CPD

Working Paper 97

Assessing the Impact of the Global Economic and Financial Crisis on Bangladesh
An Intervention Analysis

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CENTRE FOR POLICY DIALOGUE (CPD)
B A N G L A D E S H
a civil society think tank

ASSESSING THE IMPACT OF THE
GLOBAL ECONOMIC AND FINANCIAL CRISIS ON BANGLADESH

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The present paper titled **Assessing the Impact of the Global Economic and Financial Crisis on Bangladesh: An Intervention Analysis** has been prepared by *Dr Debapriya Bhattacharya*, Distinguished Fellow, CPD; *Mr Shouro Dasgupta*, Junior Consultant, CPD; and *Ms Dwitiya Jawher Neethi*, Programme Associate, CPD.

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Abstract

The global financial and economic crisis had a lagged impact on the economy of Bangladesh, resulting in declines in export, import, foreign direct investment (FDI) and foreign aid inflows. All these had concomitant negative effects on the country's various socio-economic indicators including the gross domestic product (GDP) growth rate and per capita income. While a number of papers have used descriptive analysis to investigate the sectoral impacts of the crisis in Bangladesh, this paper incorporates an Intervention Analysis approach with Vector Autoregression to extend a Solow growth model to explore the impact of the global crisis on the key economic indicators of Bangladesh. The study finds that due to the crisis, Bangladesh lost approximately 0.60 per cent of real GDP per capita growth in 2009; equivalent to a loss of USD 2 billion in real GDP.

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Acronyms

ADF	Augmented Dicky-Fuller
AIC	Akaike Information Criterion
ARIMA	Autoregressive Integrated Moving Average
CGE	Computable General Equilibrium
DFE	Dynamic Fixed Effects
DOLS	Dynamic Ordinary Least Squares
EPB	Export Promotion Bureau
EU	European Union
FDI	Foreign Direct Investment
FGD	Focus Group Discussion
GDP	Gross Domestic Product
IRF	Impulse Response Functions
LDC	Least Developed Country
ODA	Official Development Assistance
OLS	Ordinary Least Squares
PMG	Pooled Mean Group
RMG	Readymade Garments
USD	United States Dollar
VAR	Vector Autoregression
WDI	World Development Indicator

1. INTRODUCTION

The global financial and economic crisis, although belatedly, impacted the economy of Bangladesh through various channels. While the crisis originated in mid-2007, the economy of Bangladesh started to experience the adverse effects from mid-2009 (Rahman *et al.* 2010). In order to quantify the implications of the crisis on economic growth in Bangladesh, an *Intervention Analysis* approach combined with a *Vector Autoregression* (VAR) model has been used in the present paper to assess the impact of a special event on the time series of interest. In this case, the special event is the global financial and economic crisis, while the time series of interest is the gross domestic product (GDP) growth of Bangladesh over the period 1981-2011.

The paper, deploying the analytical technique mentioned above, finds evidence that Bangladesh lost 0.6 per cent of real GDP per capita growth in 2009 due to the financial crisis – equivalent to approximately USD 2 billion of real GDP.

2. LITERATURE REVIEW

Studying the implications of the global financial and economic crisis in empirical terms involves incorporating a number of critical aspects. Modelling such implications is important in order to understand the short and long-run growth impacts of economic downturns (Eichengreen *et al.* 1995). Related literature suggests that capital controls, past government deficits, inflation trend, future GDP, employment growth, and previous current account balances are usually the main factors determining the severity of impact of a crisis. It has been argued elsewhere that terms of trade and monetary policies of large economies may also cause capital flight and currency crashes (Frankel and Rose 1996).

Furthermore, it has been maintained that economic crisis leads to declines in investment on social capital such as education and health (Krueger and Lindahl 2001). Evidence has been also provided relating to decline in productivity and labour-wage deterioration as some of the major consequences of economic crises (Cole and Ohanian 1999; Chari *et al.* 2009).

Thus, it is widely recognised that the impact of global financial and economic crisis are multi-faceted and affect an economy through various channels – all of which eventually affect the growth of the economy. Accordingly, there is a need for a growth model incorporating the financial crisis to estimate the impact of the crisis on GDP growth; the crisis in this particular case would be a one-time event with implications in the subsequent time period.

2.1 Impact Assessment around the Globe

A number of papers in the recent past have attempted to investigate the impact of the global financial crisis on developing economies. The period, magnitude and channels of impact varied, but these works revealed that there was significant impact of crisis on most developing countries. See for example, Ajakaiye and Fakiyesi 2009; UNDP 2010; Khin and Kato 2010.

Risky real estate investments were transformed into complex financial instruments by their initial underwriter and American banks did their best to transfer the risk to the market and save their own capital stocks (Hoenn *et al.* 2008). This and related phenomenon resulted in a major crisis of the global banking and the financial systems manifesting in credit crunch, fall in the prices of financial assets, bankruptcies and restructuring of the banking system. This was the major cause of the global financial crisis which reverberated across the world, and affected even developing countries such as Bangladesh through fall in external demand and fluctuations of commodity prices. A review of the crisis on other developing countries in Africa and Asia would help to better understand the Bangladesh experience. Similar to Bangladesh, most of these countries lacked integration with the global capital and asset markets. Nevertheless, there is evidence that suggests that they were affected by the crisis, especially in terms of exports, remittances, and eventually decline in growth. It was assumed that Sub-Saharan African economies would not be affected by the global crisis due to their lack of integration with the global financial markets. However, the financial crisis ultimately spread over the region largely through real and financial channels (UNCTAD 2010).

Trade was the most heavily impacted channel, with world merchandise trade declining by 23 per cent in 2009 (WTO 2010) with consequences on external balance and employment – not only for oil-exporting countries, but also for oil-importing ones. Global imbalance was especially critical for oil-exporting countries which saw a major fall in oil and other raw material prices. As the main source of foreign revenue shrunk, external debt payment and other investments were delayed. Fiscal imbalance continued to grow as export revenues showed a downward trend and foreign aid fell as potential donors struggled with their own recessions (WTO 2010).

Empirical analysis by Ndambendia *et al.* (2010), using Dynamic Ordinary Least Squares (DOLS), shows that a 10 per cent fall in foreign aid leads to a 6 per cent fall in growth for Sub-Saharan Africa. The results remain consistent with Pooled Mean Group (PMG) and Dynamic Fixed Effects (DFE) methods used by Hoenn *et al.* (2008).

Foreign direct investment (FDI) in several countries across the world was also adversely affected. As the Malaysian case shows that there was an increased outflow of the existing investments by foreign companies, as well as a sharp decline in FDI inflow to the country (3.31 per cent of GDP in 2008 to 0.72 per cent of GDP in 2009).

Cambodia saw FDI inflow fall by 50 per cent in 2009 which particularly affected the garments and tourism sectors. In Bolivia, FDI fell sharply in the fourth quarter of 2008 and this pattern continued till the first two quarters of 2009 (te Velde *et al.* 2010). In the Democratic Republic of Congo, FDI fell by 6.2 per cent between FY2007-08 and FY2008-09 (Kalala and Cassimon 2010), while in Ethiopia FDI fell by 31 per cent from 2008 to 2009 (Alemu 2010). The Tanzania Investment Centre recorded a drop of about 30 per cent in the value of new investments during 2009 relative to 2008 (Lunogelo *et al.* 2010). In Sudan, portfolio investments (net) fell from USD 30.5 million in 2007 to USD (-) 33.4 million in 2008 (Ahmed 2010). Zambian investment in equities and government securities transcended to a fall in copper prices over 2008.

Economies around the world also saw varying impacts on their growth due to the global financial crisis. Namibian economic growth was impacted negatively due to a fall in the prices of exports. GDP growth contracted by 12.4 per cent in the first quarter of 2009, and it was estimated to have contracted by 0.6 per cent over the whole of 2009. The effects of the crisis heavily impacted the mining and agriculture sectors with 51 per cent and 3.8 per cent contraction in each sector respectively (UNDP 2010). In Sierra Leone, GDP declined by 2.33 percentage points between 2008 and 2009 (World Bank 2012).

Natural resource exporters, for example Nigeria, were also directly affected. The crisis was transmitted through oil price shocks, in the form of decreased prices that affected all net energy exporters adversely. During January to June 2009, 51.2 per cent decrease in oil prices caused Nigerian GDP to fall by 4.3 per cent (Ajakaiye and Fakiyesi 2009). These trends caused poverty levels to increase and household welfare to decline.

As workers were laid off around the world and employers decided to cut-down on hiring workers, countries dependent on foreign remittances were adversely affected. For example, remittances in Bolivia went down by 8.5 per cent in 2009 compared to 2008 (Jemio and Nina 2010), while in Kenya remittance inflow declined by as much as 15 per cent during the early months of 2009 (te Velde *et al.* 2010). In Uganda remittances dropped by 11.4 per cent in the last quarter of FY2008-09 compared to the corresponding period of the previous fiscal year (Ssewanyana and Bategeka 2010).

In many low-income countries, for example, Sierra Leone, global downturn affected both exports and imports. In terms of export, both price and quantity went down due to reduced earnings; and as for the import, the direct impact was through border prices (Weeks 2009). There was also a decline in the prices of key commodities exported by African countries since the second half of 2008. The prices of copper, cotton and sugar also declined by around 20 per cent over the same period. This decline in commodity prices and export volumes resulted in decrease in the export revenues of African countries. As for Cambodia, Khin and Kato (2010) seeks to quantify the impact of the global financial crisis on Cambodian garments exporters as well as its economy by using a conventional static Computable General Equilibrium (CGE) model. They estimated that in Cambodia the welfare loss was USD 281 million and 20,800 jobs were lost in the garments industry. In Nigeria, the domestic consumer price indices are to rise by 14.8 per cent, investment to decrease by 3.6 per cent, current household income to fall by 4 per cent and household consumption to fall by 2.9 per cent, all in relation to the January-June 2008 base period value. The impact of oil price shocks was more severe in Nigeria than any other country in the region due to its heavy dependence on oil revenue to run its economy (Ajakaiye and Fakiyesi 2009).

Cambodia's real GDP growth rate fell from 9 per cent in 2007 to (-) 3.8 per cent in 2009 (Jalilian and Reyes 2010), the highest drop among Asian least developed countries (LDCs). Lao PDR's growth rate declined to 5.9 per cent in 2009 from 16.4 per cent in 2007, and Bhutan's annual average growth declined to 4.5 per cent in 2009 compared to 17.3 per cent in 2007. Among the African LDCs, Angola's GDP growth rate decreased from 20.3 per cent in 2007 to (-) 0.41 per cent in 2009 (World Bank 2012); in Mozambique it fell from 6.8 per cent in 2008 to around 6 per cent in 2009 (Castel-Branco and Ossemane 2010). While in Sudan, growth dropped from 10.2 per cent in 2007 to 4.2 per cent in 2009. Equatorial Guinea's GDP

growth rate slumped to 5.3 per cent in 2009 from a high of 23.2 per cent in 2007, while Madagascar's growth rate fell to (-) 5 per cent in 2009 from 6.3 per cent in 2007. Only six of the 32 African LDCs' GDP growth increased in real terms in 2009 compared to 2007 (World Bank 2012).

Bhattacharya and Dasgupta (2012), using Impulse Response Functions (IRF) suggests that due to external demand shocks during the crisis, it may take the LDCs up to five years to return to the pre-crisis growth, while the terms of trade shocks may be persistent up to three years. The authors also suggest declines in FDI inflows and exchange rate fluctuations may have been the major drivers behind the performance drop of the LDCs.

The foregoing review of the evidences concerning the effect of the global financial crisis on countries around the world shows that the major channels of transmission of the crisis had been through decline in export value, investment, FDI, remittances – all of which were likely to affect the growth prospects of countries.

2.2 Impact Studies on Bangladesh

Bangladesh economy, similar to most countries discussed above, did not remain immune to the impacts of the recent global economic and financial crisis. The present section while discussing the consequence of the crisis on Bangladesh economy, examines the channels that were effective in its case, including export performance, import payments, remittance inflow and official development assistance (ODA).

As mentioned above, Bangladesh was not impacted by the crisis immediately. The likely reasons behind this phenomenon are: (i) lack of financial integration with the global economy preventing capital flight and a collapse of the financial market; (ii) resilience of exports in the beginning of the crisis due to the 'Wal-Mart Effect[1]' (Rahman *et al*. 2010) with export increasing at 10.3 per cent in FY2008-09; and (iii) robust remittance inflow and returning workers largely being offset by exploitation of new labour markets.

Table 1 presents a summary of the available studies on the impact of the crisis on Bangladesh. These country-specific studies mostly focused on the impacts on export, import and remittance using descriptive analysis. Many of them were done when the crisis was still unfolding. However, the distinction of the present paper is that it uses time series estimation techniques to study the overall impact of the crisis on the economic growth of Bangladesh.

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[1]The *Wal-Mart Effect* refers to continued (even higher) demand for low-priced items during recession as some consumers tend to shift their demand to lower-end products in view of reduced earnings.

Table 1: Summary of Selected Literature on the Impact of Global Crisis on Bangladesh

Paper	Focus	Methodology
Rahman, M., Bhattacharya, D., Iqbal, M.A., Khan, T.I. and Paul, T.K. (2009)	Early transmission mechanisms of the impact of the crisis on the economy – analysis of fiscal, monetary and real economy sectors to assess the strengths, weaknesses and vulnerabilities in the face of the crisis	Descriptive analysis
Murshid, K.A. (2009)	Impact of the crisis on the macroeconomic indicators such as economic growth, inflation, interest rate, public expenditure, budget deficit, exports, imports and balance of payments; Micro level impact on households, rural-urban poverty, inequality, gender issues	Descriptive analysis and focus group discussions (FGDs)
Murshid, K.A., Zohir, S.C., Ahmed, M., Zabid, I. and Mehdi, A. (2009)	Early impact of the crisis on export, import and remittance of Bangladesh	Descriptive analysis and Export Demand Function
Rahman, M., Moazzem, K.G. and Hossain, S.S. (2009)	To assess the likely social impacts of the crisis in terms of employment, labour market and social protection, with a focus on export sectors and overseas migrant workers	Descriptive analysis
Rahman, M., Iqbal, M.A., Khan, T.I. and Dasgupta, S. (2010)	Tracks the impact of the crisis through the different transmission channels (export, import, remittance, government revenue, ODA, FDI inflow and poverty rates) and their economy-wide and sectoral impacts. The paper provides an analysis of the policies and stimulus packages put in place by the government	Descriptive analysis
Taslim, M.A. and Haque, M.S. (2011)	Examines the performance of the export sector of Bangladesh with emphasis on apparel exports to the major markets during the recession	Descriptive analysis

Source: Compiled by the authors.

Economic Growth

Table 2 reveals the trend of some of the major economic indicators of Bangladesh around the crisis period (2007-2010). It may be observed that growth in case of all the six reported indicators (i.e. GDP, export, import, ODA, remittance and FDI) had been much smaller in 2010 in comparison to 2007. While GDP growth remained robust compared with many other countries during the crisis[2], it did suffer a 0.7 percentage point fall between FY2006-07 and FY2008-09 before rising to 6.1 per cent in FY2009-10, which was still lower than the pre-crisis level (6.4 per cent in 2007).

Table 2: Annual Trends of Selected Macroeconomic Indicators: FY2006-07 to FY2009-10

(in Per cent)

Fiscal Year	GDP Growth	Export Growth	Import Growth	ODA	Remittances	FDI Inflows
FY2007	6.4	15.7	16.3	5.1	24.8	6.5
FY2008	6.2	15.9	26.1	3.6	24.5	-3.0
FY2009	5.7	10.3	4.1	20.4	62.1	25.0
FY2010	6.1	4.1	5.5	-15.0	13.4	-5.0

Source: Authors' calculation using data from Bangladesh Bank and Export Promotion Bureau (EPB).

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[2]Aggregate real GDP growth of LDCs declined from 5.6 per cent in 2007 to 2.3 per cent in 2009.

Furthermore, Rahman *et al.* (2010) reported that Bangladesh suffered from a slowdown in export earnings, a lower number of workers going abroad, lower revenue earnings, and a loss of competitiveness due to the stimulus packages put in place by other countries.

Export Performance

Influenced by the decline in external demand in the developed countries[3], growth of exports from Bangladesh declined as well (Taslim and Haque 2011). Exports from Bangladesh increased by 15.7 per cent and 15.9 per cent respectively in FY2006-07 and FY2007-08; however, in the backdrop of the crisis, export growth decreased to 4.1 per cent in FY2009-10 – a drop of 11.8 percentage points over two years (Table 2).

Bangladesh is heavily dependent on its export industries[4] and these were the ones most hard-hit by the crisis. In September 2009, exports of apparels experienced a 27 per cent fall compared to the previous year. Export started to pick up again in October 2009 (18 per cent growth), indicating increasing volatility in Bangladesh's export market during FY2008-09; exports faced difficulties in view of falling demand during the second quarter of the fiscal year (October-December 2008). Export growth of knit and woven readymade garments (RMG) declined significantly in the fourth quarter of the fiscal year (April-June 2009), posting 4 per cent and 3.6 per cent growth respectively.[5]

Compared to RMG exports in the same quarter (3.8 per cent), exports of non-RMG products declined by (-) 14.8 per cent. The leather industry was hard-hit with exports declining by 46.8 per cent compared to the previous fiscal year. Available data also suggests that the rise in total exports by 10.3 per cent in FY2008-09 was mostly volume-driven (11.9 per cent increase) with average prices falling by 1.6 per cent (Rahman *et al*. 2009a).

The volatility faced by the export sector is evident from Figure 1, with the month-on-month export growth declining from a high of 70 per cent in July 2008 to (-) 30 per cent in September 2009. The pre-crisis trend growth of exports (up to August 2009) was 10 per cent, while the post-crisis trend growth declined to 6.8 per cent.

Bangladesh exports mostly consumer goods, dominated by RMG – whose global demand did not decline as much as primary products. At the same time, aided by low labour costs, price competitiveness of the RMG exporters improved during 2009 and 2010 (Taslim and Haque 2011). These factors along with the 'Wal-Mart Effect' ensured that the export sector of Bangladesh did not collapse due to the crisis.

Exports of manufactured products (in value terms) declined by 11.7 per cent during the first quarter of FY2009-10 (year-on-year), driven mostly by a fall in exports of woven and knit RMG (-9.7 per cent), while exports of tea (-85.6 per cent), agricultural products (-18.4 per cent) and frozen foods (-37.9 per cent) were also affected significantly (Rahman *et al*. 2010; CPD 2010).

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[3]Imports of USA and the European Union (EU) decreased by 34 per cent and 27.9 per cent respectively during the second quarter of 2009.

[4]Export-GDP ratio was 20.8 per cent in FY2011-12.

[5]Authors' estimates based on the Ministry of Finance data.

Figure 1: Bangladesh's Export Growth: FY2007-08 to FY2009-10 (Monthly Data)
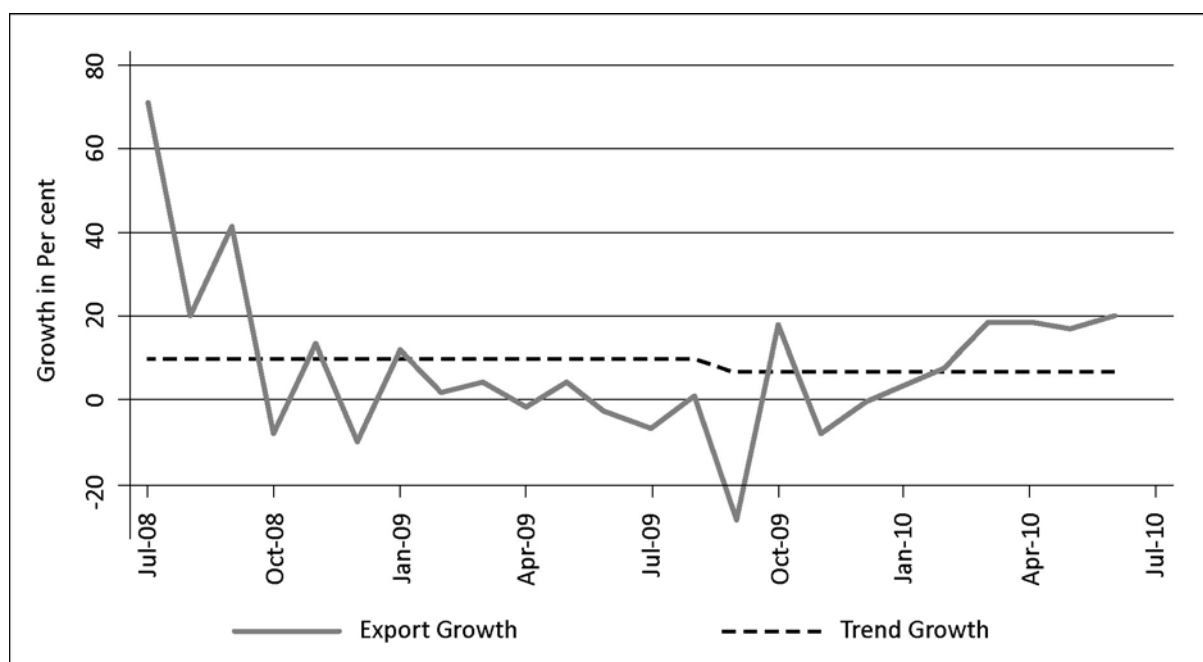
Source: Authors' estimation based on the Export Promotion Bureau (EPB) data.

Anecdotal information also suggests that a large number of exporters reduced the prices in order to cope with the crisis – with average prices of exports declining by 3.2 per cent compared to the previous fiscal year (Murshid 2009).

Import Payments

In terms of imports, during the first two quarters of 2008, total import payments posted 37.7 per cent and 11.8 per cent growth respectively, compared to the corresponding periods of the preceding fiscal year. This growth was largely accounted for by high growth in imports of crude and refined petroleum products and fertiliser. A sharp fall in the prices of these items in the international market during the latter half of the year resulted in a gradual slowdown in growth of import payments.[6] In contrast to export, the post-crisis trend growth of import payments increased to 13.2 per cent compared to the pre-crisis trend growth of 2.5 per cent.

During the last two quarters of 2008, import payments declined by 4.4 per cent and 16.6 per cent respectively (Figure 2). At the end of FY2008-09, growth of aggregate import payments came down to 4.8 per cent, compared to 25.8 per cent 2007 (Rahman *et al*. 2010). These declines were largely driven by fall in imports of capital machinery and items related to textiles due to the decrease in the number of orders placed by foreign buyers. However, these decreases in import payments may have prevented further aggravation of the unfavourable balance of payments situation that occurred due to the fall in export-related foreign exchange revenue and rise in fuel price (CPD 2010).

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[6]Oil prices decreased from USD 147 per barrel in July 2008 to around USD 40 in the first quarter of 2009 (te Velde *et al.* 2010).

**Figure 2: Bangladesh's Import Payments Growth: FY2007-08 to FY2009-10 (Monthly Data)**

Remittance Inflow

Despite the recession, remittance earnings remained robust, albeit with some fluctuations. Although monthly growth rates (Figure 3) of remittance income during FY2008-09 fluctuated, remittances receipt during FY2008-09 was 24.5 per cent higher compared to that of FY2007-08. In absolute terms, remittance increased from USD 7,914.8 million in FY2007-08 to 9,689.3 million in FY2008-09. The post-crisis trend growth of remittance inflow declined from the pre-crisis average of 23.2 per cent (July 2008 – August 2009) to 13.6 per cent since September 2009 (September 2009 – June 2010).

Notwithstanding the crisis, remittance flow remained buoyant as the flow of expatriate workers was sustained. For example, 1.6 million Bangladeshi workers left to work abroad during the two years, i.e. FY2007-08 and FY2008-09.[7] This outflow of workers subsequently resulted in 62.1 per cent increase of remittance inflow during FY2008-09. The resilience of remittances in the backdrop of the crisis can be explained partly by the terminated workers bringing back their savings to Bangladesh, shifting of savings by the remaining workers, and the increased use of formal channels to remit foreign currency to Bangladesh (Rahman *et al*. 2010; Murshid *et al*. 2009). However, the growth of remittance inflow fell to 13.4 per cent at the end of FY2009-10, with the month-on-month growth rate in June 2010 posting a negative growth.

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[7]Bangladesh Bank (2009).

Figure 3: Bangladesh's Remittance Inflow: FY2007-08 to FY2009-10 (Monthly Data)
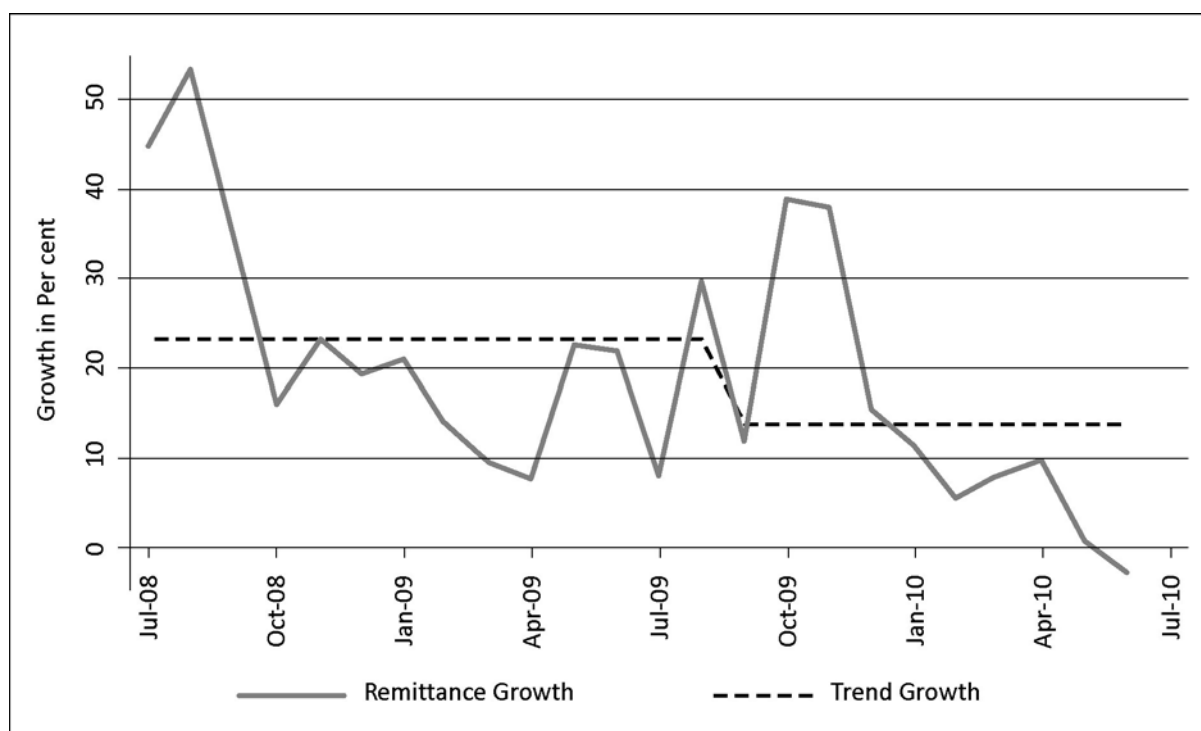
Source: Calculated from various issues of the Major Economic Indicators, Bangladesh Bank.

Official Development Assistance

Although the role of foreign aid has declined in Bangladesh economy over time, yet it finances about one-third of the total fiscal deficit of Bangladesh.[8] In FY2008-09, ODA declined by 15 per cent (Table 2) compared to the previous fiscal year. Net receipts of foreign aid during FY2008-09 decreased to USD 1,085.91 million, against USD 1,475.52 million in FY2007-08, recording a (-) 25.7 per cent fall (Rahman *et al*. 2010). Foreign aid as a percentage of GDP in Bangladesh amounted to 5.6 per cent in FY1990-91, 2.9 per cent in FY2000-01 and 1.6 per cent in FY2010-11.[9]

FDI inflows were largely unaffected by the global financial crisis mostly due to Bangladesh's lack of integration with global markets. FDI fell from USD 1,086 million in 2008 to USD 713 million in 2009; however, it increased to USD 916 million in 2010 (World Bank 2012). Bangladesh has always had lower FDI compared to its South Asian neighbours, accounting for only 4.4 per cent of total investment in the time of crisis (Rahman *et al*. 2010).

Evidence discussed above shows that low integration with the global financial and capital markets could not prevent the negative consequence of the global financial crisis for Bangladesh. The impact had been noticeable; especially with declines in export growth, overseas aid and import. While these effects were not immediate, they were similar to the impacts experienced by other developing countries. However, available data suggests that

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[8]The share of net foreign financing in the budget for FY2009-10 was 29.7 per cent.

[9]Authors' estimation based on the Ministry of Finance data.

though these effects may not have been immediate, there were lagged impacts on the sectors mentioned above. These impacts are likely to have an impact on the real GDP growth per capita. The remainder part of the paper seeks to estimate these impacts by deploying an intervention analysis combined with a VAR model in order to estimate the impact of all these channels on the economic growth of Bangladesh.

3. METHODOLOGY

3.1 Intervention Analysis

Intervention analysis has been applied by a wide range of studies to estimate the impact of events on prices or other changing phenomena. This model, introduced by Box and Jenkins (1976) and Box and Tiao (1975), was first applied to economic and environmental problems to capture the possible dynamics of both interventions and noise on time series.

Wong (1989) investigated the impact resulting from US Federal Reserve's regime change in 1979 on inflation expectations and real economic activities. Spiegel (1990) used the intervention analysis to examine the effect of the Mexican capital control policy of August 1982 on the Mexican deviation from interest rate parity. The estimation was done in terms of two alternative specifications: pulse variable and steps variable. Yoo (1998) analysed the impact of elections on tax policy in Japan using an Autoregressive Integrated Moving Average (ARIMA) intervention analysis on discretionary tax revenues for the period 1953-92 and estimates a pulse function. Goh (2005) demonstrated the usefulness of applying intervention analysis to examine the dynamic effects of the Asian financial crisis (1997) on the construction industry via macro level indicators. Since this paper is attempting to investigate the impact of the crisis on the economic growth of Bangladesh, a VAR model has been used which is more appropriate in this case.

The main focus in this type of approach is to estimate the dynamic effect on the mean level of the series (Box and Tiao 1975).

According to Box and Jenkins (1976), an intervention model is of the general form:

$$Y_t = V(B)I_t + N_t \qquad (1)$$

Where I_t is an intervention or dummy variable defined as:

$$I_t = \begin{cases} 1, t = T \\ 0, t \neq T \end{cases} \qquad (2)$$

The present financial crisis is unique in that it was initially triggered in 2007 in USA, and then spread to Europe and the rest of the world. It started to affect Bangladesh in 2009 (Rahman *et al.* 2010). Thus I_t = 1 is defined for the occurrence of the global financial and economic crisis, and I_t = 0 otherwise.

3.2 Theoretical Framework

The Solow growth model was augmented by Mankiw *et al.* (1992) to include human capital variables (such as education attainment). The function can now be written as:

$$Y(t) = K(t)^\alpha H(t)^\beta \big(A(t)L(t)\big)^{1-\alpha-\beta}; \ 0 < \alpha < 1, \beta = 1 - \alpha \tag{3}$$

Where, H is the stock of human capital.

Using the specifications provided by Solow (1956), Mankiw *et al.* (1992) and Barro (1996), where s_k and s_h are fractions of output invested in physical capital and human capital respectively, the log of output per capita at steady state can be written as:

$$\ln\left[\frac{Y(t)}{L(t)}\right] = \ln A(0) + gt - \left(\frac{\alpha-\beta}{1-\alpha-\beta}\right)\ln(n+g+\delta) + \left(\frac{\alpha}{1-\alpha-\beta}\right)\ln(s_k) + \left(\frac{\beta}{1-\alpha-\beta}\right)\ln(s_h) \tag{4}$$

Deploying a VAR model, this paper uses an augmented Solow Growth Model (Solow 1956) to incorporate the relevant determinants of economic growth along with the intervention model function (Y) to represent the global financial crisis.

$$\Delta Y_t = \alpha + Y.GFC + \lambda Z_t + \varepsilon_t \tag{5}$$

Where, ΔY_t represents log difference in real GDP per capita growth rates in Bangladesh, Z_t is a vector of up to five explanatory variables determining economic growth in Bangladesh: (i) gross capital formation as a proxy for investment; (ii) education expenditure as a proxy for human capital; (iii) government expenditure as percentage of GDP; (iv) export as a percentage of GDP; and (v) population growth.

Although these variables are of limited interest to us for this paper, the signs and the magnitudes of the variables may be used to validate the growth model.

Intervention analysis has a history of use in detecting jumps, pulses and ramps in time series, and offers an objective method for assessing the statistical significance of such changes in time series. Intervention analysis, combined with VAR modelling, offers a method designed specifically to test for abrupt changes in the mean of a time series in the presence of autocorrelation.

3.3 Data and Variables

This paper uses data from the World Development Indicators (WDI) and the Ministry of Finance during the period of 1980-2011 to investigate the impact of the global financial crisis of 2009 on GDP growth of Bangladesh.[10] The following explanatory variables were used in our regression model:

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[10]Descriptive statistics is attached in Annex Table 2.

Economic growth: The paper uses the log difference of real GDP per capita for Bangladesh as the dependent variable following standard econometric practice (Barro 1996; Mankiw *et al.* 1992).

Initial wealth: A country's level of development (initial wealth) is measured as the natural log of lagged real GDP per capita (as earlier), using a one-year lag.

Export contribution: Existing literature on economic growth suggests that export growth causes growth in output. This view is supported by, for example, O'Brien and Engerman (1991) and Hatton *et al.* (1983). This paper uses Export-GDP ratio to represent export contribution to GDP growth.

Population growth: In keeping with leading econometric growth models, a flow measure for growth of the labour force is employed, estimated by the annual log difference of population.

Investment: Natural log of gross capital formation was used as a proxy for average investment rate in physical capital (share of investment in GDP).

Government expenditure: Government spending is measured as the natural log of the percentage share of real final government expenditure in GDP.

Human capital: Econometric growth models of the past decade insist on the inclusion of human capital indicators. We followed Barro (1996) and included the ratio of education expenditure to GDP as a proxy for human capital in the absence of data on educational attainment in Bangladesh.

GFC: General functional form of intervention model from Equation (1).

4. RESULTS

4.1 Unit Root Tests

Augmented Dicky-Fuller (ADF) and Phillips-Perron tests provided evidence that all the variables are non-stationary at level (Annex Figure 1), but stationary[11] when their first-differences were taken. However, none of the variables are integrated beyond the order of I (1).

4.2 Results of Bound-Tests for Co-Integration

An Ordinary Least Squares (OLS) model was conducted before using the bound test for co-integration. Using a maximum lag order of two (2) as suggested by Pesaran and Shin (1999) for annual observations. The estimated F-statistics for Bounds Tests for Co-integration 11.65 is greater than the 1 per cent upper bound critical values.[12] This suggests that the null

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[11]Significant at the 1 per cent level.

[12]I (0): 4.280 and I (1): 5.840. The critical values taken here are for 30 observations. It is found that as the number of observations and regressors increase, critical value decreases.

hypothesis of no integration can be rejected – implying a long-run relation among the variables in the model.

Using Akaike Information Criterion (AIC), the optimum lag for the VAR model was found to be two (2).

4.3 VAR Results

A VAR model also estimated which accounts for non-stationarity and serial correlation in the data. Estimates from the VAR model (Annex Table 1) show that the coefficients for export growth, gross capital formation, government spending, and education expenditure are all positive and statistically significant at the 1 per cent level. The coefficient of initial real GDP per capita is significant at the 1 per cent level, suggesting that the real GDP growth is dependent on last year's economic performance in Bangladesh.

The coefficient of lagged export growth suggests that there is evidence of export-led growth in Bangladesh. Also, gross capital formation (proxy for physical capital), government spending and education expenditure (proxy for human capital) seems to have a significant impact on GDP per capita in statistical terms. However, the coefficient for capital formation is rather small; suggesting the impact of investment on the economic growth of Bangladesh has not been as high as expected. The coefficient for population growth, although positive, is not statistically significant. This suggests that Bangladesh is currently unable to accommodate its growing labour force to contribute to its GDP.

Most importantly, the estimates suggest that the occurrence of the global financial crisis in 2009 caused approximately 0.6 per cent decline in the real GDP per capita growth (2010) in Bangladesh; this variable is statistically significant at the 5 per cent level.

5. CONCLUSION

A review of the relevant literature concerning the impact of the global financial crisis of 2007-2008 reveals that while the transmission mechanisms were similar for most of the developing countries (viz. trade performance, FDI, remittance intake, aid inflow), the effects of specific channels of transmission varied from country-to-country. However, these effects were less than those that were felt by the USA and EU countries.

In case of Bangladesh, a delayed impact experienced on its economy starting from mid-2009 which is reflected by the relative decline in growth rates of export, remittance and foreign aid. Bangladesh's GDP growth of 5.74 per cent in 2009 was also the lowest since 2003.[13] Incorporating an Intervention Analysis approach with VAR in an extended Solow growth model, this paper finds that due to the global financial and economic crisis Bangladesh lost 0.6 per cent of real GDP per capita growth in 2009. Without the crisis, the real GDP per capita of Bangladesh could have provided a stronger base for 2010. The loss of real GDP per capita in Bangladesh was around USD 14 in 2009 (i.e. approximately Tk. 1,200 per person).

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[13]In 2003, the GDP growth rate was 5.26 per cent.

Although the value may seem small, for a population of approximately 144 million in 2009, the aggregate loss in real GDP in Bangladesh was to the tune of USD 2 billion.

Given its current level of integration in the global markets[14], fluctuations in external demand in the foreseeable future are likely to affect the exports of goods and services of Bangladesh. This once again underscores the need to strengthen the export diversification strategy for both product and services markets. The efficiency of government expenditures also needs to be improved, especially in terms of delivery of well-designed physical infrastructural facilities. This is also likely to stimulate aggregate demand in the country. Despite the anticipation of a 'double-dip' recession, the Government of Bangladesh needs to avoid cutting expenditures in social sectors, such as health and education, as well as social safety net programmes, which support the disadvantaged groups most affected by the loss in real income during global economic and financial crisis.

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[14]Bangladesh's Degree of Openness (Export+Import as % of GDP) increased from 16.8 per cent in FY1990-91 to 50.5 per cent in FY2010-11.

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Annex Tables and Figure

Annex Table 1: Impact of GFC (VAR Model)

Variable	Real GDP per Capita Growth
Log of Initial Real GDP/Capita	0.045***
	(0.0008)
Export/GDP (Lagged & Differenced)	0.143***
	(0.0066)
Government Spending/GDP (Lagged & Differenced)	0.047***
	(0.0025)
Capital/GDP (Lagged & Differenced)	0.0097***
	(0.0004)
Education Spending/GDP (Lagged & Differenced)	0.023***
	(0.0024)
Population Growth (Lagged)	-0.055***
	(0.0013)
GFC_{2009}	-0.59**
	(0.25)
Constant	-0.29***
	(0.0027)
Observations	26

Note: Standard errors in parentheses;
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Annex Table 2: Descriptive Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
Real GDP/Capita Growth	30	3.06	1.62	-0.41	5.26
GDP Growth	31	4.85	1.25	2.16	6.66
Log of GDP	31	10.58	0.51	9.75	11.61
Export Growth	31	12.29	11.95	-12.33	41.47
Capital Formation Growth	30	12.64	1.02	10.95	14.36
Population	31	119.65	17.78	89.90	147.90
Population Growth	30	1.67	0.50	0.83	3.10

Annex Figure 1: Trends of Explanatory Variables
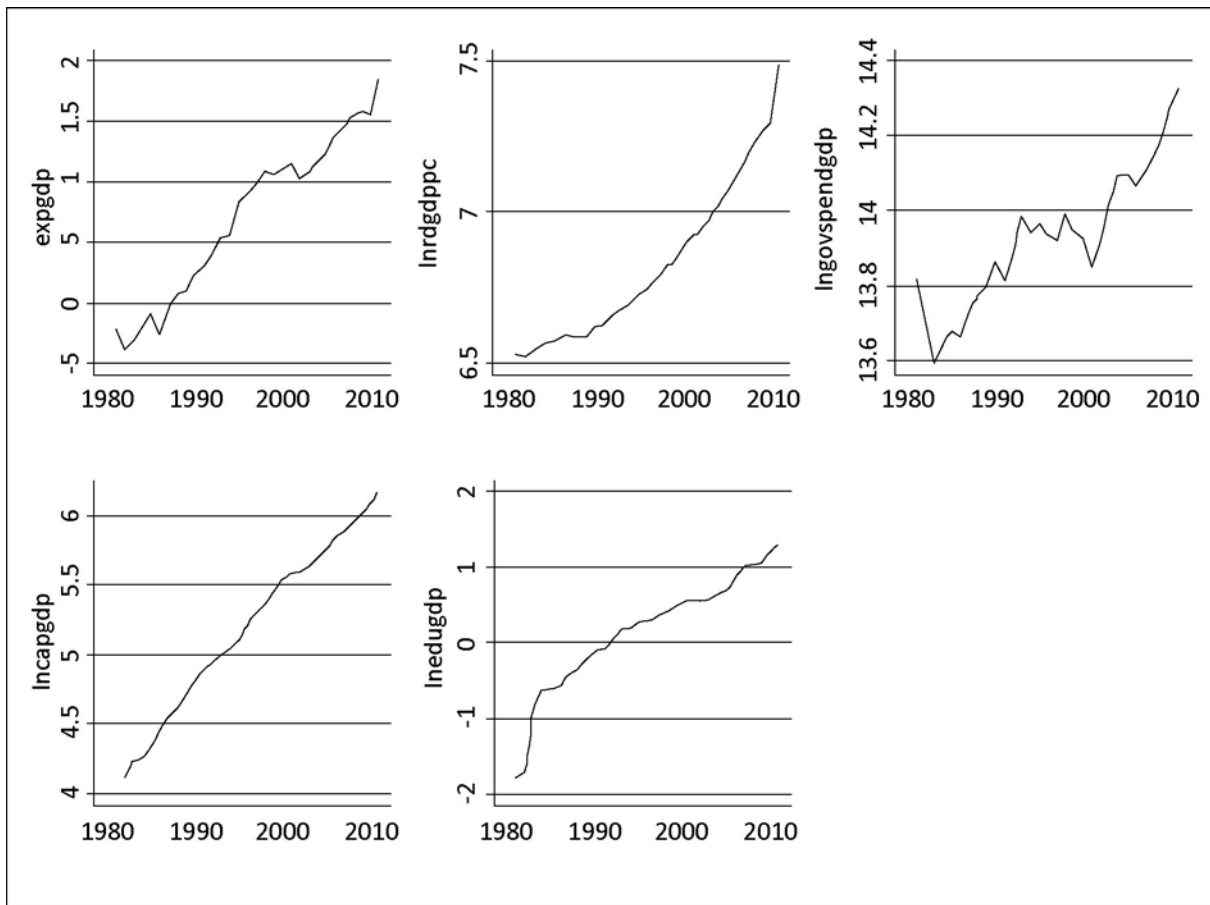
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