as the "sustainable tax rate" (p. 14). To calculate the sustainable tax rate over an horizon longer than just a few years requires long-range forecasts of demographic and macroeconomic

variables. These long-range forecasts pose obvious challenges. Broda and Weinstein (2005) meet these challenges head on for Japan. Others have adopted their general method of calculating a sustainable tax rate for Japan, including Doi et alia (2011). Here we adapt it to the case of a developing country—Bangladesh.

3. Data and methods

3.1 Methods

In this section, we discuss the method of calculating the sustainable tax rate, that is, the tax rate that if adopted immediately and maintained, after a set number of years, *n*, would return the debt-to-GDP ratio to its initial level. If after *n* years, the debt-to-GDP of Bangladesh returns to its current level then we can consider that debt level as sustainable. By knowing the sustainable tax rate, we can understand the current increase in tax revenue that is needed if future crises are to be averted. Broda and Weinstein (2005) and Doi (2008, 2009) use this method for the case of Japan. We adapt it for Bangladesh. In this approach, we use an inter-temporal budget constraint for the government, proposed by Blanchard (1990), to derive a macro model of debt sustainability.

The proposed government budget constraint is given below:

$$(1) \quad G_t - T_t + iB_{t-1} = B_t - B_{t-1}$$

where G_t stands for government expenditure excluding interest payments, T_t is revenue, and i is the interest rate at time t which is assumed to be constant. Government expenditures and tax revenue are all expressed either in real (inflation-adjusted) values and the interest rate is the real interest rate, or all expressed in nominal currency units and the interest rate is the money rate of interest. When this interest rate is multiplied by the debt outstanding at time $(t-1)$, then we get the current interest payment due at time *t*. So $(G_t + iB_{t-1})$ represents government total expenditure, from which subtracting the tax revenue will give the government deficit. This deficit can be paid by issuing new debt which will be equal to the difference between debt at times *t* and $(t-1)$. In equation (1) we do not consider seigniorage. This is a conservative assumption, because ignoring seigniorage revenue leads to a higher value for the sustainable tax rate.

Dividing both sides of equation (1) by GDP $\equiv Y_t$, and rearranging, we get

(2) $$\frac{B_t}{Y_t} = \frac{G_t - T_t}{Y_t} + \frac{(1+i)B_{t-1}}{(1+\eta)Y_{t-1}}$$

(3) $$b_t = g_t - \tau_t + \frac{1+i}{1+\eta} b_{t-1}.$$

In equation (3), $b_t = \frac{B_t}{Y_t}$, $g_t = \frac{G_t}{Y_t}$, and $\tau_t = \frac{T_t}{Y_t}$ denote government debt, government expenditures, and tax revenues, each divided by GDP, and $\eta = \frac{Y_t - Y_{t-1}}{Y_t}$ is the growth rate of GDP, which is assumed to be constant.

Repeated substitution into equation (3) of the previous year's debt-to-GDP ratio, beginning with $t = 1$, results in an expression for the debt-to-GDP ratio in future year, $t = n$, implied by the given future trajectory of primary deficits, $g_t - \tau_t$, for $t = 1, \dots, n$ (see Broda and Weinstein, 2005).

(4) $$b_n = \left(\frac{1+i}{1+\eta}\right)^n b_0 + \sum_{t=1}^{n} \left(\frac{1+i}{1+\eta}\right)^{n-t} (g_t - \tau_t) \quad .$$

By rearranging equation (4), we can write the debt-to-GDP ratio at time $t = 0$ as a function of the debt-to-GDP ratio at time $t = n$, which is given below.

(4′) $$\left(\frac{1+\eta}{1+i}\right)^n b_n + \sum_{t=1}^{n} \left(\frac{1+\eta}{1+i}\right)^{t} (\tau_t - g_t) \;=\; b_0 \quad .$$

Sustainability of government debt is defined by Blanchard (1990) as the condition in which the debt-to-GDP ratio at some future time, $t = n$, is no greater than its initial value, that is, $b_n \leq b_0$. From equation (4) the sustainability criterion is the following.

(5) $$\left(\frac{1+i}{1+\eta}\right)^n b_0 + \sum_{t=1}^{n} \left(\frac{1+i}{1+\eta}\right)^{n-t} (g_t - \tau_t) \;\leq\; b_0 \quad .$$

As noted by Broda and Weinstein (2005), equation (5) is algebraically equivalent to the following, which is another way of representing the Blanchard sustainability criterion.

$$(5') \qquad \left(\frac{1+\eta}{1+i}\right)^{n} b_n + \sum_{t=1}^{n} \left(\frac{1+\eta}{1+i}\right)^{t} (\tau_t - g_t) \quad \geq \quad b_0 \quad .$$

The sustainable tax rate, τ^*, is the lowest positive tax rate that would fulfill equation (5) if maintained over the period, $t = 1, \ldots, n$. The sustainable tax rate—deduced by Broda and Weinstein from equation (5′)—is the following.[1]

$$(6) \qquad \tau^* = \begin{cases} \dfrac{i-\eta}{1+\eta}\left[b_0 + \left\{1 - \left(\dfrac{1+\eta}{1+i}\right)^{n}\right\}^{-1} \displaystyle\sum_{t=1}^{n} \left(\frac{1+\eta}{1+i}\right)^{t} g_t\right], & if\ i > \eta \\ \dfrac{1}{n}\displaystyle\sum_{t=1}^{n} g_t\ , & if\ i = \eta \\ \dfrac{\eta-i}{1+i}\left[-b_0 + \left\{1 - \left(\dfrac{1+i}{1+\eta}\right)^{n}\right\}^{-1} \displaystyle\sum_{t=1}^{n} \left(\frac{1+i}{1+\eta}\right)^{n-t} g_t\right], & if\ i < \eta \quad . \end{cases}$$

Equation (6) demonstrates that, if the interest rate is higher than the growth rate, the current debt relative to GDP and current government expenditure relative to GDP each has a positive effect on the sustainable tax rate. But if the interest-growth rate difference is zero, the sustainable tax rate equals the average of current government expenditure relative to GDP—it is the tax rate consistent with a zero primary fiscal balance. And if the interest-growth rate difference is negative, then the sustainable tax rate is consonant with a persistent primary fiscal deficit.[2]

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[1] These are limiting cases, which are close approximations for large *n*. The expression for $i > \eta$ is derived from equation (5′) invoking the following.

$$\lim_{n\to\infty} \textstyle\sum_{t=1}^{n} \left(\frac{1+\eta}{1+i}\right)^{t} = \frac{1+\eta}{i-\eta}\ ,\ \ if\ i > \eta, \quad \text{and} \quad \lim_{n\to\infty} \left(\frac{1+\eta}{1+i}\right)^{n} = 0\ ,\ \ if\ i > \eta\ .$$

The expression for $i < \eta$ (which is not in Broda and Weinstein, 2005), is derived from equation (5) and invoking the following.

$$\lim_{n\to\infty} \textstyle\sum_{t=1}^{n} \left(\frac{1+i}{1+\eta}\right)^{n-t} = \frac{1+i}{\eta-i}\ ,\ \ if\ i < \eta, \quad \text{and} \quad \lim_{n\to\infty} \left(\frac{1+i}{1+\eta}\right)^{n} = 0\ ,\ \ if\ i < \eta\ .$$

[2] For unchanging government spending relative to GDP, $g_t = g, \forall\ t$, invoking the assumptions detailed in the previous footnote we have the following.

$$\tau^* = \left(\frac{i-\eta}{1+\eta}\right) b_0 + g \quad > g,\ if\ i > \eta$$

$$\tau^* = -\left(\frac{\eta-i}{1+i}\right) b_0 + \ g \ < g,\ if\ i < \eta.$$

We will assume in our analysis of Bangladesh that from 2022 to 2100, the interest rate is greater than the growth rate of GDP, $i \geq \eta$. This is a conservative assumption in the sense that we err on the side of finding that taxes are too low. If the growth rate of GDP exceeded the interest rate, sustainability of fiscal policy would be consonant with a smaller stream of tax revenue. For Bangladesh, now experiencing high growth, the interest rate is indeed less than the growth rate of GDP, but we expect this to change from 2021. We leave to another occasion a detailed exploration of scenarios with interest rate less than the growth rate, which is the subject of the recent AEA presidential address of Oliver Blanchard (Blanchard, 2019), applied to the US.

3.2 Source of Data

We collected historical data on nominal tax revenue and nominal public expenditure from the Bangladesh Economic Review report, chapter four. This report has been published under the Finance division, Ministry of Finance Bangladesh. Future population estimates of Bangladesh for the time 2020 to 2100 have been collected from the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. Historical data on population has been collected from the World Bank collection of development indicators. We used total population, working population of age 15-64, the older population age 65 and above from these websites. Annual data on gross and net debt, interest payment, and growth information for the period 2000-2016 have been taken from the IMF-WEO and WDI online database.

4. Results

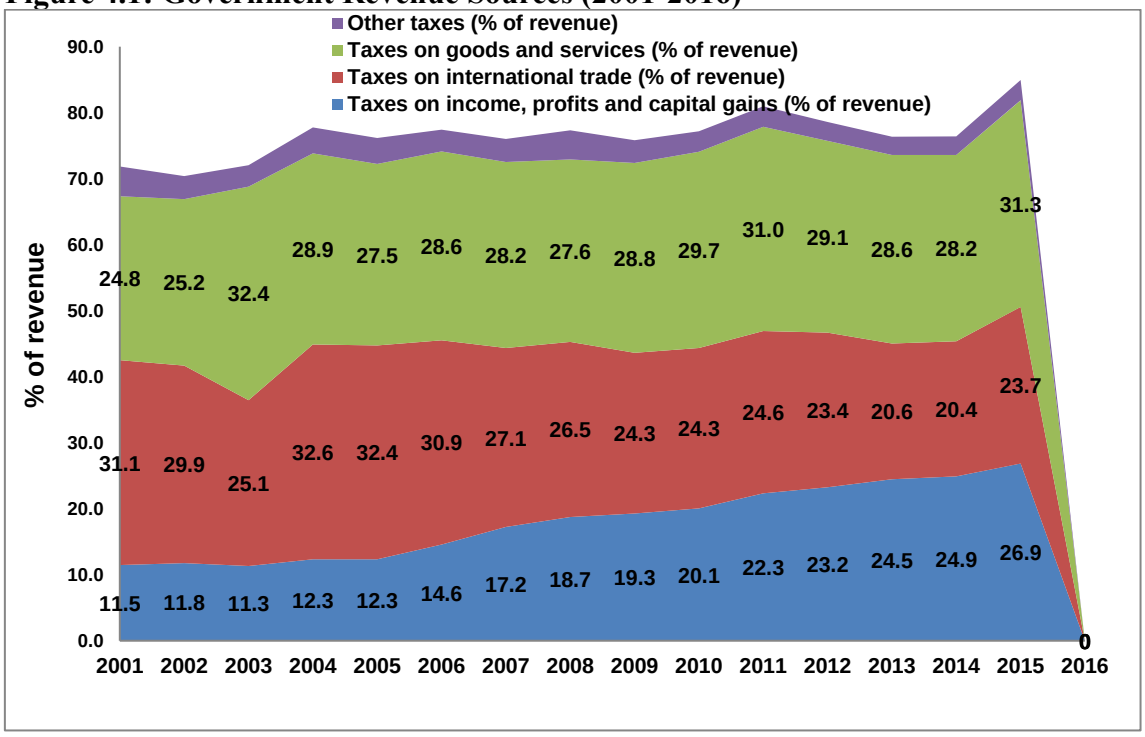
In this section we discuss the assumptions behind our forecasts of future expenditure and future debt levels for Bangladesh.

4.1 Sources of government revenue as percent of GDP

An important factor in the analysis is government revenue. Bangladesh government revenue rose from 6.61percent of GDP in 2000 to 9.83 percent of GDP in 2016 (ERD, 2016). We can see in Figure 4.1each source of that revenue. Much of the increase in revenue over the years came from income, profits and capital gains (which rose by 15

percentage points) and taxes on goods and services (which rose by 6.5 percentage points). Increase in the tax rate is very important for public debt sustainability.

Figure 4.1: Government Revenue Sources (2001-2016)

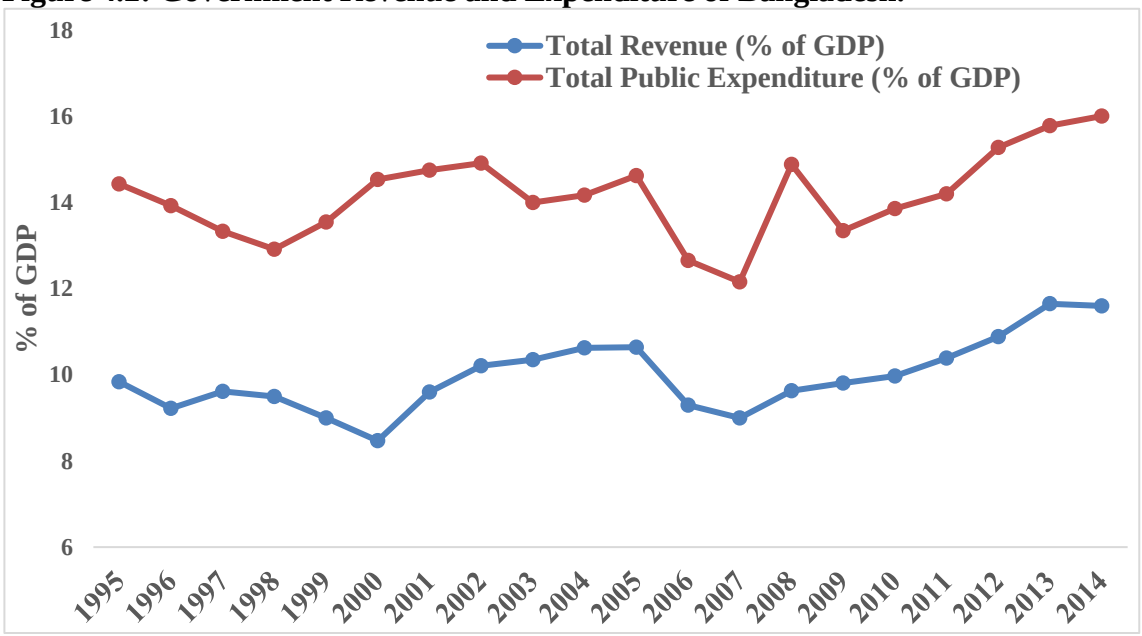


Note: Authors' own calculation, Data Source: World Development Indicator, WB

4.2 Government Revenue and Expenditure of Bangladesh

Figure 4.2 shows Bangladesh government revenues and expenditures, expressed as a share of GDP. Bangladesh government expenditures show a clear upward trend since 2007. Most of the big increases are in the years 1995, 2005 and 2013. Since 2009, revenue has been rising continuously. The figure demonstrates that the Bangladesh government's expenditure and revenue are increasing in the same pattern as in the year 2009.

Figure 4.2: Government Revenue and Expenditure of Bangladesh.

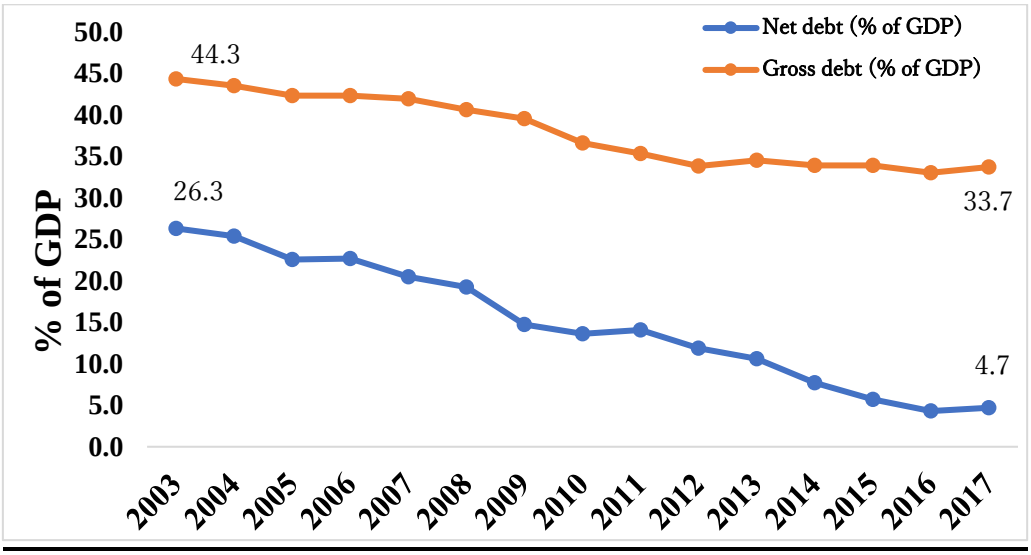


Note: Authors' own calculation

4.3 Debt level (Net debt and Gross debt) as a percent of GDP

A further component of the sustainability calculation concerns the Bangladesh government's debt position. In Figure 4.3 the blue and orange line shows net debt and gross debt for Bangladesh, 2003-2017. From the figure one can see that during 2003-2017 gross debt reaches from 44.3 to 33.7 percentage of GDP and net debt reaches from 26.3 to 4.7 percentage of GDP. So one can see that both the net and gross debt are showing declining trends since 2003.

Figure 4.3: Bangladesh's Debt Levels



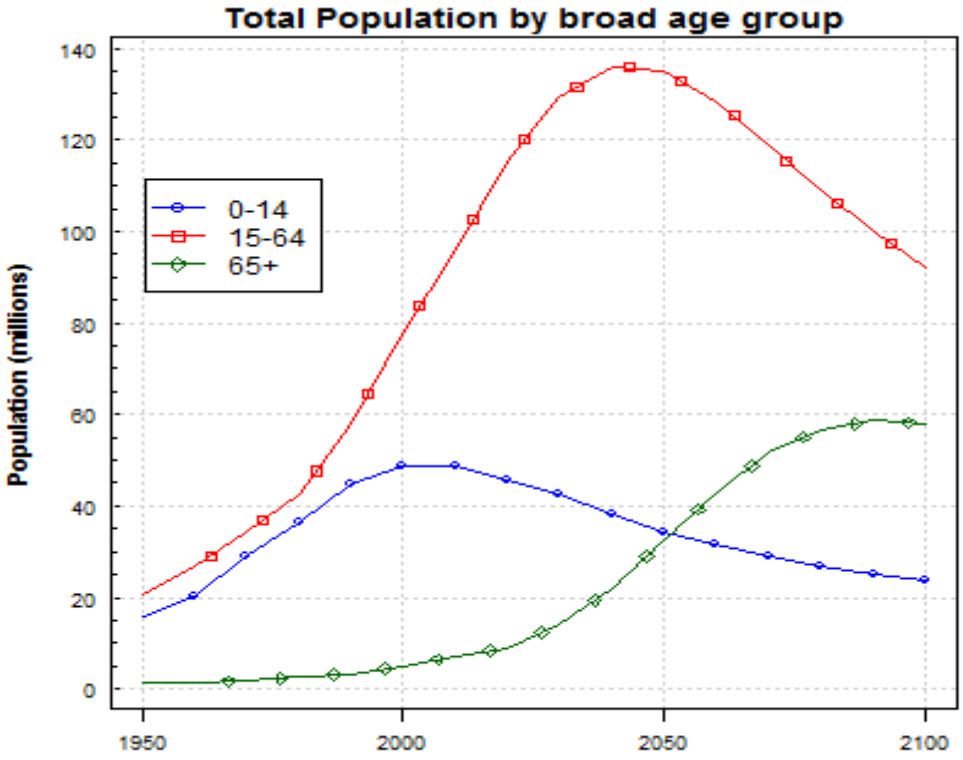
Note: Authors' own calculation

4.4 Population

For this analysis, we use historical and future population of both total and working-age (15-64) population. The historical population has been collected from World Bank (World Development Indicators) and future population of medium variant scenario has been collected from the United Nations Population Division. The United Nations Population Division uses historical data for population projection. Historical population data has been collected from population census, fertility by counts of live births by age group of mother and mortality number of deaths by age and sex 12 months prior to the survey has been collected from census, sample survey or vital registration survey through the direct or indirect question. The UN Population Division uses the cohort-component method for population projection.

Figure 4.4 shows the total population by broad age group from 1950 to 2100 for Bangladesh (Source: UN Population Division). From the figure, we can see that currently among 170 million Bangladesh population, 115 million are of working age (age 15 to 64), 45 million are of young age (age 0 to 15) and the rest of the 10 million are older (age 65 or more). Currently in Bangladesh the fertility rate is 2.1, under-5 mortality is around 25 per 1000 live births, and life expectancy is 70 for males and 75 for females (source: UN Population Division). Considering historical data up to now, population projection has been made which is given in the figure 4.4. From figure 4.4 one also can observe that because of population momentum, the Bangladesh working population will increase up to 2040, after which it will start to decline continuously, with an increase in older population up to the end of the century.

Figure-4.4: Total Population by Broad Age Group 1950 to 2100, Bangladesh.



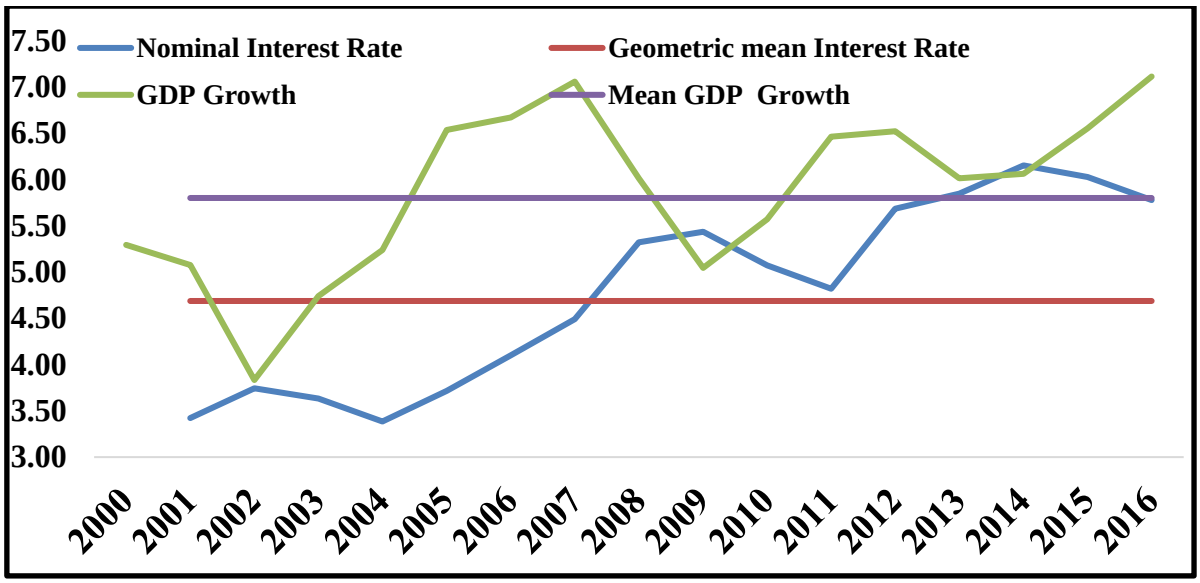
Source : UN Population Division

4.5 Interest Rate-Growth Rate Gap, Bangladesh 2000-16

The interest rate-growth rate gap is the difference between the interest rate and the growth rate i-η. The higher the interest rate gap the higher the sustainable tax rate, because existing debt becomes costlier to repay. Because of difficulties in forecasting of this variable, we will calculate sustainable tax rates for several alternative interest rate gaps ranging from 1% to 4%, with a preferred level of 2% as used by Broda and Weinstein (2005). Figure 4.5 shows the interest rate gap for Bangladesh from 2000 to 2016. We can see several notable features from graph 4.5. The interest rate shows a continuously increasing trend since 2000, but started to decline from 2014. On the other hand, there have been some large swings in Bangladesh nominal GDP over the past sixteen years. When we examine the average nominal growth rate and nominal interest rate we can see that the growth rate is higher than the interest rate over the time 2000 to 2016, which is a common scenario in a developing country like Bangladesh. The meaning of growth rate being higher than the interest rate is that the Bangladesh government will not necessarily

default in this situation even if debt is unbounded. Unbounded debt really does not mean infinite, its limitations can be calculated using a sophisticated model which is out of the scope of this study. But in this study, rather we make an assumption on the future time point when the interest rate gap scenario will be opposite of now which is given below.

Figure 4.5: Bangladesh's interest rate gap, 2000-2016



Note: Graph: Authors' calculation, Data: World Development Indicator, WB

4.6 Forecasting the time point when the interest will be greater than the GDP growth rate for Bangladesh

- Nominal interest rates for Bangladesh government debt, averaged over successive five-year intervals, from 2001 to 2016, are 3.57, 4.90 and 5.7. Interest rate increases 26.9% and 14.035% in the year 2006-2010 and 2011-2016 respectively comparing with 2001-2005.
- Nominal GDP growth, averaged over successive five-year intervals, 2001 to 2016, are 5.01, 6.0 and 6.4. GDP growth increases 16.48% and 6.25% in the year 2006-2010 and 2011-2016 respectively comparing with 2001-2005.
- If we extrapolate based on the average growth rates of interest rate and GDP, for 2011 to 2016, then we find that the interest rate will overtake the GDP growth rate by 2022-2026. Let us assume that the interest rate gap will remain positive 2100, but that the

magnitude of the difference between interest rate and growth rate can vary by 1, 2, 3 or 4 percentage points.

In this situation, a sustainable tax rate calculation is possible, as discussed in section 4. Before discussing the sustainable tax rate calculation, I will explain about Bangladesh government expenditure forecasts under three different scenarios below.

Based on extrapolation from historical data, the sustainability calculation is made for each of three different cases:

- **Case-1**: Government expenditures per person rise until 2050 at an annual rate equal to the average annual rate of growth of real GDP, 2011-2013, and after 2050 remain constant.
- **Case-2**: Government expenditures per person are always proportional to GDP.
- **Case3:** Government expenditures per person are always proportional to GDP per worker.

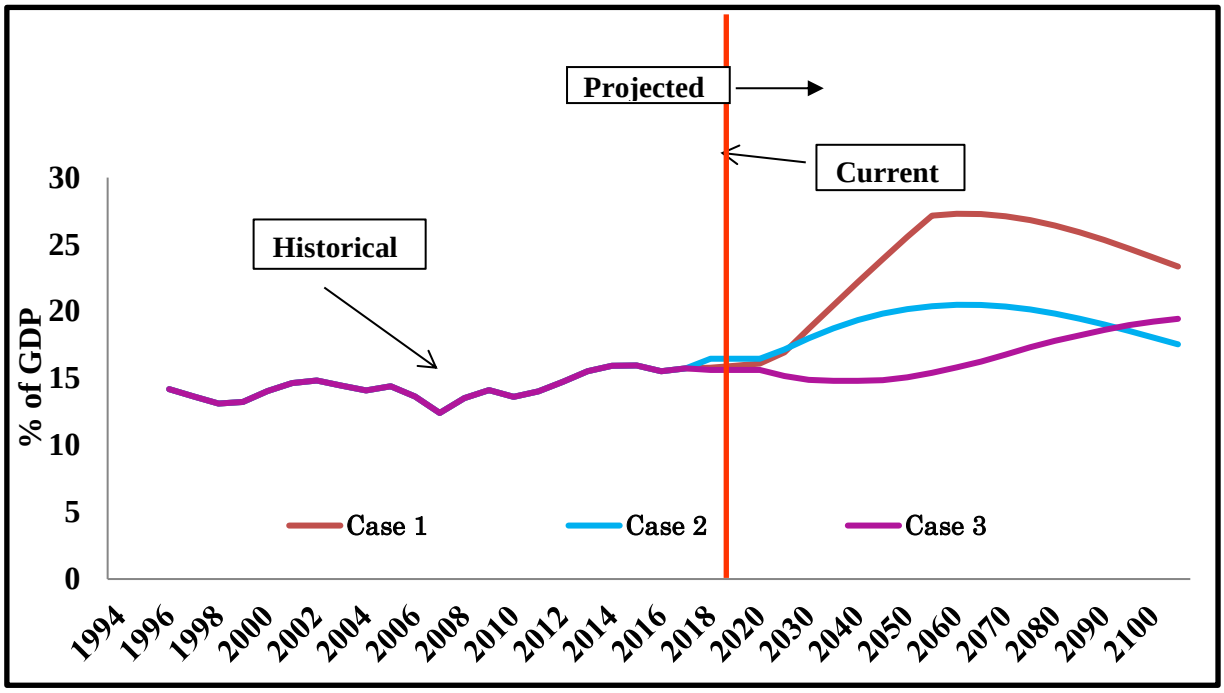
4.7 Bangladesh (2018-2100) Government Expenses as a Share of GDP by Population

An important step in projecting future expenditures is the determination of the starting values for each of the assumptions.

For *Case 3*, we compute total expenditure (as a share of GDP) multiplied by the working population divided by the total population for each year and take the average of this value over the period from 2000 to 2016. To project the future total expenditure on the total, I multiply this average by the projected total population, and divide by the projected working population.

For *Case 1*, we first compute the average per-person expenditure (as a share of GDP), and to do this we divide total expenditure (as a share of GDP) by the total population for the year 2010 to 2012, when total expenditure was highest for Bangladesh, and take the average of these values. We also considered average expenditure growth from the year 2000 to 2016, and this average is one percent. After constructing the average per-person expenditure of each year from 2016 to 2050, we multiply this average per-person expenditure by total population to get total future expenditure for Bangladesh. For the period from 2051 to 2100, per-person expenditure will be considered constant as 2050 and this expenditure will be multiplied by the projected future population to get the total expenditure.

Figure- 4.6: Bangladesh (2022-2100): Government's Total Expenditure as a Share of GDP, for the Three Different Cases



Authors' calculation

For *Case 2*, we multiply future projected population by average expenditure to get the total future expenditure as a share of GDP. To calculate average expenditure, we divide total expenditure as a share of GDP for the period 2000 to 2016, by the total population of the same period and then take an average of these values.

Figure 4.6 explores the reasons for the different forecasts. The orange, blue and purple curves show the forecasts for the total expenditure levels for three different cases based on where Bangladesh was in the year 2000. The purple line on the left side of the red vertical line shows the actual series between 2000 and 2016 and the right of the bar shows forecasts of the series under three different cases. Figures 4.6 shows the path of total transfers to each population as a share of GDP under the three different cases. These figures use the future population from United Nation (UN) website described in the previous section. In figure 4.6 orange line highlights the path of expenditures under the assumptions of the case (1). It shows the rising transfers of the expenditure to the total population as a share of GPD until 2050, and the constant expenditure as a share of GDP

for the total population for the rest of the time since 2051. In this scenario, total government expenses as a share of GDP peak in 2055 at a level of 27.3 percent of GDP. The blue line shows expenditures for total population that are treated symmetrically and grow at the rate of GDP (case 2). This scenario predicts that Bangladesh government's total expenditure will rise over the next 40 years and reach 20.5 percent of GDP. Total expenses will then gradually fall to 17.5 percent of GDP by the end of the twenty-first century. Finally, the purple line shows per-capita expenditures will grow at the rate of GDP per worker in case 3.

4.8 Sustainable tax rate calculation for Bangladesh

The data discussed in the previous section have been used to calculate sustainable tax rates for Bangladesh as done by Broda and Weinstein (2005) for Japan. In order to forecast values for the years 2022-2100, actual data of the years, 2000-2016 has been used. Here we assume for Bangladesh, the interest rate will be greater or equal to the growth rate by 2022. The sustainable tax rate has been calculated using the equation discussed in section 3 where τ^* is the sustainable tax rate, i=projected interest rate in 2022=0.08225*100, η=projected growth rate in 2022=0.07225*100, t=time at each point, n=total number of years (79 years), b_0=current debt (2022), g_t=total expenditure (2022-2100) (**Note:** under each of the three different cases, total expenditures have been calculated and have been used to calculate the sustainable tax rate), τ= Current tax rate = 9.83 % of GDP in 2016.

Table 4.1 presents the sustainable tax rate for Bangladesh for the time 2022 to 2100, under each set of assumptions. We will discuss these calculations in order from the most optimistic to the most pessimistic. *Case 3* assumes that all public expenditures will rise proportionally with GDP-per-worker. In that case, Bangladesh will become an extremely generous welfare society and sustainability is calculated such that debt-to-GDP ratio in 2100 is the same at is now. If we look at each alternative interest rate gap from 0 to 4, we find that the sustainable tax rate varies from 16.58 to 16.97 percent of GDP for *case 3*. The combination of an ever-shrinking labor force and ever higher retirement benefits means that it becomes increasingly hard to pay for the retirees. The scenario implies that Bangladesh must raise its taxes substantially, i.e. approximately 7 percentage points of GDP.

Table 4.1: Sustainable Tax Rate for Bangladesh, n=79 years

	Sustainable Tax Rate		
Forecast Rate Gap	**Case 1**	**Case 2**	**case3**
0	24.70	19.41	16.58
1	24.70	19.74	16.62
2	24.63	20.04	16.69
3	24.53	20.32	16.81
4	24.41	20.57	16.97

Case 2 assumes that per-capita expenditures will always be proportional to GDP. Here, the sustainable tax rate varies from 19.41 to 20.57, depending on the assumed interest rate gap, from 0 to 4. The sustainable tax rate is higher than for Case 3.

*Case 1*assumes that, until the year 2050, per-capita expenditure will rise at the same rate as the 2000-2016 average GDP growth rate, and after 2050 will remain constant. If government increases its per capita expenditure in this pattern, then the Bangladesh government will have to raise its tax rate near 24.70, if there is a zero-interest rate gape. With an interest rate gap from 1 to 4, the sustainable tax rate will vary from 24.70 to 24.41. For case 1, the sustainable tax rate is the highest compared with cases 2 and 3. So the Bangladesh government has to raise its tax rate approximately by 10 to 14 percent as a percentage of GDP to sustain. For case 2 and case 3 the shrinking labor force and aging population will also create political pressures against continuing with any proposed tax rate.

Another assumption underlying this type of sustainability exercise is that taxes are increased immediately to their long-run sustainable level and then kept there. While we see large changes in tax rates in short periods of time around the world, a more feasible tax path would probably have taxes increasing only gradually to their sustainable level over a prolonged period. For this reason, repeated sustainability exercises are needed with the additional restriction that taxes would only slowly converge to their long-run level. For instance, when taxes are assumed to increase linearly from the average tax rate of 9.83 percent to the sustainable tax rate in the next 10 to 52 years, the sustainable tax rate changes from 9.83 percent to 24 percent.

5. Conclusion

This study analyzed the government debt sustainability of Bangladesh, using the same method that Broda and Weinstein (2005) applied to the Japanese case. The novelty of this paper is that it projects the future trajectory of government expenditure (approximately 82 years into the future) under alternative scenarios that take into account the shrinking of the labor force and the aging of the population.

Historical data shows that from 2000 to 2018 the Bangladesh GDP growth rate was higher than the interest rate, and considering the trend, this situation will persist until 2021. This situation is safe for the sustainability of government debt. Similar findings may be found in an IMF country report (2018) for Bangladesh. Over the last two decades, Bangladesh has maintained a sustainable debt situation with moderate economic growth. The reason may be because of expansion of the ready-made garment (RMG) sector. In addition to this, Bangladesh has made remarkable achievements in education, technological advance, and financial inclusion, all of which boost the economy (Taylor, 2018)).

From 2022, the interest rate will be above the GDP growth rate, based on extrapolation. This means that the sustainability of government debt will then depend upon the future trajectory of government expenditure. In this study, I have made expenditure forecasts for three different cases. *Case1*: Government expenditures per person rise until 2050 at an annual rate equal to the average annual rate of growth of real GDP, 2011-2013, and after 2050 remain constant. *Case2*: Government expenditures per person are always proportional to GDP. *Case3*: Government expenditures per person are always proportional to GDP per worker.

For *case 1* and *case 2*, the government expenditure increases, reaches a pick point around 2055 and then starts to decline. For *case 3*, expenditure shows a continuous increasing trend. But in none of the cases does expenditure ever rise above 27.4 percent of GDP. In this situation to keep the debt situation sustainable, the Bangladesh government needs to increase its tax revenue. If the tax rate can be increased early, and maintained, it will obviate any need to raise the tax rate to still higher levels later.

A tax increase above the ‘sustainable tax rates’ constructed here, would be helpful to increase public investment and improve social safety nets without making for an

unsustainable debt situation. A similar suggestion was made by both the World Bank and the IMF in their reports. In this study, the proposed sustainable tax rate for Bangladesh from 2022 to the rest of the century is 16 to 25 percent of GDP (its current level is 9.83 percent of GDP). The range of estimates correspond to different assumed interest rate-growth rate gaps under the three cases—0, 1, 2, 3, or 4 percentage points. These sustainable tax rates will keep the debt-to-GDP ratio unchanged over the relevant horizon, given the forecasted government expenditure. Currently, the country is investing heavily in developing infrastructures. Nearly US$ 40 billion Megaprojects are underway. Padma Bridge, Dhaka Metro Rail, Matarbari Seaport, Rooppur Nuclear Power Plant, Dhaka-Chittagong Expressway, Dhaka Elevated Expressway etc. are some of the mega infrastructure projects currently underway (CRI, 2017). This type of initiative may indicate that the government is making an environment for continuation of the economic growth while increasing revenue.

In the future, the shrinking labor force and aging population (Streatfield and Karar, 2008)) might cause an unsustainable fiscal situation for Bangladesh similar to that currently facing Japan. Thailand and Korea also face pressure to meet the rising demand for pensions and long-term health care expenditure. To face this situation, the government needs to increase tax revenue.

A latent idea behind the concept of a sustainable tax rate is the tax-smoothing logic elucidated by Barro (1979, 1995). That is, under certain conditions—the marginal tax rate is proportionate to the average tax rate and all taxes are fully shifted onto labor—minimizing the burden of taxes needed to fund a projected future stream of government expenditures entails the setting of an overall tax rate that is stable through time. A single sustainable tax rate to be established and maintained into the future could be understood as fulfilling the conditions consonant with minimizing the tax burden. In other words, the sustainable tax rate is the tax-smoothing tax rate. This suggests a way of evaluating the welfare costs of deviation from the sustainable tax rate or delay in implementing it: Calculate the excess burden of taxes in all years under each scenario and compare each with the optimal case. We intend to explore these ideas further in a companion paper to this one.

References

Barro, Robert. (1979). "On the Determination of the Public Debt." *Journal of Political Economy*, 87(6), pp. 940-971.

Barro, Robert. (1995). "Optimal Debt Management." NBER Working Paper No. 5327.

Bohn, Henning. (1998). "The Behavior of U.S. Public Debt and Deficits," Quarterly Journal of Economics, 113, pp. 949-963.

Broda, Christian and Weinstein, David E. (2005). "Happy News from the Dismal Science: Reassessing Japanese Fiscal Policy and Sustainability," in Ito, Takatoshi, Hugh T. Patrick, and David E. Weinstein, eds. *Reviving Japan's Economy: Problems and Prescriptions*, Cambridge: MIT Press, 2005.

Blanchard, Olivier J. (1990). "Suggestions for a New Set of Fiscal Indicators," (Working Papers No. 79). http://dx.doi.org/10.1787/435618162862

Blanchard, Olivier J. (2019). "Public Debt and Low Interest Rates," NBER Working Paper No. 25621.

Centre for Research and Information. (2017). *Bangladesh in 2016-17: Progress and Development*, CRI (September).
http://cri.org.bd/publication/development-2017/Developement%20and%20Progress%202016-17.pdf

Countryeconomy.com. (https://countryeconomy.com/).

Doi, T., Hoshi, T., & Okimoto, T. (2011). "Japanese government debt and sustainability of fiscal policy," *Journal of the Japanese and international economies*, *25*(4), pp. 414-433.

Goswami, G. G., & Hossain, M. M. (2013). "From Judgmental Projection to Time Series Forecast: Does it Alter the Debt Sustainability Analysis of Bangladesh?" *Bangladesh Development Studies*, *36*(3), pp. 1-41.

Government of Bangladesh, Ministry of Finance. *Bangladesh Economic Review* (Various issues). Dhaka.

International Monetary Fund. (2018) *Bangladesh Staff report for the 2018 Article IV Consultation-Debt Sustainability Analysis*.
https://www.imf.org/external/pubs/ft/dsa/pdf/2018/dsacr18158.pdf

Islam, Md. Ezazul. (2008). "Public Debt Sustainability in Bangladesh," Bangladesh Bank, policy note, PN 0802.

Islam, Md. Ezazul and Biswas, Biswa Pada. (2005). "Public debt management and debt sustainability in Bangladesh," *Bangladesh development studies*, *31*(1/2), pp. 79-102.

Mahmood, T., Arby, M. F., & Sherazi, H. (2014). "Debt Sustainability: a comparative analysis of SAARC countries," *Pakistan Economic and Social Review*, pp. 15-34.

Medina, Leandro. (2018). "Assessing Fiscal Risk in Bangladesh," *Asian Development Review*, 35:1, pp. 196-222.

Streatfield, P. K., & Karar, Z. A. (2008). "Population challenges for Bangladesh in the coming decades," *Journal of health, population, and nutrition*, *26*(3), pp. 261.

Taylor, Timothy. (2018, June 13). "Bangladesh Reaches Middle Income Status," Conversable Economist, blog post. (http://conversableeconomist.blogspot.com/2018/06/bangladesh-reaches-middle-income-status.html).

United Nations. Department of Economic and Social Affairs. Population Division. New York, NY: United Nations.

World Bank Group. *World development indicators*. World Bank Publications. (https://datacatalog.worldbank.org/dataset/world-development-indicators).