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Financial Development—Economic Growth Nexus in Bangladesh

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Financial Development—Economic Growth Nexus in Bangladesh

Abstract

The main objective of this study is to investigate the causal relationship between financial development and economic growth in Bangladesh, particularly the long-run impact of financial development on capital formation and per capita income. A system of equations based on the hypothesis that financial development has long-run impact on investment and per capita income is specified and estimated using Blanchard and Quah's (1989) technique of structural vector autoregressions (SVARs). To examine the short-run dynamics among the variables in the system, however, the impulse response functions (IRFs) and variance decomposition (VDCs) are computed based on Cholesky factorization where the standard errors for VDCs are computed through 1000 Monte Carlo simulations. To substantiate the causal link among the various indicators of financial development, investment and income per capita a graphical presentation has also been used.

The graphical presentation as well as estimated coefficients of the long-run response matrix indicates that various indicators of financial development and investment have long-run impact on per capita income. The estimated results also support the argument that in the long-run financial development stimulates investment activities. The estimated coefficients of the long-run response matrix, however, do not provide any statistical evidence whether the lending rate has any impact on financial development, investment or on per capita income. This finding is in line with the conventional view that there is very little or no significant response of economic activities with respect to changes in the interest rate in a developing country like Bangladesh where the degree of monetization is relatively low. As a result, the use of short-term lending rate as a policy instrument would be ineffective in influencing domestic credit or investment and thus per capita income.

Regarding the short-run dynamics among the variables in the system, the results from IRFs indicate that both the financial development and investment have short-run impact on per capita income at the immediate year of initial shocks. The results from VDCs, on other hand, imply that all the variables in the system, such as lending rate, indicator of financial development and investment contain very useful information in predicting the future path of per capita income.

Keywords: Financial development, investment, economic growth, structural vector autoregressions (SVARs).

JEL Classification: O11, O16.

Financial Development—Economic Growth Nexus in Bangladesh [1]

1. Introduction

The existence of correlation between financial development and economic growth is well established by the theoretical as well as empirical evidence. The presence of correlation between financial development and economic growth had been initially articulated by Gurley and Shaw (1955) followed by Goldsmith (1969), McKinnon (1973) and Shaw (1973). Gurley and Shaw (1955) provided convincing evidence of co-evolution of the real and the financial sectors without attributing any specific direction of causation which is again confirmed by Bencivenga and Smith (1998). Goldsmith (1969) also finds evidence of strong correlation between financial development and economic growth in his cross-country study. McKinnon (1973) and Shaw (1973) advocate financial liberalization based on the belief that it will increase savings as well as real credit supply which will in turn induce a higher volume of investment and faster economic growth (Dixon, 1997; p. 752). Evidence of strong correlation between financial development and economic growth in these studies convincingly established a hypothesis that a well-developed and better functioning financial system supports faster economic growth.

To examine the prediction of the hypothesis that in the long-run financial development results in higher investment and output growth, this study investigates the finance-growth nexus in Bangladesh based on a long-run structural vector autoregressions **(**SVARs) model specified by Blanchard and Quah (1989). Under the long-run SVAR model, it is assumed that financial development has long-run impact on investment and income per capita. To examine the short-run dynamics among the variables in the system, however, the impulse response functions (IRFs) and variance decomposition (VDCs) are computed based on Cholesky factorization. When an economy starts to grow it creates immediate additional demand for financial services and helps grow a better financial system. At this stage the positive impact of financial development on economic growth could be modest. As development proceeds a better and well functioning financial system is established. A well developed financial system can contribute greatly extent to hastening income growth by reducing market frictions (including information and transaction costs), pooling risks, easing trade and contracts (Levine 1997, p. 691).

The rest of the paper is organized as follows: Section 2 outlines an overview of the financial development in Bangladesh and Section 3 selectively reviews the existing literature regarding the financial development and economic growth debate. Sections 4-6 contain methodology of the study including identification restrictions and preliminary data analysis. Section 7 discusses empirical results while Section 8 contains concluding remarks.

[1] The author would like to thank Resident Economic Advisor Professor Dr. Syed Mainul Ahsan for very useful comments and suggestions. The author is also greatly thankful to Md. Ghulam Murtaza, Ex-General Manager, Research Department, Bangladesh Bank for his time in reading and editing the initial draft of the paper. However, the views expressed in this paper are of the author's own and do not necessarily reflect the views of the Bangladesh Bank

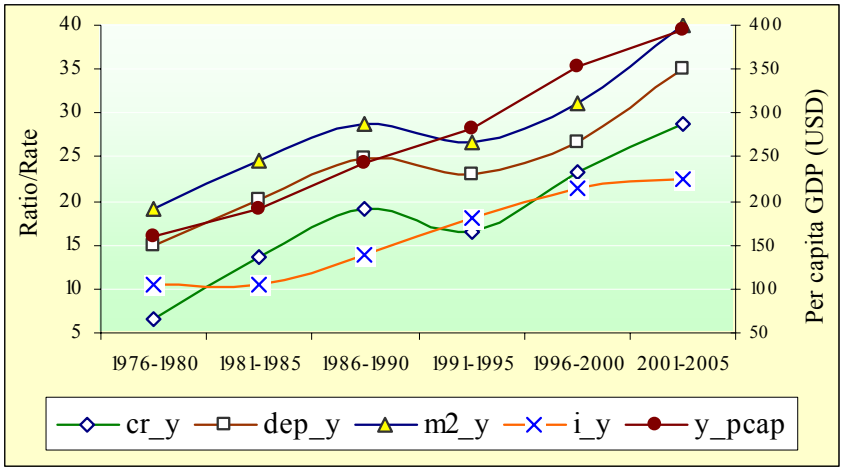
2. An Overview of Financial Development in Bangladesh

Financial intermediaries essentially involve in transferring of funds in exchange of goods, services, or promises of future returns. Development in the financial sector raises the overall efficiency of the financial institutions. As "financial development" lacks any precise definition, following the practice of existing literature [King and Levine (1993a and 1993b), Levine (1997 and 1999), and Levine and Zervos (1998)] some indicators of financial development may be used for effective policy formulation, implementation and evaluation. Accordingly, three alternative indicators of financial development, such as share of private sector credit to GDP, total deposits to GDP and the share of broad money (M2) to GDP for Bangladesh economy have been used.

Domestic credit to the private sector as a share of GDP (denoted by cr_y) is one of the popular indicators of financial development. It includes all the credit issued to the private sector by all financial institutions which gives the degree of financial intermediation and measures the financial resources provided to the private sector through loans and advances, purchase of non-equity securities, and trade credits. The second indicator of financial development is total deposits (demand plus time) as a share of GDP (denoted by dep_y) which is a relatively broader measure of financial development as it includes all the liquid liabilities of the financial system excluding currency in circulation. A third indicator, broad money as a percent of GDP (denoted by m2_y) is basically the liquid liabilities of the financial system in Bangladesh that includes currency plus demand and interest-bearing liabilities of financial intermediaries. This is the broadest measure of financial development and is considered to be a typical measure of financial "depth". It also indicates the degree of monetization with respect to the real economy.

Figure 1

Trends in the Indicators of Financial Development, Investment and Economic Growth



With a view to investigating the historical overview of indicators of financial development and their association with investment activities (measured by fixed capital formation as a share of GDP denoted by i_y) as well as per capita income (denoted by

y_pcap) annual data during 1976-2005 are used. The data as presented in Figure 1 as well as in Table 1 show that all three indicators of financial development display steady increasing trend, indicating widening and deepening of the financial system in Bangladesh over time. It is also observed that the average credit, deposit and broad money to GDP ratios increased substantially from 6.6 percent, 14.9 percent and 19.0 percent respectively over 1976-1980 to 28.8 percent 35.01 percent and 40.0 percent respectively over 2001-2005. Investment as a percent of GDP and per capita income (in current USD) also displays a similar pattern and move broadly together reflecting a close association among financial development, investment and per capita income during the period.[2] In a broader sense, the scatter-plots of the three indicators of financial development vis-à-vis investment as well as per capita income also strongly support the co-movement of financial development and economic activity (Appendices A1 and A2). Besides, a linear relationship is also observed in another scatter-plot diagram between investment-GDP ratio and per capita income (Appendix A3).

Table 1

Trends in the Indicators of Financial Development, Investment and Income

Period average	lr	cr_y	dep_y	m2_y	i_y	y_pcap
1976-1980	11.09	6.59	14.86	19.03	10.44	160.0
1981-1985	13.68	13.67	20.23	24.54	10.51	192.0
1986-1990	14.71	19.08	24.75	28.67	13.87	242.0
1991-1995	13.90	16.58	23.07	26.68	17.93	283.0
1996-2000	13.83	23.17	26.7	31.01	21.51	353.0
2001-2005	12.33	28.83	35.08	40.02	22.63	395.0

Sources: 1. On-line version of *International Financial Statistics (IFS)*, IMF.
2. *World Development Indicator* CD ROM 2003, World Bank.
3. *Annual Report and Economic Trends* (various issues), Bangladesh Bank and
4. Authors' estimates.

Notes: 1. lr = Weighted average annual interest rate on lending by banks.
2. cr_y = Domestic credit to the private sector as a percent of GDP.
3. dep_y = Total deposits as a percent of GDP.
4. m2_y = Broad money as a percent of GDP.
5. i_y = Gross fixed capital formation (gross investment) as a percent of GDP.
6. y_pcap = GDP per capita at current US dollar.

3. Literature Review

Goldsmith's (1969) paper which uses data for 35 countries is the first empirical study that investigates the finance-growth link and finds evidence of a positive correlation between financial development and economic growth. From this observed correlation he argues that financial development causes economic growth. But many researchers argue that the

[2] This apparent graphical association does not necessarily imply any causal link among them. With a view to justifying this association, however, a sophisticated econometric technique (long-run SVARs model) has been used in Section 7, which found the evidence of long-run causal link among financial development, investment and per capita income.

presence of positive correlation dose not guarantee that financial development cause economic growth. King and Levine (1993a), Levine (1997 & 1999), Levine and Zervos (1998), Rajan and Zingales (1998), Beck, Levine and Loayza (2000) and Levine, Loayza and Beck (2000) are among those who try to address the main drawbacks associated with Goldsmith's (1969) study and seek to identify the direction of causality.[3] Levine (1997) presents a very illuminating survey of the literature on finance-growth relationship. The paper examines the literature and presents a convincing argument as to how financial development helps reduce market frictions and contributes toward economic growth.

Theoretical papers such as Bencivenga and Smith (1991), Diamond (1984), and Williamson (1996 and 1998) explain various channels through which financial development could contribute positively to economic growth. Bencivenga and Smith (1991) develop an over-lapping generation (OLG) and endogenous growth model where the introduction of financial intermediaries changes the composition of agent's choice of capital and liquid assets in such a way that it induces faster economic growth. They argue that financial intermediaries have a scale advantage over individuals. As a result, they could minimize socially unnecessary capital in a predicable manner which is also growth promoting (p.195).

Diamond (1984) and Williamson (1996) in their models of delegated monitoring show that financial intermediaries have monitoring cost advantage over individuals. In a model of adverse selection with delegated screening by Wang and Williamson (1998) where ex-post screening is costly, it has been shown that by circumventing the replications of costly monitoring and by diversifying portfolio of loans, a financial intermediary can improve market outcome significantly (p. 575).

Cross-country empirical studies by King and Levine (1993a and 1993b), Fry (1978 and 1997), Levine and Zervos (1998), Levine (1997 and 1999), and Beck, Levine and Loayza (2000) predict that the causal relationship goes from financial development to economic growth i.e., financial development causes economic growth. As the introduction of financial development reduces transaction costs, information asymmetries, market frictions and pools risks, they argue that a well-developed financial system may assist in mobilizing savings and facilitate investment and thus contribute toward higher economic growth. They believe in the Schumpeterian view where financial intermediation lead to economic growth.

King and Levine (1993a) use the data for 80 countries over the period of 1960-1989 to investigate the consistency of the Schumpeterian view and the findings of Goldsmith's (1969) study. They use the concept of correlation and regression in their cross-country investigation and find that various measures of financial development are strongly correlated with real per capita GDP growth and with other measures of economic activities, such as physical capital accumulation. Levine and Zervos (1998) investigate the empirical relationship between various measures of market liquidity and economic growth. Data on 49 countries over the period of 1976-1993 indicate that stock market liquidity and banking development are both significantly correlated with capital

[3] Levine (1997, p. 704) reviews in detail the drawbacks of the Goldsmith (1969) paper.

accumulation, productivity and economic growth. In line with the findings of other cross-country studies, Fry (1978 and 1997) finds evidence that financial liberalization promotes savings and economic growth.

Levine's (1999) paper is intended to examine if the legal environment helps improve the financial system and whether such an exogenous component has any impact on economic growth. By extending the work of King and Levine (1993b), he shows that countries with an improved legal and regulatory environment have better financial systems. He also finds that the exogenous component of financial development has a positive impact on economic growth.

Rajan and Zingales (1998) examine whether financial development reduces the costs of external finance to firms. In doing so, they use a cross-country sample and find that firms that are relatively more dependent on external finance grow faster in countries with more-developed financial markets.

Beck, Levine and Loayza (2000) investigate empirical association between financial intermediaries and economic growth. They try to pinpoint the impact of financial development on the sources of economic growth, such as factor productivity growth, physical capital accumulation and private savings rates. They use a cross-country sample based on instrumental variable estimator and a panel technique that controls for the possible endogeneity problem and for country specific effects. The outcome of their study indicates that financial development has strong positive impact on economic growth and factor productivity growth but ambiguous impact on physical capital accumulation and private savings rates. Their other cross country study (Levine, Loayza and Beck, 2000) finds evidence that a better legal system and accounting standards tend to promote better financial intermediaries and thereby, faster economic growth. In general, studies that are based on cross-country observations seem to find the evidence in favour of Schumpeterian view, where financial development promotes economic growth.

Studies based on time series techniques, such as Demetriades and Hussein (1996), Hansson and Jonung (1997), Luintel and Khan (1999), and Shan et al. (2001) are dominated with the evidence of bi-directional causality. On the other hand, the paper by Choe and Moosa (1999) that uses the Granger Causality approach on Korean data and that by Xu (2000) multivariate VAR for 41 developing countries find evidence that financial development promotes economic growth. Fase and Abma (2002) also find evidence of causality running from financial development to economic growth in their cross country sample of 9 emerging economies.

There are a number of studies, however, that do not support the view that financial development causes economic growth. Demetriades and Hussein (1996) conduct a series of causality tests between financial development and real GDP for 16 developing countries. Their findings surprisingly provide very little evidence to support the view that financial development causes economic development. On the contrary, they find considerable evidences of reverse causality, where actually economic development causes financial development. They also find substantial evidences of bi-directional

causality. Their conclusion concerning the finance-growth relationship is mostly country specific and bi-directional. Shan et al. (2001) also find similar results in their study of 9 OECD countries and China; there is little support of the fact that financial development causes economic growth but a strong support for reverse and bi-directional causality. Bi-directional causality is also dominant in Luintel and Khan (1999) who investigate the long-run relationship between financial development and growth on 10 developing countries based on a multivariate VAR model.

Hansson and Jonung (1997) examine finance-growth relationship for Sweden using a very long data series (1834-1991) based on time series technique and find evidence of interaction rather than any one-way causal relationship between financial development and economic growth. Their findings also suggest that the relationship between financial development and economic growth for Sweden is time specific. They find evidence to the view that financial development caused economic growth for the period 1890-1939, but the relationship is not stable over rest of the period.

Other studies, such as Deveraux and Smith (1994), Jappelli and Pagano (1994), Singh (1997), Arestis and Demetriades (1997), and Singh and Weisse (1998) including Robinson (1952) argue that financial development does not always promote economic growth. Sometimes it may be the case that financial development has negative growth effects (Diedda and Fattouh 2002, p. 339) or no effect on economic growth. They show that economic growth may promote financial development depending on the stage of development. Contrary to the views of literature cited earlier they argue that economic development generates additional demand for financial services and hence establishes a more developed financial sector. According to their views it can be argued that economic growth leads and financial development follows.

Some other papers, however, including Gurley and Shaw (1955), Greenwood and Jovanovic (1990), Galetovic (1996), Geenwood and Smith (1997), and Bencivenga and Smith (1998) observe inextricable link between financial development and economic growth. They experience both way causality between financial development and economic growth, and give the verdict of joint evolution of the real and financial sectors during the growth process. They argue that at the initial stage of economic development 'finance follows economy'. After a certain threshold level when financial intermediaries emerge and the economy starts to benefit from the financial sector. In this sense, the evolution of financial development and economic development are jointly determined.

Few recent studies (Rousseau and Wachtel 2002, and Diedda and Fattouh 2002) observe a non-linear relationship between financial development and economic growth. They dispute any linear or monotonic relationship between financial development and economic growth. Based on the outcome of a series of rolling panel regressions Rousseau and Wachtel's (2002) study identifies an inflation threshold level in order to find an effective association between financial development and economic growth. They use data for 84 countries during 1960-1995 and find that financial development does not promote economic growth when inflation exceeds the threshold, which lies between 13 and 25 percent. The association between financial development and economic growth is

significantly positive only when inflation is about 6 percent to 8 percent below threshold level. They also observe that financial development has a strong positive impact on economic growth under disinflation.

Diedda and Fattouh (2002) present a simple OLG model with risk averse agents and costly financial transactions that predicts an ambiguous effect of financial development on the economy at low levels of development, but positive effect as development proceeds (p. 339). Applying a threshold regression model to King and Levine's (1993) data they find that there is no significant relationship between financial development and economic growth for low-income countries but significantly positive relationship for high-income countries.

Putting the evidences and predictions from the existing empirical and theoretical literature all together, it is very difficult to come up with a clear conclusion concerning the causal relationship between financial development and economic growth. Co-evolution of financial development and economic growth where the effect of financial development and economic growth is jointly determined seems to be the most reasonable candidate in explaining their relationship. In this respect both the financial and economic development are simultaneously determined.

Without disputing the idea of co-evolution of financial development and economic growth, this paper is of the view that initially the action has to start somewhere. Therefore we, along with some other authors, argue that at the initial stage of development the economy leads and finance follows.[4] When economic development attains a certain stage and financial sector is also well organized, financial sector starts to contribute towards economic growth and development. This is not a one-time shot, rather this process of give and take runs indefinitely. Now the real challenge is how to identify the processes.

4. Methodology

Structural macroeconometric models, such as the Klein interwar model, the Brookings model, the BEA model, the St. Louis model and the Taylor model that are based on hundreds of equations are replaced by the vector autoregressions (VARs). The problem of identification and endogeneity are associated with these structural macroeconometric models which can easily be overcome by the VARs approach. Sims's (1980) seminal work introduces VARs that allow feedback and dynamic interrelationship across all the variables in the system and appears to be highly competitive with the large-scale macroeconometric models in forecasting and policy analysis. The unrestricted VARs model assumes that each and every variable in the system is endogenous and does not impose any a priori restrictions. One of the drawbacks of this model is that since it does not impose any a priori restrictions and is based on reduced form equations, it is difficult to reconcile VARs with economic theory and to provide any meaningful interpretations of the estimated parameters.

[4] Greenwood and Jovanovic (1990), Galetovic 1996, Geenwood and Smith (1997), and Bencivenga and Smith (1998) and Diedda and Fattouh (2002)

In order to overcome the above difficulties with the standard unrestricted VARs some studies, such as Bernanke (1986), Blanchard and Watson (1986), and Sims (1986) have come up with a structural VARs (SVARs) model that allows contemporaneous structural restrictions. Shapiro and Watson (1988), and Blanchard and Quah (1989), on the other hand, develop an alternative SVAR method that allows long-run structural restrictions. Nonetheless the long-run structural models do not impose any contemporaneous restrictions; they allow determination of short-run dynamics in the data through impulse response functions (IRFs) and variance decompositions (VDCs). As the objective of this paper is to investigate long-run relationship between financial development and economic growth in Bangladesh, a Blanchard and Quah (1989) type of long-run structural model is estimated.

To get a better understanding about the structural VAR approach, we can start with a simple multivariate simultaneous equation system.[5] If y_t is a vector of variables of interest, '*A*' is a matrix of structural parameters, and '*B*' is a matrix of contemporaneous responses of endogenous variables to the unobserved structural shocks (ε_t) then a multivariate simultaneous system of equations can be expressed in the following form of vector representation:[6]

$$Ay_t = D(L)y_{t-1} + B\varepsilon_t \qquad (1)$$

Where *D(L)* is a matrix of lagged coefficients with p^{th} order polynomial in the lag operator, L. Pre-multiplying by A^{-1}, equation (1) gives us the following reduced form equation system

$$y_t = A^{-1}D(L)y_{t-1} + A^{-1}B\varepsilon_t \qquad (2)$$

Denoting $\beta(L) = A^{-1}D(L)$ and $e_t = A^{-1}B\varepsilon_t$ we can get the following standard VAR representation of the structural system of equations

$$y_t = \beta(L)y_{t-1} + e_t \qquad (3)$$

Here e_t is the vector of reduced form innovation with $\sim iid\ (0, E[e_t e_t^{'}] = \Sigma_e)$. From equations (2) and (3), $e_t = A^{-1}B\varepsilon_t$ (4)

Denoting $A^{-1}B = G$, it can be shown that

$$E[e_t e_t^{'}] = \Sigma_e = GE[\varepsilon_t \varepsilon_t^{'}]G^{'} = G\Sigma_\varepsilon G^{'} \qquad (5)$$

Here $\Sigma_\varepsilon = E[\varepsilon_t \varepsilon_t^{'}]$ is the variance-covariance matrix of structural innovations. Equations (4) and (5) explain the relationship between observed reduced form innovations (e_t) and unobserved structural innovations (ε_t) through the composite of structural coefficient matrix and the matrix of contemporaneous response of endogenous variables to the unobserved structural shocks. From equation (3)

$$[I - \beta(L)L]y_t = e_t$$

[5] Consult Enders (1995) for details.
[6] Assumed to be *I(0)* or stationary.

or, $y_t = [I - \beta(L)L]^{-1} e_t$

Replacing $e_t = A^{-1}B\varepsilon_t = G\varepsilon_t$ and setting $C(L) = [I - \beta(L)L]^{-1}$ we can write

$$y_t = C(L)G\varepsilon_t \quad (6)$$

Equation (6) is the moving average representation (*MAR*) for the standard VAR model where $C(L) = [I - \beta(L)L]^{-1}$ represents the estimated accumulated response to the reduced form shocks (e_t) and G represents the relationship between the regression residuals and the structural shocks. Substituting L=1, we can write

$$y_t = C(1)G\varepsilon_t \quad (7)$$

and $E(yy') = C(1)G\Sigma_\varepsilon G^{P'}C(1)^{P'}$ (8)

Here *C(1)G* is long-run response matrix to structural shocks and each element of that matrix is the sum of coefficients over a certain time horizon. In order to overcome the problem of identification, a certain number of restrictions on *C(1)G* and Σ_ε matrices need to impose. Assuming Σ_ε is an identity matrix, the long-run response matrix *C(1)G* needs *n(n-1)/2* number of additional restrictions to be exactly identified. In this case, the sufficient number restrictions on *C(1)G* could be imposed by following a Cholesky decomposition of $E(yy') = C(1)GG^{P'}C(1)^{P'}$ matrix that allow us to recognize long-run response of each variable in the system to each of the structural shock based on the conditionality of a particular long-run model.

5. Identification Restrictions

In order to investigate the long-run relationship among financial development and investment and per capita income a system of equations based on long-run SVAR model is specified. In order to impose a set of economically meaningful identification restrictions on the data, consider the following production function

$$Y = f(K, AL) \quad (9)$$

Here, Y = Real output, K = Capital, L = Labour and A = Technology. Dividing equation (9) by effective labour *(AL)*, we get the following intensive form production function

$$y = g(k)$$

We know that change in capital is nothing but investment where per capita income is an increasing function of investment or capital formation. Therefore,

$$\dot{k} = I = sy \rightarrow y = h(I) \quad (10)$$

Where '*I*' and '*s*' are investment and rate of saving respectively.
Assuming that investment (*I*) is an increasing function financial development (*F*), equation (10) can be written as

$$\dot{k} = I = i(F) \quad (11)$$

Inserting equation (11) into (10), we get

$$y = j(I, F) \tag{12}$$

The above functional relationship among per capita income, investment and financial development can be expressed as F (financial development) ➔ I (investment) ➔ y (income per capita) meaning to say that financial development generates investment and investment generates higher per capita income. The chain of causality among financial development, investment and income per capita provides the structural base for the current study.

Based on the functional relationship specified in equations (11) and (12) and incorporating a policy variable, the short-term lending rate (*lr*), we can specify the following long-run functional relationship among lending rate, financial development, investment and GDP per capita.

$$e_t^{lr} = \varepsilon_{1t} \tag{13}$$

$$e_t^{F} = A_{21} e_t^{lr} + \varepsilon_{2t} \tag{14}$$

$$e_t^{I} = A_{31} e_t^{lr} + A_{32} e_t^{F} + \varepsilon_{3t} \tag{15}$$

$$e_t^{y} = A_{41} e_t^{lr} + A_{42} e_t^{F} + A_{43} e_t^{I} + \varepsilon_{4t} \tag{16}$$

Here e_t^i is the estimated residual of the i^{th} equation from standard VAR model, A_{ij} is the long-run response of the i^{th} variables to the j^{th} structural shock and ε_{it} is the structural shock from the i^{th} variable in the system. The restrictions stated in equations (13)-(16) have some interesting implications regarding financial development-economic growth relationship in that it asserts financial development has long-run effect on investment and per capita income. Income per capita, on the other hand, has no long-run effect on financial development. Blanchard and Quah's (1989) technique of SVAR is employed to estimate the long-run response matrix. To examine the short-run dynamics among the variables in the system, however, the impulse response functions (IRFs) and variance decomposition (VDCs) are computed based on Cholesky factorization.

6. Preliminary Data Analysis

To examine the long-run relationship between financial development and income per capita, a four-variable long-run structural vector autoregressions (SVARs) model is specified and estimated. In line with the standard practice of the finance-growth literature, annual data on financial development as proxied by the domestic credit to the private sector as a percent of GDP, gross fixed capital formation as a percent of GDP, per capita GDP at current USD and, a policy variable, lending rate during 1976-2005 are used to estimate the model.[7] The notation and definition of variables used in this study are stated below where all of the variables except the lending rate are in their natural logarithmic form.

[7] Two other variables, such as total deposits as a percent of GDP and broad money (M2) as a percent of GDP are also used for possible alternative indicators of financial development.

1. lr = Weighted average annual interest rate on lending by banks
2. cr_y = Domestic credit to the private sector as a percent of GDP
3. dep_y = Total deposits as a percent of GDP
4. m2_y = Broad money as a percent of GDP
5. i_y = Gross fixed capital formation (gross investment) as a percent of GDP and
6. y_pcap = Per capita GDP at constant USD.

As Blanchard and Quah's (1989) technique of long-run SVAR requires all variables to be stationary, a series of unit root tests, such as Augmented Dickey Fuller (ADF, 1981), Phillips Perron (PP, 1988), and Kwiatkowski, Phillips, Schmidt and Shin (KPSS, 1992) are employed to determine the order of integration for each of the variables used in the study. The results of unit root tests are reported in Table 2 indicating only the lending rate is I(1) or non-stationary while rest of the variables are trend stationary. Because I(1) variable is inappropriate for Blanchard and Quah's SVAR estimation, the lending rate is used in its first differenced form and is found to be stationary (Table 2).

Table 2

Results of Unit-root Tests

Variables (in natural log)	without trend			with trend			Decision
	DF	PP	KPSS	DF	PP	KPSS	
Rate							
Lending rate (lr) $^{\varphi}$	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)
Lending rate at 1st difference (dlr) $^{\varphi}$	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
Financial development							
Domestic credit to the private sector as a percent of GDP (cr_y)	I(0)	I(0)	I(1)	I(0)	I(0)	I(0)	I(0)
Total deposit as a percent of GDP (dep_y)	I(0)	I(0)	I(1)	I(0)	I(0)	I(0)	I(0)
Broad money as a percent of GDP (m2_y)	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)	I(0)
Investment							
Gross fixed capital formation as a percent of GDP (i_y)	I(1)	I(0)	I(1)	I(1)	I(0)	I(0)	I(0)
Income							
Per capita GDP at current USD (y_pcap)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)

Notes:
1. φ = without log, I(1) = unit-root and I(0) = stationary.
2. Lag length for ADF tests are decided based on Akaike's information criterion (AIC).
3. Maximum Bandwidth for PP and KPSS test are decided based on Newey and West (1994).
4. All the tests are performed on the basis of 5% significance level.

In order to generate the long-run response matrix, initially we need to estimate a 4-variable unrestricted VAR model. The lag length in the initial estimation of VAR model is decided at 4 based on Akaike information criterion (AIC) making all the residuals

white noise. The estimated results for Blanchard and Quah's SVAR model are presented in Table 3.

7. Empirical Results

In order to examine the finance-growth relationship the estimated parameters of the long-run response matrix, and computed IRFs and VDCs are used.[8] The estimated parameters of long-run response matrix are presented through equations (14a)-(16a) and computed VDCs and IRFs are reported respectively in Table 4 and in Figure 2. Regarding the relationship between financial development and economic growth, the estimated long-run response matrix indicates that financial development has a positive and statistically significant long-run impact on both the investment-GDP ratio as well as on per capita GDP.[9] A one percent positive shock to financial development (credit-GDP ratio in this case) will generate about 0.7 percent positive impact on investment-GDP ratio and about 0.6 percent positive impact on per capita income meaning more domestic credit to the private sector generates more investment activities and hence more per capita income.

The estimated results also indicate that there is a positive and significant relationship between investment activities and per capita income. In the long-run a one percent positive shock to investment-GDP ratio will generate about 0.1 percent positive impact on per capita income. On the other hand, the long-run response of financial development, investment and per capita income with respect to lending rate changes remain broadly insensitive. The results of the long-run response matrix indicate that a one unit shock to the lending rate does not have any significant impact on any of the variables in the system indicating credit, investment and output insensitivity with respect to the changes in lending rate. This finding supports the view that there is little response of economic activity with respect to changes in interest rate in a developing country like Bangladesh where the degree of monetization is relatively low. Although there is no statistical relationship between the policy variable (i.e., lending rate) and the target variables (i.e., credit and investment), the presence long-run relationship among financial development, investment activity and per capita income have very interesting and strong policy implications for Bangladesh economy.

In general, the findings of the long-run response matrix imply that, also argued by Levine and others, financial development has long-run direct positive impact on per capita income as well as long-run indirect impact via higher investment activities by reducing market frictions, pooling risks, easing trade and contracts. In order to observe the short-run dynamics among the variables in the system, the IRFs and VDCs are computed with the appropriate confidence bands and standard errors shown in Figure 2 and Table 4 respectively.

[8] While long-run response matrix is estimated by Blanchard and Quah's long-run SVAR technique, the IRFs and VDCs are computed from unrestricted VARs technique based on Cholesky decomposition where standard errors of VDCs are generated by 1000 Monte Carlo simulations.

[9] Two other indicators for financial development, such as total deposits as a percent of GDP and broad money (M2) as percent of GDP also produce similar results regarding financial development—economic growth nexus which are not reported here but available on request.

Table 3

Estimates for the Long-run Responses to One s.d. Structural Shocks

$$e_t^{cr\_y} = \underset{(1.76)}{0.26^{*}}\, e_t^{lr} \qquad (14a)$$

$$e_t^{i\_y} = \underset{(-1.89)}{-0.26^{*}}\, e_t^{lr} + \underset{(6.98)}{0.68^{***}}\, e_t^{cr\_y} \qquad (15a)$$

$$e_t^{y\_pcap} = \underset{(-1.05)}{-0.13} e_t^{lr} + \underset{(7.06)}{0.63^{***}} e_t^{cr\_y} + \underset{(6.95)}{0.09^{***}} e_t^{i\_y} \qquad (16a)$$

Notes:

1. Figure in the parentheses are z-statistic (t-value).
2. The results in the above table are estimated when domestic credit to the private sector as a percent of GDP is used as an indicator of the financial development. Results for the other two indicators of financial development, such as total deposits as a percent of GDP and broad money (M2) as a percent of GDP are found to be similar which are not reported here but available on request.
3. *** = significant at 1 percent level and * = significant at 10 percent level.

Impulse response functions of each of the variables based on Cholesky factorization to shocks to financial development and investment are reported in Figure 2.[10] A response is considered as significant if it does not contain the zero line within its confidence bands (± 2 *s.d.*). Figure 2 indicates that both the financial development as well as investment has significant short-run positive impact on per capita income in the immediate year of initial shock. However, the IRFs do not provide any statistical evidence of having short-run impact of financial development on investment and vice-versa

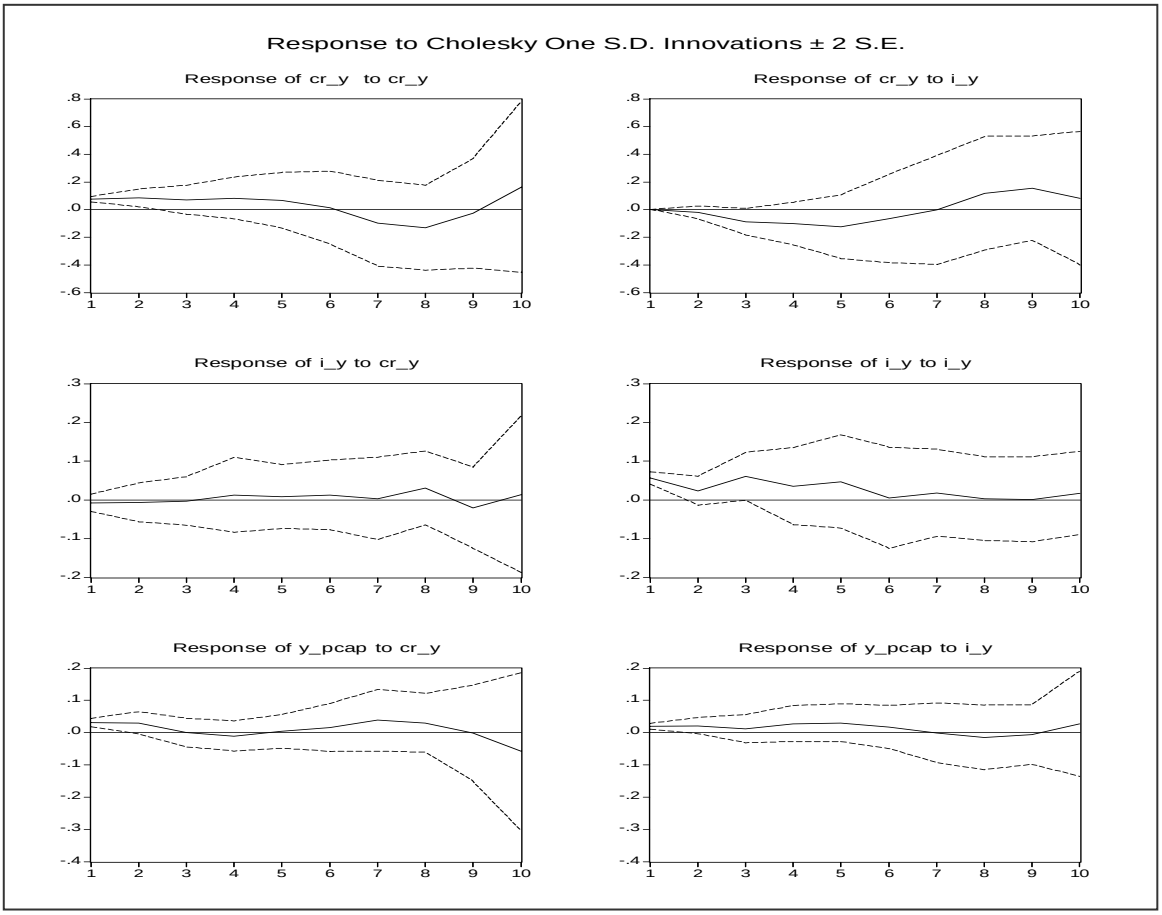
Forecast error variance as reported at the top of Table 4 which contains the VDCs of domestic credit to GDP ratio indicate that the lending rate and the financial development variable explain most of the forecast error variance in the domestic credit to GDP ratio. The lending rate alone explains more than 50 percent of the variance in financial development which is significant from the 8th time horizon onwards. Financial development explains about 41 percent of its own forecast error variance up to the 4th time horizon. The forecast error variance of financial development explained by investment and per capita income are not statistically significant. Therefore, despite the absence of any long-run impact of the lending rate changes on financial development, the movement of lending rate, however, contains useful information in predicting future movement of the financial development indicator.

The middle part of the Table 4 summarizes the forecast error variance of investment-GDP ratio. Likewise, the forecast error variance of financial development, the lending

[10] The ordering of the variables in Cholesky factorization is as follows: Lending rate as a policy variable has been placed first in the order. As our intention is to see the impact of financial development on investment and per capita income, the financial development variable has been placed in the second position followed by investment and per capita income respectively in the third and forth places.

rate explains about the 50 percent of the variability in the future investment-GDP movement from the 8th time horizon onwards. At the initial years (1st-8th time horizons), however, the movement of investment-GDP ratio itself seems to be an important factor in explaining the future path of investment-GDP ratio. Two other variables, such as financial development and per capita income do not contain any useful information in predicting future path of investment-GDP ratio.

Figure 2
Impulse Response Functions



Forecast error variance in per capita income as explained in the bottom part of Table 4 indicates that more than 70 percent of the forecast error variance of per capita income is explained jointly by the indicator of financial development (credit-GDP ratio) and investment-GDP ratio during the initial 4 years. During this period, about 14 percent of the forecast error variance in per capita income is explained by the variable itself. In forecasting the future movement of per capita income, changes in the lending rate seems to be an important factor as it explains about 70 percent of the total forecast error variance in per capita income after 12th time horizon onwards. Therefore, all the variables in the system namely lending rate, domestic credit-GDP ratio as an indicator of financial development and investment-GDP ratio are important in predicting future path of per capita income movement.

Table-4:
Variance Decompositions of Financial Development, Investment and per Capita Income

Time Horizon (Year)	Explained by shocks in			
	Lending Rate	Financial Development	Investment	Income per Capita
1. Variance Decompositions of Financial Development				
4	27.61	40.57**	31.30	0.52
	(-16.84)	(-19.77)	(-17.74)	(-3.75)
8	52.89**	21.60	20.17	5.33
	(-17.81)	(-16.48)	(-16.43)	-(6.28)
12	63.72**	18.84	12.40	5.04
	(-18.80)	(-17.16)	(-16.36)	(-6.15)
16	70.36**	12.72	11.15	5.77
	(-19.54)	(-17.10)	(-16.54)	(-6.26)
20	70.72**	14.63	8.64	6.01
	(-19.77)	(-17.72)	(-16.90)	(-5.92)
2. Variance Decompositions of Investment				
4	31.86	2.02	61.57**	4.54
	(-16.95)	(-14.64)	(-19.07)	(-5.01)
8	43.29**	5.95	45.68**	5.08
	(-17.84)	(-16.17)	(-18.21)	(-5.91)
12	50.09**	14.15	31.19	4.57
	(-18.92)	(-16.75)	(-17.60)	(-5.50)
16	62.32**	15.56	17.73	4.40
	(-19.59)	(-17.01)	(-17.41)	(-5.71)
20	57.43**	28.07	10.56	3.94
	(-19.89)	(-17.84)	(-17.38)	(-5.73)
3. Variance Decompositions of Income per Capita				
4	13.92	38.56**	33.56**	13.96**
	(-16.54)	(-17.96)	(-16.22	(-6.90)
8	41.35	28.39	19.56	10.70
	(-18.80)	(-17.04)	(-16.14	(-6.53)
12	66.24**	11.94	15.14	6.68
	(-19.64)	(-17.24)	(-16.46	(-5.94)
16	70.69**	14.13	8.94	6.24
	(-19.67)	(-17.32)	(-16.86	(-5.99)
20	65.60**	20.35	8.34	5.71
	(-20.14)	(-17.57)	(-17.00	(-5.92)

Notes:
1. First entry in each cell is the point estimates of the percentage of forecast error variance of variable *i* as explained by shocks to variable *j*. Monte Carlo (1000) simulated standard errors are reported in the parenthesis.
2. ** indicate point estimates are statistically significant at 5% level assuming that the estimates are asymptotically normally distributed.

8. Summary and Conclusion

The intention of this paper is to investigate the long-run relationship between financial development and economic growth, particularly, the long-run impact of financial development on investment and per capita income. Accordingly, a system of equations based on some theoretical predictions is specified and estimated using Blanchard and Quah's (1989) technique of SVAR. To examine the short-run dynamics among the variables in the system, however, the impulse response functions (IRFs) and variance decomposition (VDCs) are computed using Cholesky factorization where the standard errors for VDCs are computed through 1000 Monte Carlo simulations.

An overview of financial development in Bangladesh as discussed in Section 2 shows steady increasing trend in all the indicators of financial development, investment-GDP ratio and income per capita with a clear indication of a close association among them during 1976-2005. Although this apparent association does not necessarily imply any causal link between financial development and per capita income, the estimated long-run response matrix strongly support the hypothesis that financial development has long-run impact on per capita income.

The estimates of long-run response matrix indicate that financial development has long-run impact on both investment-GDP ratio and on per capita income. The results also confirm that investment's share of GDP has long-run impact on per capita income as well. Thus, financial development in Bangladesh has direct as well as indirect (via investment) long-run impact on per capita income. These results, therefore, support the main hypothesis of the study that financial development has long-run impact on income per capita. As the estimated results of the long-run response matrix indicate that while the lending rate does not have any statistically significant impact on any of the variables in the system, the lending rate as a policy instrument would not be useful in expanding credit or in stimulating economic activity.

Regarding the short-run dynamics among the variables in the system, it has been observed from the IRFs that a positive shock in credit-GDP ratio or investment-GDP ratio generates a positive short-run response in per capita income, i.e., both credit and investment GDP ratios have short-run positive impact on per capita income. The results from VDCs, on the other hand, indicate that all the variables in the system, such as the lending rate, indicators of financial development and investment's share of GDP contain very useful information in predicting the future path of per capita income even though lending rate does not have any long-run impact on any of the variables in the system.

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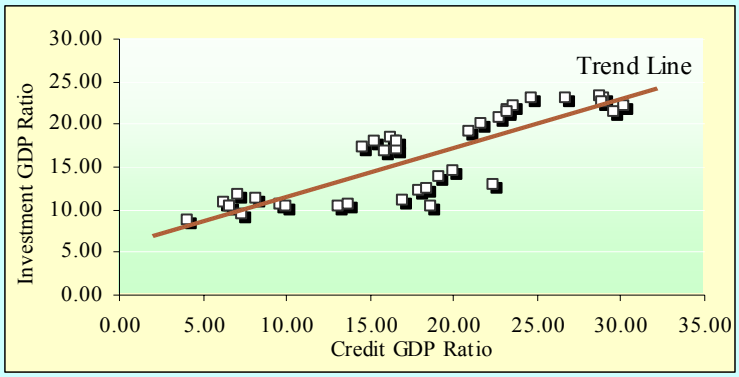
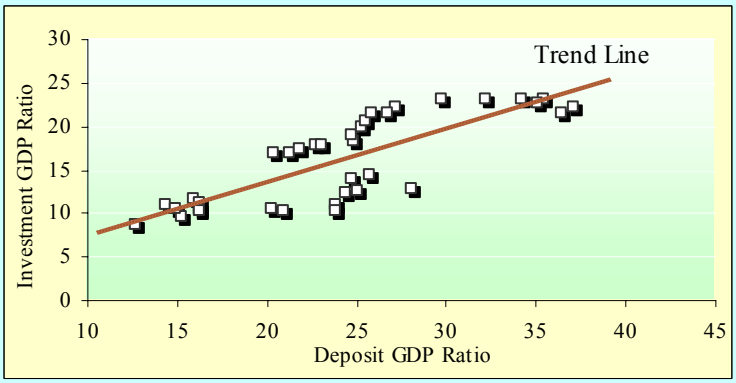
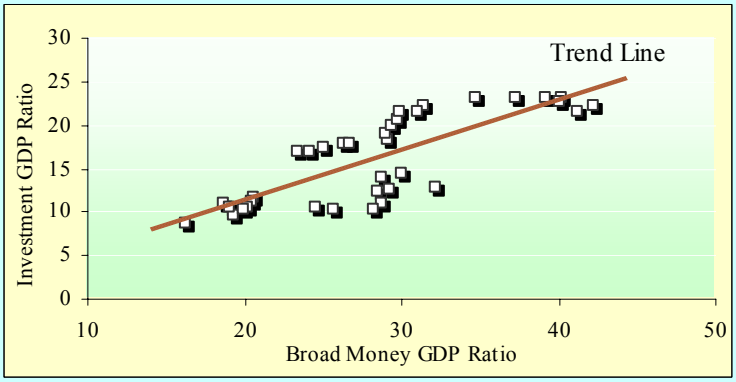
Appendix A1

Financial Development and Investment Relationship

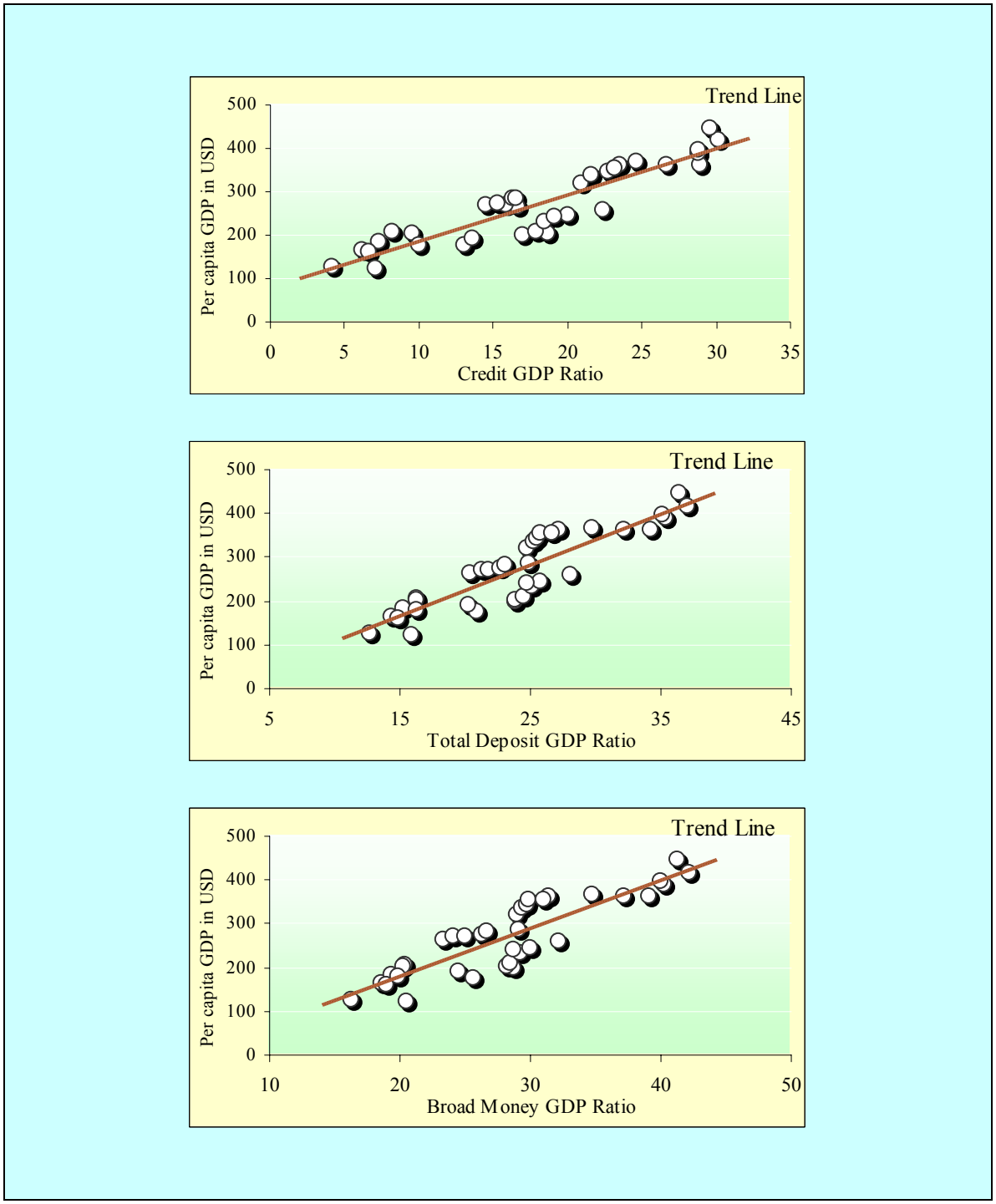






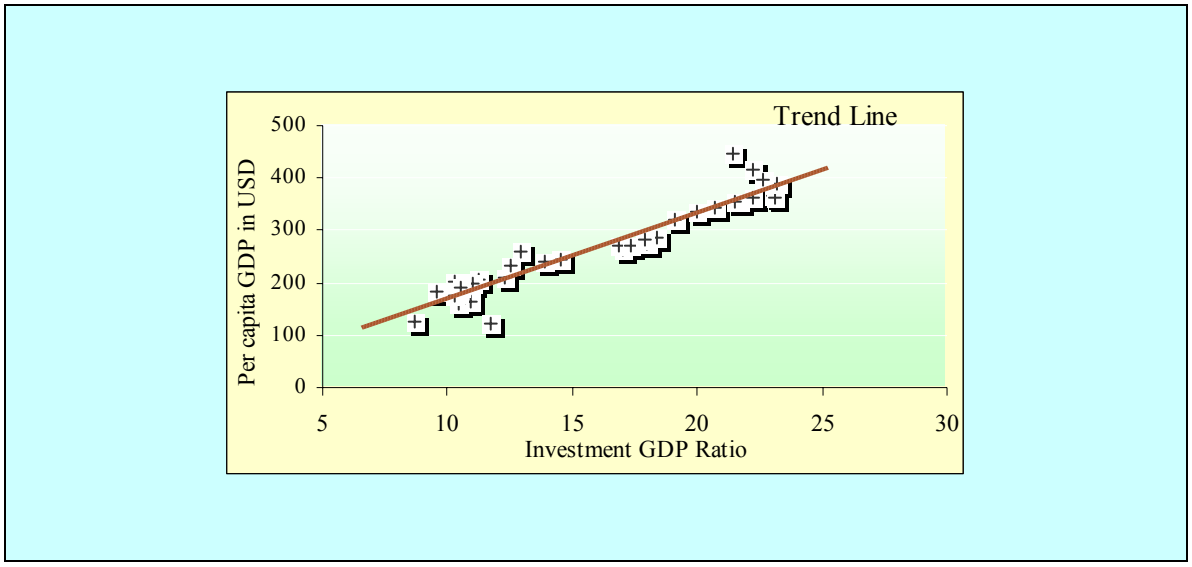
Appendix A2

Financial Development and Per Capita GDP Relationship



Appendix A3

Investment and Per Capital GDP Relationship



Appendix A4

Data

Period	lr	cr_y	dep_y	m2_y	i_y	y_pcap
1976	11.62	4.15	12.71	16.26	8.69	126
1977	11.03	7.07	15.86	20.51	11.72	122
1978	10.66	6.22	14.33	18.65	10.96	164
1979	11.12	7.32	15.21	19.33	9.57	183
1980	11.04	8.18	16.22	20.40	11.26	206
1976-1980	**11.09**	**6.59**	**14.86**	**19.03**	**10.44**	**160**
1981	13.07	9.61	16.30	20.22	10.53	202
1982	13.53	10.02	16.23	19.91	10.39	178
1983	13.55	13.11	20.96	25.62	10.30	176
1984	13.75	16.97	23.81	28.74	11.04	200
1985	14.50	18.63	23.83	28.19	10.28	204
1981-1985	**13.68**	**13.67**	**20.23**	**24.54**	**10.51**	**192**
1986	14.66	17.88	24.43	28.52	12.30	209
1987	14.70	18.46	25.07	29.24	12.53	232
1988	14.66	20.02	25.76	30.00	14.52	244
1989	14.68	22.37	28.09	32.22	12.92	259
1990	14.83	16.66	20.40	23.38	17.05	264
1986-1990	**14.71**	**19.08**	**24.75**	**28.67**	**13.87**	**242**
1991	14.99	15.92	21.29	24.13	16.90	270
1992	15.12	14.55	21.80	24.98	17.31	269
1993	14.39	15.29	22.72	26.31	17.95	273
1994	12.78	16.27	24.83	29.06	18.40	285
1995	12.22	20.88	24.71	28.94	19.12	319
1991-1995	**13.90**	**16.58**	**23.07**	**26.68**	**17.93**	**283**
1996	13.41	21.60	25.29	29.39	19.99	337
1997	13.69	22.79	25.48	29.69	20.72	345
1998	14.02	23.24	25.82	29.85	21.63	353
1999	14.16	23.55	27.13	31.40	22.19	362
2000	13.86	24.67	29.78	34.71	23.02	368
1996-2000	**13.83**	**23.17**	**26.70**	**31.01**	**21.51**	**353**
2001	13.75	26.71	32.17	37.22	23.09	362
2002	13.16	28.93	34.22	39.13	23.15	362
2003	12.78	28.76	35.42	40.24	23.21	389
2004	11.01	30.14	37.11	42.24	22.24	418
2005	10.93	29.62	36.47	41.25	21.46	447
2001-2005	**12.33**	**28.83**	**35.08**	**40.02**	**22.63**	**395**

Sources: 1. On line version of *International Financial Statistics* (IFS), IMF.
2. *World Development Indicator* CD ROM 2003, World Bank.
3. *Annual Report and Economic Trends* (various issues), Bangladesh Bank.

Notes: 1. lr = Weighted average annual interest rate on lending by banks.
2. cr_y = Domestic credit to the private sector as a percent of GDP.
3. dep_y = Total deposits as a percent of GDP.
4. m2_y = Broad money as a percent of GDP.
5. i_y = Gross fixed capital formation (gross investment) as a percent of GDP.
6. y_pcap = GDP per capita at current US dollar.