

## **Bangladeshis External Debt and its Burden: An Application of Domar's Dynamic Debt Burden Model**

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**Abstract:** *This paper attempts to analyse the external debt of Bangladesh and evaluate its burden for the period 1974 – 2012. It applies Domar's dynamic debt burden model to assess the country's external debt burden. Our analysis shows that debt service payment by the country has steadily risen and stood at 1504 million U.S. dollars in 2012 which is equal to Tk. 11897.14 crore. It has been found that the debt-GDP ratio and the debt-export ratio show an increasingly fluctuating pattern over the years. Results of Domar's dynamic debt burden model show that the dynamic debt burden of Bangladesh is 4.11 percent of its GDP. This implies that Bangladesh needs to raise about 4.11 percent of its GDP yearly to be able to service the external debt.*

**Keywords:** *External Debt, Debt Burden, Bangladesh, Domar's Debt Burden Model*

### **1. Introduction**

Developing country governments often consider the financing through debt an important instrument as it accelerates the pace economic development. Countries facing current account deficit are encouraged to take external debt to boost their economic growth. The government needs to make sure that the expected rate of return of the development projects through this type of financing exceeds the cost of borrowing from external sources. For example, Tanzi and Blejer (1988) report that an efficient investment of borrowed funds can enhance the capacity of paying debt service of the borrowing country out of the forthcoming higher income. The debates of Cole (1960), and Kuznets (1965) as cited in Wijnbergen (1989) specially in the case of United Kingdom and United States produce such evidences. Over many decades in the past, these two countries had extensive debt which turned them into lenders at a later stage. Rao et al (1994) argue that a coun-

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try that borrows for capital formation must repay the debts and become a creditor sooner or later.

Bangladesh, since its inception in 1971, continues to depend heavily on external debt to fill the fiscal and external sector deficit. Therefore, a high level of debt stock and debt servicing emerged in the decade of 1980s and continued to be so in the decades of 1990s and 2000s. External debt has now become a concern of both fiscal and monetary policies in Bangladesh as the increasing amounts of public debt and payment of debt service are likely to exert a pressure on the macroeconomic stability by crowding out private investment. It reduces the capacity of the government for public investment. External debt hence becomes one of the main challenges faced by developing countries like Bangladesh. External debt and its repayments are likely to act as a hindrance to the economic growth and development of developing countries.

Malik, Hayat and Hayat (2010) analysed the relationship between external debt and economic growth in Pakistan for the period of 1972-2005, applying time series econometric method. Results show that external debt is negatively and significantly associated with economic growth. Results also indicate that debt servicing has negative and significant effect on economic growth. Hameed, Ashraf and Chaudhary (2008) analyze whether there is any relationship between external debt and economic growth in Pakistan for the period 1970-2003. Results show that debt service ratio affects economic growth negatively in the long-run, which in turn reduces the ability of the country to pay its debt.

Adesola (2009) examines the effect of external debt service on sustainable economic growth in Nigeria and concludes that a negatively significant relationship exists between GDP and external debt. Cholifihani (2008) analyzes the relationship between public debt service and GDP in Indonesia for 1980-2005. Result shows a debt overhang problem in the long run in Indonesia.

Siddiqui and Malik (2001) examined the effect of external debt on economic growth in South Asian countries and report that the impact of foreign debt on economic growth is positive and statistically significant. Ayadi and Ayadi (2008) investigate the impact of external debt and its debt servicing requirements on economic growth in Nigerian and South African economies. Results show that external debt along with its servicing requirements have had negative impact on economic growth in Nigeria and South Africa. Loganathan, Sukemi and Sanusi (2010) examine whether there is any relationship between external debt and macroeconomic performance in Malaysia for the period of 1988-2008. They find that there is a significant long-run and short-run relationship between external debt and performance of macroeconomic variables in Malaysia. Kumari (1996) investigates the relationship between external debt and economic growth in developing countries. Results report that debt flows do not contribute automatically to the economic

growth; domestic efforts make these flows to contribute to economic growth.

Faiz (2003) and Pasha and Ghaus (2001) assess the evolution of public debt and factors which contribute towards economic growth in Pakistan. Results indicate that the rise in debt to GDP ratio is the result of cumulative effects of large primary budget deficit along with the non-interest current account deficit. A review on debt dynamics indicates that the increasing debt stock and burden is the possible result of the twin deficits, exchange rate fluctuations and high interest rate payments. This paper is designed to assess the extent and burden of external debt of Bangladesh covering the period 1978 to 2002.

The rest of the paper is organized as follows. Section 2 explains the state of external debt, debt service, debt-GDP and debt-export ratios of Bangladesh. Section 3 details the Domar (1944) model of debt burden. Results of the debt burden model are presented in Section 4. Section 5 concludes.

## 2. External Debt and Debt Service

### 2.1 Debt Outstanding and Debt Service of Bangladesh

Bangladesh has a considerably significant amount of external debt. Data on external debt and debt service of Bangladesh, debt-GDP ratio, and debt-export ratio are presented in Table 1. Total external debt of Bangladesh stood at 501.00 million U.S. dollars in 1974. This rose to 5941.00 million after five years in 1984. The rise continued and the external debt outstanding amounted to 15373.00 million U.S. dollars in 1994. After another ten years in 2004, the amount stood at 18511.00 million U.S. dollars. This then rose and stood at 22095.00 million U.S. dollars in 2012. Table 1 shows that total external debt of Bangladesh steadily rose from 501.00 million U.S. dollars in 1974 to 22095.00 million U.S. dollars in 2012. This implies an average growth of 553.69 million of external debt per year.

Debt service which is the sum of principal and interest paid back each year gives an indication of the burden of external debt. Debt service payment was about 27.24 million U.S. dollars in 1974 and it rose to about 1504.06 million in 2012. This means that Bangladesh paid about Tk. 11897.14 crore in 2012 as debt service. This is by any consideration a huge amount of money.

**Table 1: Data on External Debt, Debt Service, GDP and Tax (in Current Million U.S. Dollar) for Bangladesh (1974-2012)**

Year	Total debt (D)	Debt service	Debt service-GDP ratio	Debt service-export ratio	GDP (Y)	Tax (t)
1974	501.00	27.237	0.22	3.70	12512.4605	373.9958
1975	974.00	106.877	0.55	2.90	19448.3481	579.6489
1976	1577.00	137.782	1.36	4.75	10117.1133	534.4258
1977	1828.00	143.098	1.48	7.04	9651.1493	486.2246

1978	2783.00	140.242	1.06	5.56	13281.7671	685.0855
1979	3193.00	199.558	1.28	6.11	15565.4803	812.2262
1980	3400.00	239.255	1.32	5.49	18138.0491	908.5216
1981	4383.00	192.411	0.98	5.27	19714.5655	1093.6181
1982	4959.00	217.16	1.20	5.21	18050.8982	980.8325
1983	5452.00	212.886	1.24	5.74	17184.6801	907.6582
1984	5941.00	283.39	1.45	3.28	19591.4800	966.2159
1985	6281.00	330.014	1.53	5.55	21613.2308	1096.5436
1986	7438.00	444.768	2.11	5.35	21089.7000	1080.1008
1987	8364.00	521.03	2.22	5.17	23474.5484	1257.9417
1988	9473.00	497.027	1.94	5.63	25638.7494	1397.7889
1989	9879.00	507.607	1.83	5.75	27744.4873	1523.2468
1990	10609.00	735.489	2.41	6.12	30495.0815	1756.1100
1991	12714.00	592.527	1.91	6.66	30957.4454	1789.1420
1992	13330.00	532.544	1.70	7.59	31293.8269	2029.3457
1993	13615.00	520.666	1.62	9.02	32063.8072	2925.4334
1994	15373.00	538.612	1.59	9.00	33853.0818	3122.4297
1995	16767.00	754.631	1.99	10.86	37939.7530	3733.7844
1996	15166.00	647.233	1.59	11.08	40666.0156	3753.9946
1997	15025.00	667.767	1.58	11.99	42318.7993	4072.5232
1998	14033.00	622.506	1.41	13.33	44091.7541	4184.2385
1999	14843.00	699.624	1.53	13.19	45694.0724	4113.2314
2000	16211.00	769.119	1.63	13.98	47124.9255	3989.1714
2001	15074.00	664.074	1.41	15.38	46987.8428	4510.8156
2002	16276.00	717.31	1.51	14.28	47571.1301	4855.9495
2003	17411.00	662.974	1.28	14.21	51913.6615	5374.7841
2004	18511.00	653.478	1.16	15.46	56560.7440	6006.5869
2005	18777.00	801.471	1.33	16.58	60277.5610	6384.9992
2006	19420.00	713.758	1.15	18.97	61901.1167	6689.0579
2007	20713.00	992.718	1.45	19.78	68415.4214	7166.2625
2008	20265.00	888.863	1.12	20.34	79554.3507	8824.8285
2009	20858.00	955.336	1.07	19.43	89359.7674	10055.0572
2010	20336.00	1026.778	1.02	18.41	100357.0224	11488.0725
2011	22086.00	1492.658	1.33	22.90	111879.1217	13374.6605
2012	22095.00	1504.063	1.29	23.17	116355.0573	14525.3318

Source: World Bank, World Development Indicators, 2014;

Bangladesh Economic Review 2003 and 2013, Government of Bangladesh

## 2.2. Debt Service-GDP Ratio and Debt Service-Export Ratio

Debt service-GDP and debt service-export ratios presented in Table 1 can be considered to assess the burden of external debt. The Table shows that debt service-GDP ratio was 0.22 percent in 1974. This rose to 1.45 percent in 1984, and then increased to 1.59 percent in 1994. The ratio fell to 1.16 percent in 2004 and then rose again to 1.29 percent in 2012. Table shows that the ratio was the highest in 1990 (2.41 percent) and lowest in 1974 (0.22 percent). Table 1 further shows that the debt service-export ratio was 3.70 percent in 1974, which rose to 5.74 percent in 1983 and to 9.00 percent in 1994. This ratio stood at 15.46 percent in 2004 and 23.17 percent in 2012. The ratio becomes the highest in 2012 (23.17 percent) and lowest in 1975 (2.90 percent). The range of the highest and the lowest is about 20.27 percent, which implies a huge burden.

## 3. Domar's Dynamic Burden of Debt Model

When the government of a country accepts external debt, it requires to pay interest charges on its debt. If the payment of debt service is made from tax revenue, then this constitutes a burden on the public. The burden of public debt should not only include the absolute amount of interest charges and the resulting tax but also the ratio of the additional tax and national income (Domar, 1944). An absolute increase in tax might not create any hardship on the public if income grows (Domar, 1944); rather what matters is an increase in the tax-income ratio. The debt burden model of Domar is expressed briefly as follows.

The debt model of Domar can be written as:

$$D'(t) = \alpha Y(t) \quad (0 < \alpha < 1) \quad (1)$$

where  $D(t)$  denotes total debt outstanding,  $D'(t)$  lag of  $D(t)$  and  $Y(t)$  denotes GDP. Assuming that interest rate is constant at rate  $I$ , the interest induced tax,  $T(t)$  is proportional to the debt outstanding which may be expressed as:

$$T(t) = iD(t) \quad (2)$$

Domar describes the burden of public debt under situations of income growth. If income grows at a constant relative rate  $\beta$ , then we obtain the equation:

$$Y'(t) = \beta Y(t) \quad (0 < \beta < 1) \quad (3)$$

The debt burden, can then be expressed as:

$$B(t) = \frac{T(t)}{Y(t)} = i \frac{D(t)}{Y(t)}$$

The time paths of  $D(t)$  and  $Y(t)$  should be derived to obtain the debt burden. Let us integrate (3) in order to get  $Y(t)$  and then substitute this into (2) and solve the

resulting first-order differential equation for  $D(t)$ . We can then treat this problem as one of solving a second-order differential equation. By differentiating (2) with respect to  $t$  and using (3) and (2) successively, we obtain:

$$D''(t) = \alpha Y'(t) = \alpha \beta Y(t) = \beta D'(t)$$

$$\text{That is, } D''(t) - \beta D'(t) = 0 \quad (4)$$

The general solution for this equation is:

$$D(t) = A_1 e^{\beta t} + A_2$$

If we denote the initial values of  $D$  and  $Y$  as  $D(0) = D_0$  and  $Y(0) = Y_0$  and setting  $t = 0$  in the general solution, we obtain that:

$$D(0) = A_1 + A_2 = D_0 \quad (5)$$

Again if we set  $t = 0$  in the derivative of the general solution, it is obtained that,  $D'(0) = \beta A_1$ . Since equation (1) implies  $D'(0) = \alpha Y(0) = \alpha Y_0$ , it follows that

$$\beta A_1 = \alpha Y_0 \quad (6)$$

Now if equations (5) and (6) are simultaneously solved, then we obtain:

$$A_1 = \frac{\alpha}{\beta} Y_0 \quad \text{and} \quad A_2 = D_0 - \frac{\alpha}{\beta} Y_0$$

So the definite solution of (4) takes the following form:

$$D(t) = \frac{\alpha}{\beta} Y_0 e^{\beta t} + D_0 - \frac{\alpha}{\beta} Y_0$$

This depicts the time path of the public debt. The other time path can also be obtained. If the initial condition is taken into consideration, it can be derived from equation (3) that:

$$Y(t) = A e^{\beta t} \quad \text{or} \quad Y(t) = Y_0 e^{\beta t}$$

Now the debt burden function can be written as follows:

$$B(t) = iD(t)/Y(t) = \{i(\alpha/\beta)Y_0 e^{\beta t} + iD_0 + i(\alpha/\beta)Y_0\} / Y_0 e^{\beta t}$$

This equation can explain what will happen to  $B(t)$  if government borrowing is to continue indefinitely at the indicated rate or what is the limit of  $B(t)$  as  $t$  becomes infinite. For this, each term on the right is multiplied by  $e^{-\beta t}$ , thereby transforming the burden function into the following:

$$B(t) = \{i(\alpha/\beta)Y_0 + [iD_0 - i(\alpha/\beta)Y_0] e^{-\beta t}\} / Y_0$$

Since  $e^{-\beta t} \rightarrow 0$  as  $t \rightarrow \infty$ , the second term in the numerator will tend to zero. There-

fore, the dynamic debt burden can be finally obtained that:

$$\lim_{t \rightarrow \infty} B(t) = \frac{i(\alpha/\beta)Y_0}{Y_0} = \frac{i\alpha}{\beta} \quad (7)$$

It can be concluded from this equation that if income grows at a constant relative rate, the debt burden will not increase without bounds but will approach a finite limit, depending on the values of the parameters  $\alpha$ ,  $\beta$  and  $i$ .

#### 4. Results of Domar's Debt Burden Model

We now estimate the parameter of the equations to predict the debt burden of Bangladesh using the data contained in Table 1. In Domar's Dynamic Burden of Debt Model, equation (1) states that:

$$D'(t) = \alpha Y(t) \quad (0 < \alpha < 1)$$

The estimate of  $\alpha$  is obtained using OLS approach as:

$$\alpha = 0.0087$$

Equation (2) states that if interest rate is a constant  $i$  so that the interest induced tax  $T(t)$  is proportional to the debt outstanding:

$$T(t) = iD(t)$$

The estimate of  $i$  is found applying OLS as:

$$i = 0.354$$

Equation (3) states that if income grows at a constant relative rate  $\beta$ , then the equation we obtain as:

$$Y'(t) = \beta Y(t) \quad (0 < \beta < 1)$$

Applying OLS, the estimate of  $\beta$  becomes:

$$\beta = 0.075$$

Finally, the dynamic debt burden is derived from the relationship:

$$\lim_{t \rightarrow \infty} B(t) = \frac{i(\alpha/\beta)Y_0}{Y_0} = \frac{i\alpha}{\beta}$$

Substituting the estimated values of  $\alpha$ ,  $\beta$ , and  $i$  into the above relationship:

$$\begin{aligned} \text{Dynamic debt burden} &= 0.0024 / 0.0446 \\ &= 4.11 \text{ percent} \end{aligned}$$

We can therefore conclude that the dynamic debt burden of Bangladesh is 4.11 percent of its GDP. This means that Bangladesh needs to raise tax for repaying external debt to the tune of 4.11 percent of GDP. Raising revenue earning through

imposing more tax to pay the debt service increases the price level of the economy and hence reduces the disposable income of the people. Besides, if the government attempts to pay the public debt through money creation, this causes inflationary pressure on the economy.

## **5. Conclusion**

This paper aims to analyse Bangladesh's external debt and estimate the country's dynamic debt burden using the data for the period from 1974 to 2012. We apply the dynamic debt burden model of Domar (1944). The analysis shows that debt service payment has steadily risen and stood at 1504.06 million U.S. dollars in 2012. The analysis also shows that the debt-GDP ratio and the debt-export ratio fluctuated over the years. The results of the Domar debt model show that the dynamic debt burden is 4.11 percent of Bangladesh's GDP. This means that Bangladesh needs to raise tax for repaying external debt to the tune of 4.11 percent of GDP.

### *References*

- Adesola, W.A., 2009, "Debt Servicing and Economic Growth in Nigeria: An Empirical Investigation", *Global Journal of Social Sciences*, 8, 2, 1-11.
- Ayadi ,F. S. and Ayadi, F.O., 2008, "The Impact of External Debt on Economic Growth: A Comparative Study of Nigeria and South Africa", *Journal of Sustainable Development in Africa*, 10, 3, 234-264.
- Bangladesh Economic Review 2003*, Ministry of Finance, Government of Bangladesh, Dhaka.
- Bangladesh Economic Review 2013*, Ministry of Finance, Government of Bangladesh, Dhaka.
- Chiang, A.C., 1967, *Fundamental Methods of Mathematical Economics*, Tokyo: McGraw-Hill.
- Cholifihani, M., 2008, "A Cointegration Analysis of Public Debt Service and GDP in Indonesia", *Journal of Management and Social Sciences*, 4, 2, 68-81.
- Cole, G., 1960, *Introduction to Economic History*, New York: Macmillan.
- Domar, E.D., 1944, The 'Burden of the Debt and the National Income', *American Economic Review*, 34, 4, 798-827.
- Faiz, B., 2003, "An Analysis of Budget Deficit: Debt Accumulation, and debt Instability", *The Pakistan Development Review*, 42, 3, 177-195.
- Hameed, A., Ashraf, H. and Chaudhary, M.A., 2008, "External Debt and its Impact on Economic and Business Growth in Pakistan", *International Research Journal of Finance and Economics*, 20, 132-140.
- Kumari, P., 1996, "External Debt, Foreign Exchange Constraint and Economic Growth in Developing Countries", *Finance India*, X, 2, 394-396.
- Kuznets, S., 1965, *Modern Economic Growth*. New Haven, Conn.: Yale University Press.
- Loganathan, N., Sukemi, M.N. and Sanusi, N.A., 2010, "External Debt and Macroeconomics Performance In Malaysia: Sustainable Or Not?" *Global Economy and Finance Journal*, 3, 2, 122 - 132.
- Malik, S., Hayat, M.K. and Hayat, M.U., 2010, "External Debt and Economic Growth: Empirical Evidence from Pakistan", *International Research Journal of Finance and Economics*, 44, 88-97.
- Pasha, H. A. and Ghaus, A, 2001, "Sustainability of Public Debt in Pakistan", A conference Paper No. 21, Available at: [www.spdc.org.pk/pubs/cp/cp21.pdf](http://www.spdc.org.pk/pubs/cp/cp21.pdf)

- Qureshi, M.N. and Ali, K., 2010, "Public Debt and Economic Growth: Evidence from Pakistan", *International Research Journal of Finance and Economics*, 53, 100-108.
- Rao, V. V. B., Dacuila, T. C., and Pau, W. Y., 1994, *ASEAN External Debt Perspectives*. Singapore: Times Academic Press.
- Siddiqui, R. and Malik, A., 2001, "Debt and Economic Growth in South Asia", *The Pakistan Development Review*, 40, 4, 677-688 .
- Tanzi, V. and Blejer, M. I., 1988, "Public debt and fiscal policy in developing countries", in Arrow, J. K., and Boskin, M. J. (Eds.). *The Economic of Public Debt*. (pp. 230-263). London, International Economic Association.
- Wijnbergen, V. S., 1989, "External debt, inflation and the public sector: Towards fiscal policy for sustainable growth". *World Bank Economic Review*, 3, 3, 297-320.
- World Bank, 2014, *World Development Indicators 2014*, Washington.