ECONOMIC GROWTH ESTIMATION: CASE STUDY OF PAKISTAN

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CERTIFICATE

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Liaqat Qazi

First and foremost, I offer my gratitude to **Allah** almighty, for without His Grace the completion of this task would not have been possible. After that, I beseech Allah to bestow His blessings upon the **Holy Prophet Muhammad** (peace be upon him). Following that I would like to thank my beloved ***parents***, my ***grandmother*** and my younger brother, ***Meraj Qazi***.

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ABSTRACT

The determination of the determinants of economic growth is remarkably significant. In Pakistan, many researchers presented their economic growth models, but all models have some bias due to missing relevant variables. All models are not imposing prior zero restriction on other models. This situation creates a confusion that which model is good or close to good.

This study explores the determinants of economic growth by using all relevant variables in a single model to overcome this missing variable bias. The data used is used for the period of 1980 to 2015 of real GDP, current expenditure, development expenditure, education, energy consumption, external debt, exchange rate, exports, health, imports, foreign direct investment, physical capital and reserves.

The ARDL cointegration procedure is employed to identify the long-run and short-run relationships between economic growth and its determinants. We conclude that most of the variables have long-run relationship with economic growth. Education, exports, FDI, reserves and physical capital have a positive and statistically significant impact on economic growth in the long-run. However, current expenditure, health (life expectancy) and imports have a negative and statistically significant impact on economic growth in the long-run.

Current expenditure, exports, exchange rate, health, imports, FDI, and reserves are significant in the short-run. Moreover, the model is free from the problems of heteroscedasticity and serial correlation. The model is stable for policy analysis and results have important policy implications.

Key words: Economic growth, Human capital, ARDL model, ECM model, Pakistan.

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CHAPTER 1

INTRODUCTION

Economic growth is a major concern for policymakers around the world. Policymakers attach so much importance to economic growth due to several reasons. For one, it can help reduce poverty. Though economic growth may not directly reduce poverty, any considerable reduction in poverty in the long run is very unlikely with it. Hence, economic growth is a must for third world economies, that are experiencing with high levels of poverty. Two, economic growth helps decrease unemployment. Growth is likely to create new job opportunities and improve the conditions of the existing ones. Economic stagnation is may raise unemployment rates and result in social suffering. Three, it can reduce budget deficits. Increased economic activity may provide governments with adequate sources to meet their budgetary requirements. Four, increased economic growth is likely to ameliorate the living conditions of the masses. It can enable governments to increase their spending on social welfare causes without increasing the tax-burden. Hence, policymakers' preoccupation with economic growth is obvious.

1.1 Debates about Growth Theory

Economic growth is of interest to developed as well as developing countries worldwide. Traditions neoclassical growth models assumed decreasing returns to capital. Moreover, neoclassicals treated technological progress as an exogenous. Romer (1986), Lucas (1988) and Rebelo (1991) renewed interest in the growth theories with endogenous growth models. Unlike the neoclassical models, these models assumed constant and increasing returns to capital. Moreover, Romer (1990), Aghion and Hewitt (1992), Grossman and Helpman (1991, Chs. 3,4)

argued that constant and increasing returns to capital depend on innovation. Technological innovations in turn depended on monopoly profits that incentivized research. Barro (1996) argues that economic growth is positively impacted by higher life expectancy and initial schools, better terms of trade and improved rule of law situation. Moreover, he argues that it is negatively impacted by higher inflation, fertility rates and government consumption.

In the case of Pakistan, a developing country, a plethora of research has been conducted on the subject. Chaudhary and Qaisrani (2002) pointed out the positive role of excess foreign reserves in physical capital accumulation and hence output. Moreover, Siddiqui (2004) studied the impact of the consumption of different sources of energy consumption on economic growth. However, Satti *et al.* (2014) studied the impact of only coal consumption.

1.2 Objectives of the Study

This study seeks to assess the long-run impact of the various determinants of economic growth. In view of this objective of this study, we will address the following research question.

1.3 Research Question

1. What are the potential determinants of economic growth in Pakistan?
2. Is there any long-run relationship between the variables?
3. Is there any short-run relationship between the variables?

1.4 Significance of the study

Many researchers on the subject have omitted key variables, while others have included them and excluded some variables used by the former. By excluding variables, the researchers have automatically assumed that the impact of the excluded variables is zero. However, this may not be true as the same variables been incorporated in other research works and their impacts has

been assessed as significant on economic growth. We attempt to incorporate auxiliary variables that determine economic growth in our model because after doing that we can better assess impact of the relevant variables.

CHAPTER 2

LITERATURE REVIEW

Several studies have been carried out trying to ascertain the relationship between economic growth and its various determinants in the case of Pakistan. Abbasa and Foreman-Peck (2007) used time series data for Pakistan for the period 1960 to 2003 and employed the Johansen method of cointegration in their analysis. The analysis suggested that the contribution of human capital to output was likely to increase with better technical knowhow. Investments in secondary education and health were associated with increased productivity and favorable for investment in the industry. Moreover, human capital made up for slightly less than 20 percent of the improvement in per capita GDP. Khan and Khan (2011) studied the correlation between FDI and economic growth across the sectors in Pakistan by using the data for the period 1981-2008. Granger causality and panel cointegration framework was employed. Panel cointegration suggested a long run positive impact of FDI on economic growth. Moreover, causality also ran from FDI to economic growth in the long run. However, bidirectional short run causality was detected between FDI and economic growth. The sectoral analysis suggested varying impacts of FDI on the growth of these sectors. In the primary and services sector, FDI caused growth; while in the manufacturing sector growth caused foreign FDI.

From here onwards, we have divided the literature for the various variables being studied.

2.1 Human Capital

Investment on human capital have a two-fold effect on the welfare of a state. For one, the general welfare of the masses is enhanced and two, it promotes economic growth as well. The importance of human capital in economic growth is acknowledged by both neoclassical growth

models and the endogenous growth models. Nonetheless, in the neoclassical models, economic growth is considered to ultimately depend on technological progress. However, the endogenous growth models attach greater importance to human capital as a determinant of economic growth. Researchers have used different proxies for human capital. Some have used education as a proxy human capital (*inter alia*: Mankiw et al., 1992; Barro and Lee,1993), while others also used health as a proxy (Sachs and Warner, 1997; Taniguchi and Wang, 2003). Stewart *et al.* (1998) found a bidirectional relationship between human capital development and economic growth.

In the case of Pakistan Khan *et al.* (2005) assessed the impact of investments on human capital on economic growth in Pakistan in addition to other variables traditionally viewed as the determinants of economic growth. Improvement of institutions on qualitative lines and physical capital accumulation were paying the highest dividends in terms of economic growth. However, investments on education and health facilities also had a significant impact on economic growth.

Aziz *et al*. (2008) studied the impact of higher education on economic growth in Pakistan using the data from 1978 to 2008 by employing the Cobb-Douglas production function. They found that higher education had a significant impact on economic growth and suggested increased emphasis on higher education.

Chaudary *et al*. (2009) also assessed the function of higher education in growth for Pakistan and data from 1972 to 2005 was used. They employed the Johansen cointegration and Toda and Yamamoto Causality in the framework of VAR to assess the long-run impact. The analysis of the data revealed that a long-run relationship did exist between the variables. However, tests revealed a unidirectional causality which ran from economic growth to higher studies and not the vice versa.

Afzal *et al*. (2010) assessed the link between schooling and economic growth in the short run as well as the long run in Pakistan. The ARDL approach was employed in the study and data of variables, inflation rate, school enrolment, real GDP and physical capital in real terms for span of time ranging from 1970-1 to 2008-9 was used for the study. The empirical results suggested the presence of co-integration and two-directional causality between schooling and economic growth in the long run. However, both variables were inversely related in a two-way short-run relationship. Inflation was associated with the lack of macroeconomic and thus checked economic growth and also schooling in the long term.

Chaudary *et al*. (2010) studied the relationship between trade openness, human capital investment and growth in Pakistan. Data from 1972 to 2007 were used for this study and the co-integration method was used along with granger causality test. Co-integration in the short run as well as long run was detected, and causality ran from trade openness and human capital to growth. Results suggested sustainable economic growth was favorable for schooling and trade liberalization policies.

Afzal *et al*. (2010) studied the relationship between schooling and growth by employing ARDL and granger causality approaches on the data of the period 1970-71 to 2008-09. Co-integration and a feedback causal relationship between schooling at all levels and economic growth was found. Significant impact of higher education on economic growth was detected and the confidence level was highest for economic growth to schooling. The authors suggested increased investment on tertiary education, so that it may increase economic growth and in turn schooling as well.

Qadri and Waheed (2010) did a time series analysis of human capital and economic growth using the data of 1978 to 2007. The indicator used for education had been adjusted for

health and then used in the Cobb-Douglas production function and a long run relationship was detected. Test were conducted to determine how robust and sensitive the results were, and the robustness of the findings was confirmed by the test. Education was a significant and major driving force behind economic growth. The study further suggested increased investment on education and health. Afzal *et al*. (2012) studied the relationship between schooling, poverty, capital stock and growth. Data of these variables was used of the period 1971-2 to 2009-10 was used. The ARDL results suggested a positive and significant relationship in the short run as well as long run between capital stock and growth. However, the impact of education on economic growth was in the long run, significant nonetheless. The Augmented Granger Causality test proved a two-way causality between schooling and growth, between growth and poverty and between education and poverty. Furthermore, adoption of pro-education policies was suggested that would help alleviate poverty. Asghar *et al*. (2012) conducted an analysis between human capital and economic growth using cointegration methods and causality tests. Human capital was defined in terms of education and health. Data of Pakistan of the period 1974 to 2009 was used. Long run cointegration was found between the variables. Causality tests were also employed, and stability was checked using CUSUM and CUSUMSQ. Results suggested a positive relationship of human capital on growth, notwithstanding the low levels of investment on health and schooling in Pakistan. The study suggested further investments on health and schooling.

2.2 Energy Consumption

Aqeel and Butt (2001) studied the correlation between consumption of energy and growth for Pakistan by employing co-integration techniques and Granger causality as given by Hsiao. Results of the study indicated that growth caused consumption of energy as well as petroleum. However, no relationship could be detected between gas consumption and growth in the

economy. However, the authors pointed out that it had been observed in the energy sector that consumption of electricity promoted growth in the economy without any feedback. They suggested that policies for energy growth be chosen in a manner that increases growth in the economy. Siddiqui (2004) studied the relationship between the use of energy and growth in the economy. The study showed that increase in energy consumption increased economic growth and a decrease slowed down growth in the economy. However, the effect of different energy sources was different as the effect of electricity and hydrocarbons on economic growth was high and significant. Moreover, hydrocarbons also had a reserve causal effect as well. Zaman *et al*. (2011) studied the effect of oil consumption across the sectors on growth in the economy in Pakistan, using the error correction model (ECM). The data for the span 1972 to 2008 of Pakistan was used in the study. The study revealed that the sectors involved in the production of some sort such as the transportation sector, power sector and the industry made a positive contribution to the economy and these sectors were the major consumer of oil. However, the sectors which were the minor consumers of oil and were the end users of oil such as households, the government and the agriculture sector made a negative contribution to the economy. Stability was checked and proved by the ECM. Single directional causality was detected between GDP, transportation and industry with energy sector. Satti *et al*. (2014) focused on the correlation between consumption of coal and growth in the economy in Pakistan using the data for the period 1974 to 2010. The results of the VECM Granger causality method suggested a two-way causality between the two. Moreover, no structural instability existed over this period as indicated by the CUSUM and CUSUMSQ diagrams.

2.3 External Debt

Governments often rely on foreign and domestic debts to finance their budget deficit. Investing the impact of external debt on economic growth, Levy and Chowdhury (1993) reached the conclusion that it negatively impacted economic growth by hampering capital accumulation and egging on flight of capital from the debt-ridden country as investors would fear higher taxes. However, while investigating the impact of domestic debt on economic growth in India, Singh (1999) found support for the Ricardian Equivalence that hypothesizes the neutral nature of domestic debt.

Pakistan has often been in deficit and has relied on capital inflow and debt from abroad to finance its deficit. Foreign assistance and has not been readily available. In comparison, domestic debt has been more accessible. Sheikh *et al.* (2010) studied the effects of domestic debt on the growth of the economy in Pakistan using the data from 1972 to 2009 and employed the Ordinary Least Square (OLS) technique. The results showed that domestic debt had a positive impact on economic growth, which indicated that the domestic debt had been utilized by the government for financing expenditures that boosted the economy. However, due the heavy burden of non-developmental public expenditures, the servicing of domestic debt had a negative impact on economic growth in Pakistan. Moreover, the study found that the negative effects of debt servicing outweighed the positive effects of domestic debt and thus, recommended policies to ease the burden of domestic debt.

Even though foreign debt is not readily accessible for third world countries including Pakistan, foreign debt makes up for a major portion of their incomes. Malik *et al.* (2010) studied the relationship between foreign debt and economic growth in Pakistan by doing a time series analysis of the data for the period 1972 to 2005. The results revealed that foreign debt had a

negative and significant impact on economic growth. Moreover, foreign debt servicing was also inversely and significantly related to economic growth as debt servicing deserves the avenues for growth.

2.4 Exchange Rate

He (2010) suggested that China's fixed exchange rate regime played a key role in the rapid growth of its economy. He also observed that fixed exchange rate regime boosted productivity in the long run. Moreover, Chen (2012) confirmed his views while studying the data of 28 provinces of China. Cheung and Lai (1998) investigated the role played by exchange rate in economic growth by analyzing the data of 5 fast growing Asian economies. The findings of Musyoki et al. (2012) suggested a negative effect of volatile real exchange rate.

In the case of Pakistan, Ahmad *et al*. (2013) examined the effect of exchange rate, inflation, FDI and capital accumulation on economic growth using the data for the period 1975-2011. OLS was applied as the data was found stationary at level form. The resulted suggested a significant negative impact of exchange rate and inflation on economic growth. One percent increase in the exchange rate induced a 0.55 reduction in economic growth and inflation induced a 0.29 percent reduction in GDP for every one percent increase in inflation. Impact of capital accumulation on economic growth was found insignificant, while FDI had a positive significant impact. GDP increased by 0.37 percent for every one percent increase in FDI. The model was found to be structurally stable and free from the problems of serial correlation and heteroskedasticity. The study further suggested that improvements must be made in quality of goods exported so as to smoothen the balance of trade.

2.5 Exports and Imports

Following the formation of the World Trade Organization (WTO) in 1995, world economies have increasingly adopted trade liberalization policies. Countries have aimed to achieve export-led growth. Hence, several studies have tried to the study the export-led growth hypothesis.

Sharma and Dhakal (1994) conducted a cross-sectional study of 30 developing countries. The study showed mixed results. Some countries had experience export-led growth, while others had experienced, growth led expots. Moreover, no relationship could be observed in case of the other countries.

Ekanayake (1999) studied the role of exports in economic growth for eight developing Asian countries namely Pakistan, India, Korea, Indonesia, Thailand, Philippines, Malaysia and Sri Lanka. The study employed cointegration and error correction models and used the data for the period 1960 to 1997. The study gave strong empirical backing to the conventional wisdom which suggested a strong positive contribution of exports to economic growth. The results suggested export-led economic growth for Malaysia and a two-way causality for the rest of the countries. Short run causality ran from economic growth to growth in exports for all countries except Sri Lanka, but strong evidence for reverse causality that ran from growth in exports to economic growth did not exist.

Thornton (1997) studied six European economies. In the case of Italy, Norway and Sweden causality ran from exports to growth. However, in the case of UK the causality ran from growth to exports. Moreover, the results for Denmark and Sweden showed a two-way causality.

In the case of Pakistan, Abbas (2012) studied the correlation between exports and economic growth using data for the period 1975-2010. It was an attempt to check the efficacy of

the export promoting policy of Pakistan in the 90s. Johansen Cointegration and Granger Causality were used to assess the short and long run causality. One positive cointegration equation existed and Granger causality results suggested that causality ran from economic growth to exports both in the short run and long run. The study further suggested that attempts must be made to boost production in Pakistan as it would lead to increased exports.

Shahbaz and Rahman (2014) analyzed the relations between exports, development of the financial sector and economic growth in Pakistan. ARDL was applied to analyze the long run relationship and ECM for the short run. The direction of the causal relationship and robustness of the model were also tested. Long run cointegration was found between the variables and results suggested that development of the financial sector and economic growth promoted growth in the exports. Feedback relationship was detected between development of the financial sector and economic growth, financial development and exports growth and exports and economic growth. The paper further suggested that economic growth must be simulated, and financial sector be developed to spur sustained growth in exports.

2.6 Foreign Direct Investment (FDI)

As regional integration has increased, Multinational Corporations (MNCs) have made increasing investments in the third world economies. Moreover, foreign direct investment (FDI) is deemed a necessary ingredient for economic growth in developing states. FDI ensures the transfer of technology to the recipient countries. FDI also helps impart better skills to the labor force and encourages local investors to invest as well.

Bhagwati (1978, 1994) among others has observed that countries, that pursue policies of export promotion, tend to benefit more from FDI as compared to those, which pursue protectionist policies of import substitution.

In the case of Pakistan, Falki (2009) studied the effect of foreign direct investment (FDI) on economic growth using the data for the period 1980-2006. This correlation was assessed by applying the production function that was theoretically based on the endogenous growth theory and other important variables such as trade, capital stock and labor were also used. The analysis suggested a negative, though insignificant relationship between economic growth and FDI coming into Pakistan. Policy recommendations were also made based on these findings.

Ghazali (2010) investigated the causal correlation between FDI, local investment and economic growth in Pakistan by using the data for the period 1981-2008. The results suggested two-way causality between FDI and local investment, local investment and GDP growth and one-way causality running from FDI to economic growth in the long run. Moreover, strong positive relationship was detected between FDI, local investment and GDP growth as large local investment encouraged GDP growth, and vice versa. Long run positive cointegration existed between FDI inflow, local investment and GDP growth. Since FDI inflows into Pakistan spurred local investment and economic growth, the paper recommended that policies be adopted to attract foreign direct investment in such a manner that boosts local investment and economic growth.

Iqbal *et al*. (2010) examined the causal relationship between foreign investment, trade and GDP growth using quarterly data for the period 1998-2009 for Pakistan. The results of the VAR model showed a long run correlation among the variables. The findings of VECM test for causality suggested a two-way causal relationship between FDI, exports and GDP growth. FDI impacted trade positively in Pakistan. The study further recommended that security of the foreign investors must be ensured and FDI be invested in underdeveloped areas of Balochistan and rural Sindh.

2.7 Physical Capital Accumulation

May researchers have used physical capital accumulation as a variable in their studies. For instance, Shahbaz *et al*. (2015) examined the correlation between consumption of renewable energy and growth in the economy in Pakistan and used labor and capital as additional likely variables causing economic growth. The ARDL and rolling window approaches were employed on quarterly data of Pakistan for the span of 1972 Q1 to 2011 Q4. The cointegration methods and causality test established a long run causal relationship between the variables. The results showed that that consumption of renewable energy, labor and capital speed up growth in the economy. Moreover, the results showed a feedback relationship between consumption of renewable energy and growth in the economy.

Similarly, Dutta and Ahmed (2004) investigated the correlation between trade liberalization and growth in Pakistan's industry using the data for the period 1973-95 and used endogenous growth modeling. Cointegration and error correction models were employed. The results showed a long run correlation between additions to industrial value and major variables that contributed to it, namely capital accumulation, real exports, the labor force, import tariffs and enrolment to secondary school. In addition, error correction modelling was employed to analyze the short-run relationship. The error correction term was found to be significant statistically.

2.8 Reserves

Chaudhary and Qaisrani (2002) studied the impact of unstable imports, exports and foreign exchange reserves on economic growth in Pakistan. Furthermore, the impact of unstable exports on investment and inflation was analyzed. The results suggested that unstable exports did not impact investment and economic growth. However, excess foreign reserves did lead to

increased capital accumulation and had a positive impact on output. Though export instability did not impact capital accumulation and domestic investment, unstable exports could indirectly impact capital goods imports and economic growth negatively through its impact on foreign reserves. Moreover, the study recommended that high levels of foreign resources should be maintained to sustain economic growth and highlighted the importance of imports in industrial growth.

2.9 Public Investment

The existing literature analyzing the role of public investment in economic growth has put forth two opposing viewpoints. One camp [Arrow and Kurz (1970); Barro (1990)] argues that public investment has a positive impact on economic growth. According to this camp, public investment has positive spillover effects and crowds in private investment. However, the second camp [inter alia: Khan (1996); Devarajan et al. (1996)] highlight the inefficiency of public investment and fear that it crowds out private investment.

Ghani and Din (2006) examined the impact of public investment in the economic growth process in the case of Pakistan. Vector autoregressive (VAR) approach was employed. Keeping in view the theoretical backdrop of the topic, variables such as investment of the private sector and public consumption were also included the model. The findings of the study suggested that economic growth was mostly caused by private sector investments and no concrete conclusions could be drawn about the role of public sector investments in the economic growth process and same was the case for public consumption.

CHAPTER 3

METHODOLOGY AND MODEL SPECIFICATION

3.1 Data Sources and Description of Data

This research uses data of the different variables for the period 1980 to 2015 for Pakistan. Data has been extracted from various issues of the Economic Survey of Pakistan, Handbook of Statistics on Pakistan Economy 2015, WDI databank and IFS.

Growth Function

$$Y = f(CX, DX, ED, EDU, ENG, EX, EXR, FDI, HE, IM, PC, RSV)$$

Econometric Model

$$lnY = \beta_0 + \delta_1 lnCX + \delta_2 lnDX + \delta_3 lnED + \delta_4 EDU + \delta_5 ENG + \delta_6 EX + \delta_7 EXR + \delta_8 HE + \delta_9 lnFDI + \delta_{10} IM + \delta_{11} PC + \delta_{12} lnRSV + U_t$$

Where

Variable	Explanation	Expected Sign
Ln	= Natural logarithm	
Y	= Real gross domestic product, used as a proxy for economic growth. Real GDP as a proxy of economic growth has also been used by among others Katircioglu (2009), Rehman, Farooq and Sarwar (2011).	
β_0	= Constant	
CX	= Current Expenditure	-
DX	= Development Expenditure	+
ED	= External Debt.	-
EDU	= Education. Gross educational enrolment has been used as a proxy for the educational quality of the human capital.	+
HE	= Health. Life expectancy has been used a proxy for the quality of life and health of the human capital. Health along with education have been used as proxies to assess the impact of human capital on economic growth.	+
ENG	= Energy Consumption. Energy use (kg of oil equivalent per capita).	+
EX	= Exports in real terms	+

EXR	= Exchange Rate	-
FDI	= Foreign Direct Investment	+
IM	= Imports in real terms	-
PC	= Real Physical Capital. Gross fixed capital formation has been used as a proxy of physical capital in real terms. The proxy has already been used by Abbas & Peck (2007) & Afzal Butt, Rehman & Begum (2009) among others.	+
RSV	= Reserves	+
U_t	= Disturbance term.	

3.2 ARDL Bound Testing

To explain the dependent variable, the Autoregressive distributed lag (ARDL) model uses the current value and lag of the explanatory variables and the lag of the dependent variable. Davidson *et al.* (1978) suggested the ARDL methodology for modeling the consumption function of the United Kingdom. ARDL model starts with a general and large form of the model and subsequently reduces its size and changes the variables by the imposition of non-linear and linear restrictions (Charemza and Deadman, 1997). ARDL model is among the most general and unrestricted models in econometric literature. The general to specific approach of the ARDL model is helpful in addressing problems such as autocorrelation and misspecification, and choosing an appropriate model.

The simplest and basic form of the ARDL model is ARDL (1, 1). Consider the following ARDL (1, 1) model

$$Y=\alpha + \beta_1 X_t + \beta_2 X_{t-1} + \beta_3 Y_{t-1} + \varepsilon_{yt}$$

Hendry and Richard (1983), Hendry, Pagan and Sargan (1984) and Charezma and Deadman (1997) suggested that if restrictions were imposed on ARDL (1, 1), we can come up

with many appropriate models at least ten. Following are a few important instances of such restrictions

1. $\beta_1 = \beta_2 = 0$ First order autoregressive process,
2. $\beta_2 = \beta_3 = 0$ Static regression,
3. $\beta_2 = 0$ Partial adjustment equation,
4. $\beta_3 = 1, \beta_1 = -\beta_2$ First difference equation

Spurious regression may result due to missing variable. Thus, the general to specific approach of the ARDL model and its inclusion of the lag structure could provide better results.

3.3 Model Specification

The ARDL version of the equation is

$$\Delta lnY_i = \beta_0 + \sum_{i=1}^{p} \lambda_i \Delta\, lnY_{t-i} + \sum_{i=1}^{p} \mu_i \Delta\, lnDX_{t-i} + \sum_{i=1}^{p} \gamma_i \Delta\, lnED_{t-i} + \sum_{i=1}^{p} \theta_i \Delta\, EDU_{t-i}$$
$$+ \sum_{i=1}^{p} \omega_i \Delta\, ENG_{t-i} + \sum_{i=1}^{p} \tau_i \Delta\, EX_{t-i} + \sum_{i=1}^{p} \pi_i \Delta\, EXR_{t-i} + \sum_{i=1}^{p} \theta_i \Delta\, HE_{t-i}$$
$$+ \sum_{i=1}^{p} \varphi_i \Delta\, lnFDI_{t-i} + \sum_{i=1}^{p} \sigma_i \Delta\, lnCX_{t-i} + \sum_{i=1}^{p} \psi_i \Delta\, lnRSV_{t-i} + \sum_{i=1}^{p} \upsilon_i \Delta\, PC_{t-i}$$
$$+ \sum_{i=1}^{p} \lambda_i \Delta\, IM_{t-i} + \delta_1 lnY_{t-1} + \delta_2 lnDX_{t-1} + \delta_3 lnED_{t-1} + \delta_4 EDU_{t-1}$$
$$+ \delta_5 ENG_{t-1} + \delta_6 EX_{t-1} + \delta_7 EXR_{t-1} + \delta_8 HE_{t-1} + \delta_9 lnFDI_{t-1} + \delta_{10} lnCX_{t-1}$$
$$+ \delta_{11} lnRSV_{t-1} + \delta_{12} PC_{t-1} + \delta_{13} IM_{t-1} + \varepsilon_t$$

The ARDL technique begins with the bound test. In the first step, the equation is estimated by the OLS method, followed by the F-test to assess the existence of long-run relationship between the variables.

The null hypothesis of the F-test

$$H_0 = \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = \delta_8 = \delta_9 = \delta_{10} = \delta_{11} = \delta_{12} = \delta_{13} = 0$$

The null hypothesis means that long-run relationship does not exist between the variables, while the alternate hypothesis means that long-run relationship exists between them.

$$H_0 = \delta_1 \neq 0, \delta_2 \neq 0, \delta_3 \neq 0, \delta_4 \neq 0, \delta_5 \neq 0, \delta_6 \neq 0, \delta_7 \neq 0, \delta_8 \neq 0, \delta_9 \neq 0, \delta_{10} \neq 0, \delta_{11} \neq 0, \delta_{12} \neq 0, \delta_{13} \neq 0$$

The F-statistic thus calculated is compared with two given sets of tabulated values as given by Pesaran *et al* (2001). If the calculated F-statistic value exceeds the upper bound of the critical value, cointegration exists and thus we reject the null hypothesis. On the hand, if the calculated F-stat value is less than the lower bound of the critical value, we accept the null hypothesis that there is no cointegration. However, results remain inconclusive, if the calculated F-stat falls within the critical range (Pesaran and Pesaran 1997).

ARDL technique runs $(p + 1)^k$ number of regressions, to find the optimal number of lags for every variable. Where p is maximum lag length and k is number of variables. One can select the model based on Akaike‟s Information Criteria (AIC), which selects maximum number of relevant lags and Schawrtz-Bayesian Criteria (SBC), which selects the least possible number of lags thus giving a parsimonious model.

In the second step, the long-run relationship is assessed by using the ARDL selected with the help of AIC or SBC. In case, long-run relationship exists between the variables, there exists an error correction tendency.

5.4 ECM Representation of the ARDL Model

The correction model estimated in the third step is as follows,

$$\Delta lnY_i = \beta_0 + \sum_{i=1}^{p} \lambda_i \Delta\, lnY_{t-i} + \sum_{i=1}^{p} \mu_i \Delta\, lnDX_{t-i} + \sum_{i=1}^{p} \gamma_i \Delta\, lnED_{t-i} + \sum_{i=1}^{p} \theta_i \Delta\, EDU_{t-i}$$

$$+ \sum_{i=1}^{p} \omega_i \Delta\, ENG_{t-i} + \sum_{i=1}^{p} \tau_i \Delta\, EX_{t-i} + \sum_{i=1}^{p} \pi_i \Delta\, EXR_{t-i} + \sum_{i=1}^{p} \theta_i \Delta\, HE_{t-i}$$

$$+ \sum_{i=1}^{p} \varphi_i \Delta\, lnFDI_{t-i} + \sum_{i=1}^{p} \sigma_i \Delta\, lnCX_{t-i} + \sum_{i=1}^{p} \psi_i \Delta\, lnRSV_{t-i} + \sum_{i=1}^{p} \upsilon_i \Delta\, PC_{t-i}$$

$$+ \sum_{i=1}^{p} \lambda_i \Delta\, IM_{t-i} + aECM_{t-1} + U_t$$

The error correction term shows how quickly the model adjusts back to the long-run level of equilibrium after suffering a shock in the short-run.

5.5 Residual Analysis

To make sure that the model fits well, diagnostic tests which examine heteroskedasticity, functional form, serial correlation and normality are conducted. Moreover, Pesaran and Pesaran (1997) suggest that in order to check the stability of the model, Brown *et al* (1975) test should be used. If the plots of the cumulative (CUSUM) and cumulative sum of squares (CUSUMSQ) stats fall within the critical range at 5 percent significance level, the model is said stable.

CHAPTER 4

EMPERICAL RESULTS AND ANALYSIS

To assess the relationship between the variables, ARDL approach to cointegration was applied. This chapter presents the results of the unit root test and the ARDL methodology.

4.1 Unit Root Test Results

ARDL methodology is dependent upon the characteristics of the time series data. Thus, unit roots have to be tested first. That is because the ARDL framework requires that none of the variables be I(2) to avoid spurious results. The bound test assumes that the variables are I(0) or I(1) stationary. Hence, Ouattara (2004) maintains that if any of the variables is I(2) stationary, the results of the bound test as given by Pasaran et al (2001) would not be valid. Therefore, to ensure that none of the variables is I(2), Augmented Dickey-Fuller (ADF) test is conducted. The ADF results are presented in Table 1.

Table 4.1: Augmented Dickey-Fuller Test Results

Variable	At Level			At First Difference		
	None	Intercept	Intercept & trend	None	Intercept	Intercept & trend
lnGDP	16.785	-0.1979	-2.6708	-0.7186	-6.1311*	-6.0378*
lnDX	3.0974	-0.2235	-2.2825	-5.2452*	-3.8734*	-3.8961*
lnED	7.4051	-1.9248	-0.5201	-1.4352	-5.0451*	-5.8024*
EDU	6.2899	0.9698	-1.5892	-1.3170	-6.2877*	-6.5438*
ENG	2.8655	-2.3473	-0.2151	-3.8443*	-4.5315*	-5.0715*
EX	-4.9702*	-6.0332*	-6.4064*	-8.8740*	-8.7415*	-8.5621*
EXR	4.3270	1.1817	-1.8183	-3.6034*	-5.1621*	-5.3889*
lnFDI	2.0327	-1.3013	-1.8422	-4.8071*	-5.1855*	-5.1482*
HE	2.0345	-1.1821	-3.7921*	-2.7893*	-7.1808*	-7.0610*
IM	-5.6373*	-5.8178*	-5.7308*	-7.8666*	-7.7411*	-7.6674*
PC	-3.5962*	-4.3782*	-4.3340*	-8.2445*	-8.1204*	-8.0158*
lnRSV	2.2347	-0.2941	-2.4929	-5.1040*	-5.8130*	-5.7315*
lnCX	6.3331	4.0911	0.7357	-1.3934	-4.0839*	-5.9272*

*Significant at 5 percent level.

According to the ADF results the order of integration of the various variables is shown in the table 2.

Table 4.2: Order of Integration

Variable	None	Intercept	Intercept and trend
LnGDP		I(1)	I(1)
lnDX	I(1)	I(1)	I(1)
lnED		I(1)	I(1)
EDU		I(1)	I(1)
ENG	I(1)	I(1)	I(1)
EX	I(0)	I(0)	I(0)
EXR	I(1)	I(1)	I(1)
lnFDI	I(1)	I(1)	I(1)
HE	I(1)	I(1)	I(0)
IM	I(0)	I(0)	I(0)
PC	I(0)	I(0)	I(0)
lnRSV	I(1)	I(1)	I(1)
lnCX		I(1)	I(1)

As shown in table 2, all variables are either I(0) or I(1). Considering this fact, the ARDL approach to cointegration is the best approach to use.

4.2 Cointegration Results

After fulfilling the requirements of the model, tests were conducted to examine the long-run relationship between the variables. ARDL bound test was applied to assess the cointegration by using the F-statistic. The results of cointegration are shown in table 3.

Table 4.3: Cointegration Results

Test Statistic	Value	K
F-statistic	5.531848	12

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	4.14	3.79
5%	4.85	4.41

It is clear from table 3 that the calculated F-statistic is higher than critical bounds. Hence, evidence exists for long-run relationship between the variables.

The dynamic ARDL model was estimated by using Schwarz Bayesian Criterion (SBC) as the lag-selection criteria as SBC selected models are the most parsimonious model and their prediction error is lower than AIC.

Table 4.4: Autoregressive Distributed Lag (ARDL) Model

Variable	Coefficient	t-stat	p-value
lnGDP (-1)	0.580972 (0.217695)	2.6687	0.0321**
lnDX	0.215853 (0.104169)	2.0721	0.0770*
lnDX (-1)	0.223435 (0.087556)	2.5519	0.0380**
lnED	-0.667254 (0.266669)	-2.5021	0.0409**
lnED (-1)	0.275733 (0.227083)	1.2142	0.2640
EDU	0.047177 (0.026368)	1.7892	0.1167
EDU (-1)	0.017487 (0.024746)	0.7066	0.5026
ENG	0.004930 (0.001852)	2.6624	0.0323**
ENG (-1)	-0.000777 (0.001764)	-0.4406	0.6727
EX	0.001774 (0.001029)	1.7242	0.1283
EX (-1)	0.001724 (0.000822)	2.0961	0.0743*
EXR	-0.003230 (0.005369)	-0.6015	0.5664
EXR (-1)	-0.013932 (0.005761)	-2.4182	0.0462**
HE	0.014388 (0.010445)	1.3775	0.2108
HE (-1)	0.006354 (0.010068)	0.6311	0.5480
IM	-0.002534 (0.001029)	-2.4630	0.0433**
IM (-1)	-0.002341 (0.001817)	-1.2883	0.2386
lnFDI	0.117281 (0.033614)	3.4890	0.0101**
lnFDI (-1)	0.024007 (0.028876)	0.8313	0.4332
lnRSV	0.209494 (0.073614)	2.8458	0.0248**
lnRSV (-1)	-0.067252	-1.0236	0.3401

	(0.065697)		
lnCX	-0.466505 (0.198766)	-2.3470	0.0513*
lnCX (-1)	-0.376967 (0.199130)	-1.9013	0.0992*
PC	0.002804 (0.001723)	1.6276	0.1476
PC (-1)	-0.000838 (0.004144)	-0.2022	0.8455
C	3.877891 (2.022324)	1.9175	0.0967*
R-Squared	0.9998	Adjusted R-Square	0.9995
		DW stat	2.5605

**Significant at 5 percent level. *Significant at 10 percent level.

Diagnostic Tests

Serial Correlation (LM) = 1.3324(0.249), Functional Form =1.8625(0.181)

Normality (LM) = 0.7293(0.650), Heteroscedasticity (LM) = 2.9353 (0.085)

It is evident from the results of the dynamic model as shown in table 4 that the coefficients of lnY(-1), lnDX, lnDX(-1), lnED, ENG, EX(-1), EXR(-1), IM, lnFDI, lnRSV are statistically significant and are helpful for explaining lnY. The model also cleared all the diagnostic tests and was found to be free from problems such as Heteroscedasticity and Serial Correlation.

To check the model for stability, CUSUM and CUSUM Squares were employed. The results of the tests as shown in figures 1 and 2 show that the calculated lines fall within the critical bound at 5 percent significance level. Henceforth, it can be deduced that the model is stable and free from any structural break.

Figure 4.1

Plot of Cumulative Sum of Recursive Residuals

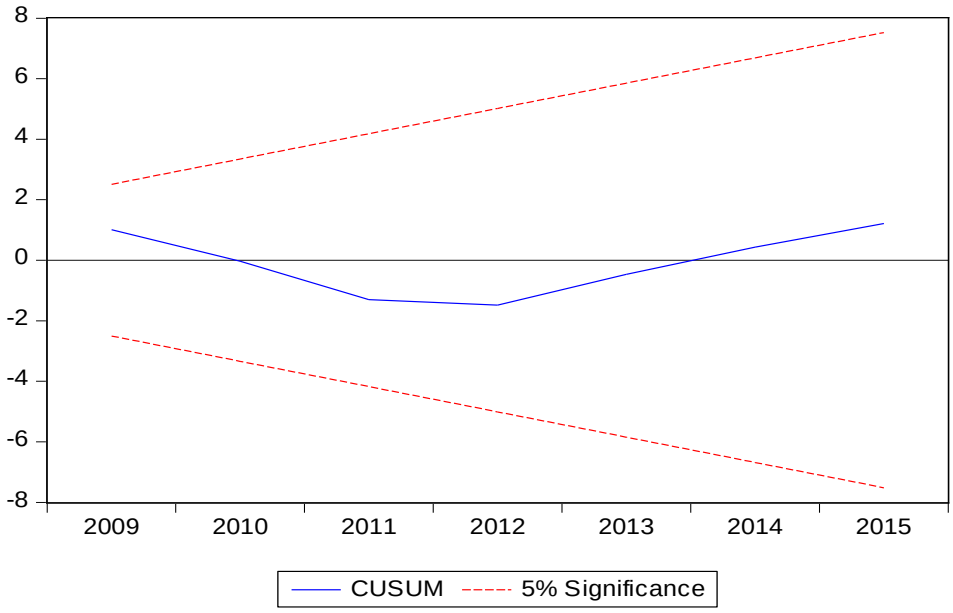
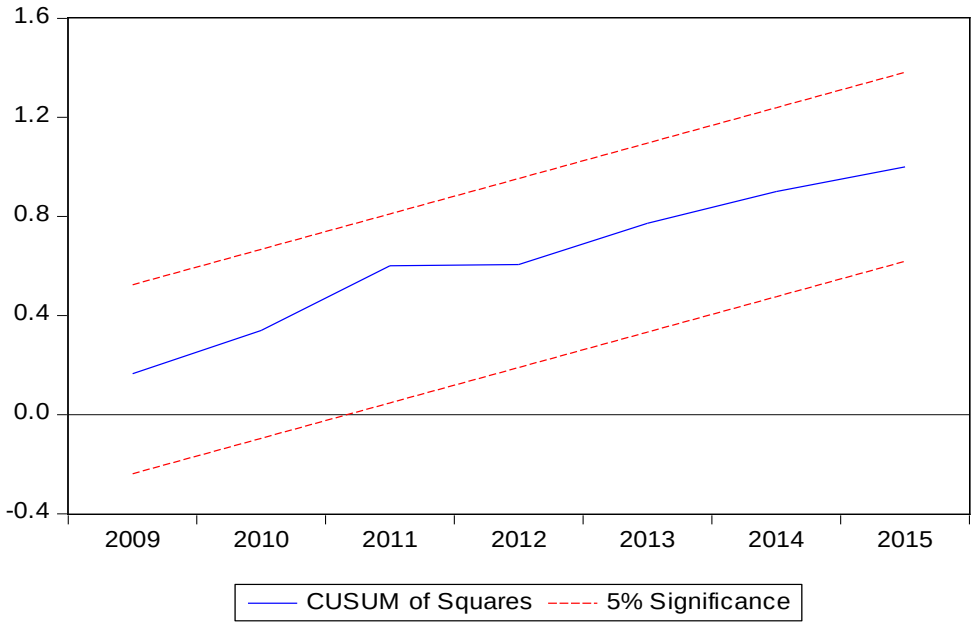


Figure 4.2

Plot of Cumulative Sum of Squares of Recursive Residuals



After ensuring the stability of the model, the Long-run coefficients of the ARDL are given in table 5 below.

Table 4.5: Estimated Long-run Coefficients of the ARDL Model

Variable	Coefficient	t-stat	p-value
EDU	0.467821 (0.255468)	2.7394*	0.0289
EX	0.095271 (0.044310)	2.1501*	0.0686
EXR	-0.035423 (0.026138)	-1.3552	0.2174
HE	-0.736212 (0.353126)	-2.0848*	0.0755
IM	-1.081650 (0.859668)	-2.0938*	0.0745
ENG	0.000199 (0.005580)	0.0356	0.9726
lnFDI	0.350631 (0.134775)	2.0714*	0.0771
lnRSV	1.422658 (0.142014)	2.1213*	0.0716
lnCX	-1.858225 (0.938650)	-2.1045*	0.0734
PC	0.426175 (0.197407)	2.1588*	0.0677
lnDX	0.201880 (0.371045)	0.5440	0.6033
lnED	-0.007489 (0.703879)	-0.0106	0.9918
Constant	141.373287 (66.618664)	2.1221*	0.0715

*Significant at 10 percent level of significance

The EDU is 0.4678 and statistically significant, which means 1 percent increase in gross education enrolment will induce 0.47 percent increase in real GDP in the long-run. The value of HE is -0.7362 and statistically significant, which implies that 1 percent increase in health conditions will lead to 0.73 percent decrease in real GDP in the long-run. The EX is 0.0952 and statistically significant, which shows that 1 percent increase in exports will lead to 0.10 percent

increase in real GDP in the long-run. The IM is -1.0816 and statistically significant, which implies 1 percent increase in imports will induce 1.08 percent decrease in the real GDP in the long-run. The value of lnFDI is 0.3506 and statistically significant, which means that 1 percent increase in foreign direct investment will increase real GDP by 0.35 percent in the long-run. The lnRSV is 1.4226 and statistically significant, which means that 1 percent increase in reserves will lead to 1.42 percent increase in the real GDP in the long-run. The lnCX is -1.8582 and statistically significant, which implies that 1 percent increase in current expenditures of the government retard economic growth by 1.85 percent in long-run. The PC is 0.4261 and statistically significant, which highlights that 1 percent increase in physical capital boosts economic growth by 0.43 percent in long-run. The signs of ENG and lnDX are positive, but insignificant. Moreover, the sign of EXR and ED were negative, but insignificant.

Table 4.6: ECM Representation of the ARDL Model

Variable	Coefficient	t-stat	p-value
EDU	0.172169 (0.026368)	1.831230	0.1097
EX	0.012110 (0.001029)	6.771635	0.0000
EXR	-0.014670 (0.005369)	-2.732294	0.0292
HE	0.040413 (0.010445)	3.869325	0.0061
IM	0.003795 (0.001029)	3.688947	0.0078
ENG	0.001631 (0.001852)	0.880843	0.4076
lnFDI	0.875858 (0.033614)	7.806314	0.0000
lnRSV	1.534496 (0.073614)	8.767442	0.0000
lnCX	-1.725642 (0.198766)	-8.930198	0.0000
PC	0.059145 (0.001723)	7.327945	0.0000

lnDX	0.082892 (0.104169)	0.795750	0.4523
lnED	0.002123 (0.266669)	0.007962	0.9939
ECM(-1)	-0.455914 (0.217695)	-2.094285	0.0745

Table 6 of short run results shows that EX, EXR, HE, IM, lnFDI, lnRSV, lnCX and PC are significant. However, EDU, which was significant in the long-run, is insignificant in the short run. This is mainly due to the fact that education is a slow process and its impact takes longer to become apparent. As observed the short-run impact of HE is positive as improved health conditions increase labor force productivity. However, the improvement in health conditions lead to longer average lifespans, which causes a strain on the economy through pensions and other social security systems. The ECM(-1) is negative as required and significant at 10 percent level of significance. The ECM(-1) is -0.4559, which implies that the adjustment process is quick. About 46 percent disequilibrium of the previous year gets adjusted in the current year.

CHAPTER 5

CONCLUSION AND POLICY IMPICATIONS

5.1 Conclusion

This study investigated the relationship between economic growth and various variables, namely current expenditure, development expenditure, education, energy consumption, external debt, exchange rate, exports, health, imports, foreign direct investment, physical capital and reserves. Real gross domestic product was used as a proxy for economy growth. Data for the variables was taken for the period 1980 to 2015. ARDL bound testing framework was used in the study. Unit root test, Augmented Dickey-Fuller (ADF) test was conducted and it was ensured that none of the variables was I(2) stationary. Following this, the bound test was conducted. The F-Statistic of the bound test exceeded the critical levels confirming that cointegration existed between the variables.

Empirical results showed that education, exports, FDI, reserves and physical capital had a positive and statistically significant impact on economic growth in the long-run. However, current expenditure, health (life expectancy) and imports had a negative and statistically significant impact on economic growth in the long-run.

The Error Correction Term was negative as required and statistically significant at 10 percent level of significance. The value of the coefficient of ECM(-1) was 0.4559, which showed that readjustment was quick as around 46 percent of the disequilibrium of the previous year was adjusted in the current year. The results also showed that current expenditure, exports, exchange rate, health, imports, FDI, and reserves were significant in the short-run. Moreover, it was found

that education was significant only in the long-run and not in the short-run, which can be explained by the fact that education is slow process and takes longer to show its impact on economic growth. In addition, the impact of health (life expectancy in this case) on economic growth was found to be negative in the long-run, but positive in the short-run. This is because improved health conditions increase the productivity of the labor force thus positively impacting economic growth in the short-run. However, better health facilities increase the average lifetime in the long-run thus increasing the burden on the economy in the long-run through pensions and social security plans for the aged. The diagnostic tests confirmed that the model was free from the problems of Heteroscedasticity and Serial Correlation. Plus, the results of the CUSUM and CUSUM Squares tests confirmed that the model was stable and fit for policy analysis.

5.2 Policy Implications

The results of this study suggest that policymakers should move funds from current expenditures, which retard economic growth, to sectors that encourage economic growth in the long-run such as education. Moreover, efforts should be undertaken to provide an environment that is conducive for local as well as foreign investments. Moreover, exports should be encouraged, and imports checked to boost economic growth in Pakistan.

Moreover, efforts should be undertaken to create a conducive environment for foreign direct investment. Besides, proper provision of health facilities must be ensured as they increase labor force productivity in the short-run. Furthermore, policies must be put in place to keep our national reserves high, in order to harness the long-run positive impact of increased reserves on economic growth. Physical capital too has positive impact on economic growth. Therefore, a more business friendly environment can go a long way in making the current physical capital

more profitable and attracting new investments in Pakistan. As previously observed current expenditures of the government have a huge negative impact on economic growth through crowding-out of the private sector. This asks for much deliberation on the part of policy makers. Policymakers must ensure that funds are transferred from this non-productive use to more productive sectors such as education, so that the Pakistan can embark upon a path to economic prosperity.

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