STATE BANK OF PAKISTAN

RESEARCH BULLETIN

Volume 14, Number 1 **2018**

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Announcement

Reconstitution of the Editorial Board of SBP Research Bulletin

Editorial Board of SBP Research Bulletin has been reconstituted with effect from August 22, 2018. Following are members of the new Editorial Board.

Dr. Waqas Ahmed	Editor
Dr. Zulfiqar Hyder	Associate Editor
Dr. Abdullah Tahir	Associate Editor

The new Editorial Board appreciates contributions of the outgoing Editor, Dr. Muhammad Nadim Hanif.

SBP Research Bulletin aims to stimulate intellectual discussion by publishing high-quality research in the area of macroeconomics with special emphasis on monetary and exchange rate economics and polices, including those related to banking and finance. SBP Research Bulletin regularly publishes scholarly work in the form of articles, short notes, opinions and book reviews. So far, 14 volumes have been published including the current issue. The Research Bulletin was originally published twice a year, however, this is being published annually since 2012 to improve quality of the work. Initially, it was an in-house research journal whereby only SBP's staff contributed. Later, contributions from researchers outside SBP have also featured in the SBP Research Bulletin. The Research Bulletin is indexed in EconLit. SBP also indexes the Research Bulletin into global database of research papers in economics (RePEc).

The new Editorial Board is taking steps to further improve the quality and standing of this economics research journal. These include expansion of the Advisory Board and adherence to the Higher Education Commission's guidelines for further improvement in journal rankings.

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SBP Research Bulletin
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Nowcasting LSM Growth in Pakistan

Fida Hussain, Kalim Hyder and Muhammad Rehman[1]

Abstract: *This paper attempts to nowcast Large-scale Manufacturing (LSM) growth in Pakistan, which is generally used as proxy for economic activity in Pakistan. For this purpose, the dynamic factor and penalized regression models are used to extract the unique information set from a range of variables having close association with LSM. Given high seasonality induced volatility in LSM growth, we have also attempted to nowcast the trend and cycles separately. The estimation results show that the predicted LSM series fairly tracking the actual LSM series. Moreover, penalized regression models perform remarkably well in tracing cycles in LSM growth. However, dynamic factor model is quite successful in tracing the underlying trend growth but not the cycles.*

JEL Classification: C53, E43, E44, O53

Keywords: Nowcasting, Large-scale Manufacturing, Factor Model, Rigid Regressions, Pakistan

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1. Introduction

As actual quarterly or annual GDP date is generally released with a considerable lag, policymakers and analysts keep track of a range of macroeconomic variables to make informed judgments about future state of economic activity. In this context, the policymakers have been putting a lot of efforts to narrow the information gap by tracking a range of indicators. Recently, a number of studies have attempted to get a kind of early estimate for GDP (before its release) using econometric techniques. These techniques use information on macroeconomic variables most related with GDP for which more frequent data is available with a minimum lag to produce early estimates for the target variable.

This technique, similar in nature with leading indicators' approach, is known in the literature as nowcasting. Banbura et al. (2010) and Tiffin (2016) define nowcasting in most simple terms as prediction of the present, near term future, and very recent past. Kliesen and McCracken (2016) called nowcast as "tracking forecasts" as they observed that many central banks track latest information on a range of economic indicators to assess the direction and level of economic activity. The literature shows that use of nowcasting is not limited to forecast GDP, but is also being used as a tool to forecast other macroeconomic variables like inflation, investment, consumption, unemployment, etc. for which data is released with a lag.

Tiffin (2016) records that nowcasting has become a routine at many central banks. Some of the leading central banks including Reserve Bank of New Zeeland, Federal Reserve, Bank of England, Central Bank of Turkey, Bank of Canada, to name a few, use nowcasting to get estimate for quarterly GDP well before its official release. In case of Pakistan, GDP data is not published on quarterly basis. The first estimate of GDP for a fiscal year is released by the close of the same year. Large-scale Manufacturing (LSM) is the only major component of GDP on which data is available on a monthly basis, but with a lag of about two months from the end of reference period. LSM is also often used as proxy for ongoing trends in real GDP during a year.

Therefore, we have chosen LSM as the target variable to start with. To best of our knowledge, this is first such attempt in case of Pakistan. The data on large number of LSM components and other most related variables is usually available within 15 to 20 days after the end of a month. Since LSM is used as a proxy for GDP growth, nowcast or an early estimate for LSM growth could also be used as input for projecting/forecasting other key macroeconomic variables like credit to private sector, tax revenue, trade, inflation, money growth, etc.

We have factor models and penalized regression techniques to nowcast LSM growth in Pakistan. We have chosen 18 data series, either component of LSM or have strong association with LSM. The data spans from first quarter of fiscal year 2000 to the

third quarter of fiscal 2017. To filter information from this set of variables to get near term forecast or early estimate for LSM growth, we have used dynamic factor model, ridge, lasso and elastic net methods. The same set of 18 indicators is considered for all the techniques for Nowcasting LSM in Pakistan. The estimates show that all these techniques perform reasonably well in predicting LSM growth (and the cycles and trends separately) in next quarter. However, dynamic factor models almost fail to trace the cyclical part.

The rest of the paper is organized as follows. The section II discusses the estimation methodologies applied in this paper. Section III describes the structure of GDP data, choice of target variable and macroeconomic variables used to nowcast LSM and Section IV concludes the paper.

2. Methodology

Optimal utilization of available information is central to nowcast techniques. However, some variables or groups of variables in the available information set may provide similar conclusions due to strong collinearity within these variables. To address this empirically, while ensuring maximum utilization of all available information, the data series are needed to be filtered to get a unique or a common solution. Factor models and penalized regression methods are the two popular techniques used in the literature for this purpose. These methods help to extract information from a large set of high frequency data having close association with the target variable and are also strongly correlated amongst themselves.

Factor models

There are many techniques in literature to extract common factors. Chamberlain and Rothschild (1983), factor models are most widely used for nowcasting economic variables. In this study, we have followed Stock and Watson (2002), which used principal component (PC) method to extract the factors. The main reasons for choosing PC for estimation of factors are: 1) PC gives consistent estimates of true latent factors, 2) PC based forecasts are asymptotically efficient, and 3) these results are robust.[2]

In view of the fact that we are using a large set of data to nowcast LSM, this can potentially create over-parameterization problem in the model. One of possible ways to solve the problem is to use "factor models". These models transform potential explanatory variables in few unobserved factors which confine the correlation among the data. This method uses these factors instead of original series as explanatory variables in the model.

[2] For more detail, see Stock and Watson (2002).

The most famous method to extract unknown factors from the large set is *principal component (PC) analysis*. This method linearly projects correlation matrix of explanatory variables to orthogonal linear combination of the underlying indicators or principal components. In this procedure, set of explanatory variables, say $\boldsymbol{X}_t$ of dimension m, is transformed into a cross-correlation matrix, say $\boldsymbol{Z}$. Then we find eigenvectors of $\boldsymbol{Z}$, say $\boldsymbol{P}$. The Eigen vector matrix $\boldsymbol{P}$ actually transform matrix $\boldsymbol{X}_t$ into orthogonal linear combinations known as principal components:

$$\boldsymbol{P}'.\boldsymbol{X}_t = \boldsymbol{PC_t} \tag{1}$$

Observe that Eq. (1) end up with m Principal components (PCs). Each of the PC has some power to explain the overall set of data. However different PCs have different explanatory power. Their explanatory power can be determined by corresponding eigen values of $\boldsymbol{Z}$. Therefore, sum of eigen values is used as selection criterion for maximum number of PCs that are used in the model. The criterion is defined as follows:

$$sum\ of\ \text{Descending}\ Eigen\ values\ of\ \boldsymbol{Z} \cong 0.9$$

Corresponding to these Eigen values we select Eigen vectors and thereby PCs. In order to relate PCs with LSM growth; Y_t, we need a bridge equation framework. In our case bridge equation has following representation, which we call a factor model.

$$Y_t = \alpha + \boldsymbol{\Lambda}.\boldsymbol{PC_t} + \varepsilon_t; \quad \varepsilon_t \sim i.i.d\ N(0, \textstyle\sum_{\varepsilon}) \tag{2}$$

In Eq. (2) we have made one innovation. In this innovation we have supposed time variation in factor loadings of $\boldsymbol{PC_t}$. This innovation allows us to incorporate policy impact, internal or external shocks and structural impact. We model time variation of factor loadings as a random walk. Therefore Eq. (2) can be re-written as:

$$Y_t = \alpha + \boldsymbol{\Lambda_t}.\boldsymbol{PC_t} + \varepsilon_t; \quad \varepsilon_t \sim i.i.d\ N(0, \textstyle\sum_{\varepsilon}) \tag{3}$$

$$\boldsymbol{\Lambda_t} = \boldsymbol{\Lambda_{t-1}} + \nu_t; \quad \nu_t \sim i.i.d\ N(0, \textstyle\sum_{\nu}) \tag{4}$$

This model is known as *dynamic factor model*. Eq. (3) and Eq. (4) constitute a state space model. Here Eq.(3) is a measurement equation and Eq. (4) is a transition equation. This equation can be estimated by Kalman filter.

Penalized models

Penalized regression methods are estimation techniques used in the environment of high collinear regressors. High correlation among variables forces to consider statistical limitations of the linear regression models, such as co-linearity and over fitting. These limitations might have large influence on out of the sample stability of estimates and in-sample validation of the parameters. The *penalized models* try to reduce the variance of estimates (relative to OLS estimates) by imposing some

restrictions on coefficients of predicting series and thereby improve forecasts (see e.g. Tiffin (2016), Elmer (2011), Schneider and Wagner (2008), etc).

Following Tiffin (2016), we have used three penalized regression methods that take care of collinearity problem and dimensionality problem. These include:

1) Lasso regression method,
2) Ridge regression method, and
3) Elastic net regression method.

Let us analyze the collinearity problem in OLS estimation and one among many possible solutions (penalized estimation technique) in more formal way. As we know that OLS estimation technique minimizes residual sum of square (RSS). So minimization results can be written as:

$$B = (\boldsymbol{X}_t{}'\boldsymbol{X}_t)^{-1}\boldsymbol{X}_t{}'Y_t \tag{5}$$

Since variables in $\boldsymbol{X}_t$ are supposed to be highly collinear, therefore $\boldsymbol{X}_t{}'\boldsymbol{X}_t$ will become nearly singular and making it difficult to invert. Penalized regression adds a positive constant say λ to the diagonal of $\boldsymbol{X}_t{}'\boldsymbol{X}_t$ matrix and make the matrix $\boldsymbol{X}_t{}'\boldsymbol{X}_t$ non-singular. In new setup Eq. (5) can be re-written as:

$$\mathrm{B} = (\boldsymbol{X}_t{}'\boldsymbol{X}_t + \lambda I)^{-1}\boldsymbol{X}_t{}'Y_t \tag{6}$$

It means that we are basically minimizing following function with respect to B:

$$\binom{\mathrm{Min}}{\mathrm{B}}\ \Gamma = \sum_{t=1}^{T}\left(Y_t - \mathrm{B}_0 - \sum_{i=1}^{n} x_{i,t}\mathrm{B_i}\right)^2 + \lambda\sum_{i=1}^{n} B_i^2 \tag{7}$$

Where $x_{i,t}$ are variables in $\boldsymbol{X}_t$ and $\mathrm{B_i}$ are parameters in vector B.

Eq. (7) can be rewritten as:

$$\binom{\mathrm{Min}}{\mathrm{B}}\ \Gamma = RSS + \lambda\sum_{i=1}^{n} B_i^2 \ \ ; \ \ 0 \le \lambda \le 1 \tag{8}$$

In more formal form:

$$\binom{\mathrm{Min}}{\mathrm{B}}\ \Gamma = RSS + Penalty\left(\widehat{\mathrm{B}}\right); \ \ 0 \le \lambda \le 1; \tag{9}$$

Here λ is a tuning parameter or penalty term on the sum of squares of parameters $\mathrm{B_i}$. If $\lambda = 0$, the minimization problem reduces to OLS regression analysis, whereas $\lambda > 0$ means more penalty on the parameters for making them non-zero. So values of λ decides between fit of the model, i.e. RSS and size of the parameters. So the question is how to choose the critical value of the parameter λ. This is done by a re-sampling technique known as *cross validation*. In this technique we divide the whole sample into K equal sets. We take one part of the sample and call it validation sample and rest of $(K-1)$ parts as training sets. Now, for given value of $\lambda \in (0\ \ 1)$, we estimate the model for validation sample and then forecast the values in the training sets and estimate forecast errors. This process is repeated for all possible values of

$\lambda \in (0\ \ 1)$ and all validation and training sets. This gives us cross validation curve function. We choose λ, that minimizes this cross validation curve.

The penalty terms in Eq. (9) can be of different nature. It depends upon the objective of the researcher. The penalty term that we have defined in Eq. (8), is known as ridge penalty. [3] In ridge regression, we minimize RSS along with sum of square of parameters.

Penalty term can also be defined as absolute value of the parameters. This penalty is known as Lasso penalty.[4] The Lasso regression problem can be defined as:

$$\binom{\text{Min}}{\text{B}}\ \Gamma = RSS + \lambda \sum_{i=1}^{n} |\text{B}_\text{i}|\,; \quad 0 \le \lambda \le 1; \tag{10}$$

Ridge regression gives better results when some of the variables with better forecasting ability have values closer to zero. Lasso regression has ability to discard some of non-important variables. So it gives us a parsimonious model. We can combine the virtues of both penalties, in a single model known as *elastic net model*. The structure of the model is as follows:

$$\binom{\text{Min}}{\text{B}}\ \Gamma = RSS + \lambda \sum_{i=1}^{n} \left[(1-\alpha)B_i^2 + \alpha|\text{B}_\text{i}|\right]; \quad 0 \le \lambda \le 1; \alpha > 0; \tag{9}$$

Elastic net model is basically weighted sum of lasso and ridge penalties. We estimate this parameter α i.e. weight parameter of penalties, in cross validation process. We start process for $\alpha = 1$ and perform the k-fold cross validations for all $\lambda \in (0\ \ 1)$. This gives us validation curve function. We repeat this process for $\alpha = 2,3, \ldots \ldots s$; where s is a sufficient large number. The process generates validation curve space. We select those $\alpha's$ and $\lambda's$ that minimizes the validation curve space. Estimation under optimum parameters gives us a parsimonious model which has better predicting properties.

Before using the above methods, we first transformed high frequency data (monthly data) into low frequency data (quarterly data). Since transformation techniques for stock and flow variables are different. Therefore, we have used two different transformation techniques.

Suppose variable, F_t^q, is quarterly counterpart of its monthly variable z_t^m. For the flow variables, like CPI etc., quarterly variable is estimated as:

$$F_t^q = \frac{1}{3} \sum_{k=t-2}^{t} z_k^m$$

Similarly for stock variables

$$S_t^q = \sum_{k=t-2}^{t} z_k^m.$$

[3] Ridge regression in the literature is first introduced by Hoerl and Kennard (1970).
[4] The LASSO estimator is first introduced by Tibshirani (1996).

It is here important to note that, after transformation, we seasonally adjusted the series and calculated growth rates.

3. Data and estimation results

Pakistan Bureau of Statistics (PBS) is responsible for compilation and publication of National Income Accounts (NIA) of Pakistan. PBS compiles NIA on annual basis and publishes provisional growth estimates by close of the fiscal year. These estimates are based on the actual data of first nine months of the fiscal year, that is, July-March. The revised full fiscal year data is released with a lag of one year.

Although PBS publishes data on some of the components of GDP on a monthly basis, these are usually available with a considerable lag. For example, data on large-scale manufacturing index is available on monthly basis with a lag of about two months. Similarly, data on production of minerals, oil and gas production and electricity generation is published on monthly basis but is available with a lag of more than two months.

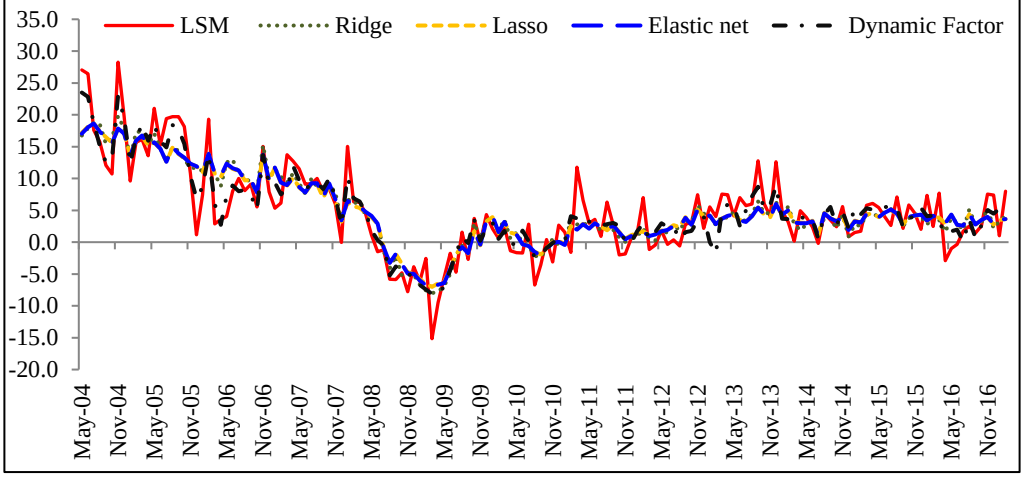
As Pakistan does not have quarterly GDP data, we use quarterly LSM growth as the target variable. We aim to get an estimate for LSM growth for the current month and quarter well before its official release, benefitting from the early release of data on a range of LSM components and those having strong association with the LSM. We include the variables for which data is published by PBS itself or the associations/institutions that provide data to PBS for compilation and releases. We also consider variables that State Bank of Pakistan (SBP) and/or financial markets monitor to assess the state of economic activity. For example, the data on confidence surveys, interest rate spreads, credit, and external sector indicators on which the data is compiled and published by SBP. The list of input variables with frequency and timings of the release is given in Annexure 1.

The timeliest data is on sales variables and financial markets like cement, automobile, and oil sales, interest rate spread, commodity prices and inflation which are available within five to six days from the reference period. The data on imports, export, remittances and private sector credit is available within two to three weeks period from the reference period. The timeline for data on tax collection, an important indicator of LSM performance, is not fixed and its release date varies from a week to three weeks.

Given that some of the series are relatively noisy in Pakistan, LSM being one of them, we have seasonally adjusted these before calculating year-on-year growth rates. All the data series are monthly, starting from July 2004.

The plot of predicted LSM series using dynamic factor model and penalized regression model (lasso, ridge and elastic net) shows that all the technique perform reasonably well in tracking the overall LSM growth (Figure 1).

Figure 1: Overall LSM Growth



With the objective to explore which technique perform better in tracing the underlying trajectory and cyclical part of the LSM, all the estimations are repeated on the trend and cycles of LSM index. As depicted in Figure 2, all models perform better in tracing the LSM growth trajectory. However, dynamic factor models almost fail to trace the cyclical part of the series (Figure 3).

Figure 2: Trend Growth in LSM

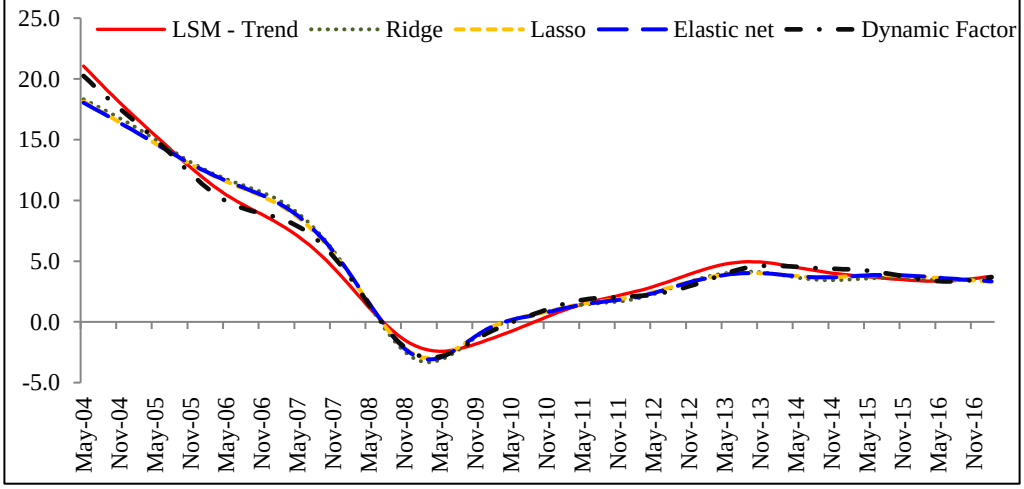
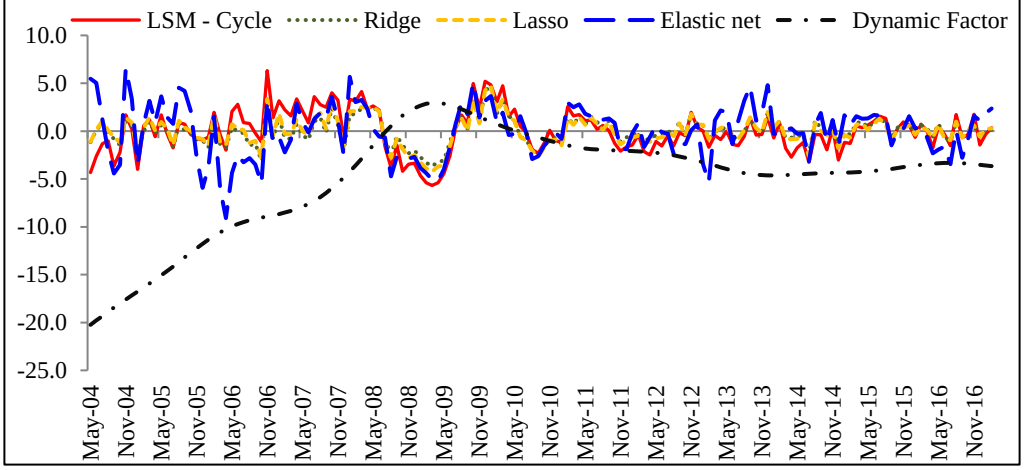


Figure 3: Cycles in LSM Growth



As a robustness check, we have estimated all these models on quarterly data (see Annexure 2). The results are not very different from the estimates based on monthly data.

Performance of the models is evaluated using RMSE criteria, which shows that the dynamic factor models perform the best in case of capturing movement in overall and trend in LSM (Table 1). However, this model fails in tracing the cycles. Lasso technique performs better in tracing the cycle. Regarding the failure of the dynamic factor models to capture the cyclical parts, it is because as Tiffin (2016) described due to the lack of "variable selection", which is done through the penalized models following Tiffin (2016).

Table 1: Root means Square Errors of LSM Nowcasting

	Ridge	Lasso	Elastic net	Dynamic Factor
Overall	42.3	43.9	43.9	31.8
Trends	11.6	11.0	11.5	6.5
Cycle	15.6	13.8	28.9	94.6

4. Conclusion

Nowcasting or near term forecasting is designed to reduce the information lags of data dissemination. Nowcasting is an emerging technique and many central banks are using it in their routine tasks. This paper is an effort to nowcast LSM growth in Pakistan. LSM is available at relatively higher frequency (monthly) than the actual GDP (annual) and is considered best indicator of economic activity. The process of nowcasting starts with the identifying determinants or variables having close association with LSM, which are released earlier than LSM. These determinants

include production of important sectors, prices, credit, interest rates and tax collection, external trade and inflows. There is a possibility that these determinants may be highly correlated amongst themselves and may not provide unique set of information. Therefore, conventional forecasting techniques have limited capacity to resolve this issue.

Search for the unique information by filtering collinear information and nowcasting of LSM is carried out by using the dynamic factor model and penalized regression models. Dynamic factor model pre-filter the determinants by using the principal component method and the penalized regression models treat collinearity during the estimation process. These techniques are utilized to nowcast overall LSM growth along with its underlying trend and cycle. Seasonal patterns in production, exogenous and policy induced shocks are main reason for Nowcasting cyclical and trend components of LSM growth. Based on the forecast evaluation indicators, all the techniques perform better in predicting the overall LSM growth. Dynamic factor model performs the best in tracing the underlying trend of LSM growth but it fails in nowcasting the cyclical part. The performance of penalized methods is same in case of trend and cycles.

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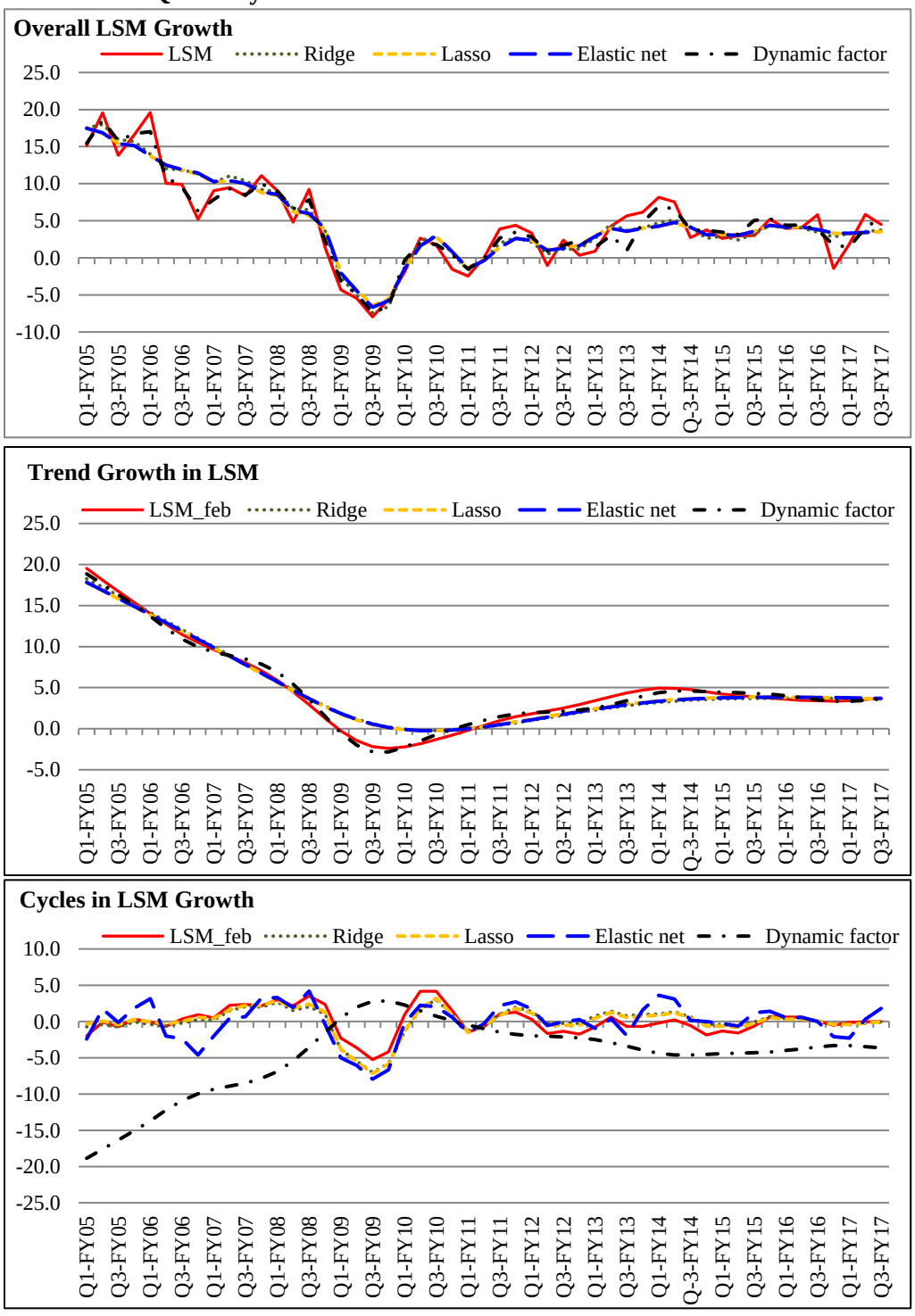
Appendix

Annexure I: List of Data Series – Frequency and Lags

No	Real/nominal	Series	Unit	Frequency	Delays
1	Real	Large-scale manufacturing index	Indices	Monthly	6 to 7 weeks
2	Real	Cement sale	Million tons	Monthly	1 week
3	Real	Automobile sale	Units	Monthly	1 week
4	Nominal	Private sector credit	Billion rupees	Weekly	3 weeks
5	Nominal	Wholesale price index	Indices	Monthly	1 to 2 days
6	Nominal	Imports	Million US$	Monthly	2 weeks
7	Nominal	Exports	Million US$	Monthly	2 weeks
8	Nominal	Consumer price index	Indices	Monthly	1 to 2 days
9	Real	Real effective exchange rate index	Indices	Monthly average	-
10	Nominal	Oil prices	Rupees/bbl	Daily/monthly avg.	1 to 2 days
11	Nominal	Workers' remittances	Million US $	Monthly	2 weeks
12	Nominal	Foreign direct investment	Million US $	Monthly	1 week
13	Nominal	Total tax collection	Billion rupees	Monthly	2 weeks
14	Nominal	Direct taxes	Billion rupees	Monthly	2 weeks
15	Nominal	Indirect taxes	Billion rupees	Monthly	2 weeks
16	Nominal	Sales taxes	Billion rupees	Monthly	2 weeks
17	Nominal	Federal excise duty	Billion rupees	Monthly	2 weeks
18	Nominal	Customs duties	Billion rupees	Monthly	2 weeks
19	Nominal	Interest rate spread (1Y-3M)	Percentage	Monthly	1 day

Annexure 2: Quarterly Nowcast of LSM Growth



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Interest Elasticity of Banks Deposits: A Study of Pakistan

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Abstract: *We have estimated real interest rate elasticity of real private remunerative bank deposits for the case of Pakistan using a multiple regression model. We have used time series data for the period of 1979 to 2016. In addition to real interest rate, real income, workers' remittances, and government borrowing turned out to be significant determinants of real private remunerative deposits level in Pakistan. We found that a 1.0 percentage increase in real interest rate was associated with 0.3 percent increase in real private (remunerative) bank deposits in Pakistan during 1979-2016.*

JEL Classification: C3 and E4

Key Words: Elasticity, Interest Rate, Deposits

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1. Introduction

In neoclassical Economics, economic growth of a country is a function of its savings. In other words, the rate of growth of a country depends upon preferences of its people between current and future consumption. The real rate of return is the core determinant of how much consumption can be made in future by forgoing today's consumption. Higher real return should discourage current consumption and encourage savings to have extra consumption in future. There are various channels to invest one's forgone consumption to earn returns in future. Two main channels are banks and stock markets. However, in developing countries, there is another place to invest savings and that is with the government. In Pakistan, government borrows from people through 'Central Directorate of National Savings (CDNS)' using its various schemes (National Saving Schemes or NSS) like 'Prize Bonds,' 'Regular Income Certificates', etc. Pakistan's financial system is traditionally a bank based system[2]. Banks have their branches even in remote areas of country.

Does return to bank deposits really matter to reduce consumption expenditures, and to increase savings to eventually raise deposits for the case of Pakistan? If yes then, how much? Answers to these questions are important for the central bank, the State Bank of Pakistan (SBP). From the policy perspective, if there are demand pressures in the economy, SBP increases the policy rate in order to cool the economy. Raising the policy rates should impact private consumption expenditures negatively by making savings more attractive. The other channel of SBP's success in its pursuance to reduce the aggregate demand pressures is to impact private investment expenditures in the country by influencing the cost of borrowing from the banking system.

After financial sector reforms and restructuring in 1990s, SBP has been using market based policy instruments to guide the economy in desired direction/level (Hanif, 2003). Incomplete and slow pass-through of changes in policy rate to money market and bank's retail interest rates impairs the effectiveness of monetary policy transmission mechanism. Recent study (Khan and Hanif, 2012) shows that while there is a swift pass-through from the policy rate to money market rates, the impacts of changes in money market rates on the bank deposit rates is not only sluggish, but also incomplete[3]. More specifically, response of returns on deposits is confined to only 60 to 68 bps following 100 bps changes in money market rates and it takes 2 to 6 months to realize this impact. Despite revealing about the sluggishness of banks' return to

[2] A system where financial intermediaries, like banks, play greater role in increasing the saving rate and allocating savings amongst different competing sectors of the economy is called a bank based (financial) system as in Germany and Japan. If stock markets are more active in playing such role then it is called a market based (financial) system as in USA. In an ideal situation, it is the combination of effective legal and judicial infrastructure of the country with both the banks and the stock markets which ameliorates market imperfections and provides 'competitive and sound financial services' to promote economic growth by channeling financial resources in response to price signals.

[3] However, banks' lending rates are more responsive to changes in money market rates.

depositors in response to changes in SBP policy rate and money market rates; this study does not guide anything about the responsiveness of the bank deposits to changes in returns to depositors.

Only one study[4] in the past attempted to estimate such elasticity of bank deposits in Pakistan but that study is about 25 years old. Nishat and Bilgrami (1989) estimated (interest) elasticity of time deposit to be 0.3 for the period of 1959-60 to 1985-86. Most of this duration (particularly 1972-73 to 1989-90) was marked with suppressed financial sector characterized by credit ceiling, directed and subsidized credit, control on deposit and lending rates, etc. Financial landscape of Pakistan has significantly changed during the past quarter century; particularly after financial sector reforms and restructuring which started in 1990. The restructuring process in Pakistan included two types of actions: one for strengthening financial institutions and the other for developing efficient financial markets. Other than incorporation of new commercial banks, nationalized commercial banks have been privatized and today more than four-fifths of banking sector assets are in private sector. Pricing structure has been completely rationalized. It is important now to have a fresh look at the return[5] elasticity estimate for bank deposits (and investment accounts, in case of Islamic Banking Institutions).

In the next section, we discuss the conceptual framework used in this study to estimate the interest elasticity of banks deposits in Pakistan while considering other determinants. Then we provide a brief about data used and methodology applied, before we brief about behavior of banks deposits and interest rate, and discuss the empirical estimate of interest elasticity of private remunerative banks deposit in Pakistan during the period under study. This study is concluded with some remarks based on the discussion in the main text.

[4] Nishat and Bilgrami, 1989.

[5] Pakistan is an Islamic Republic State. In Islamic Shariah 'interest' is prohibited. SBP introduced Islamic Banking, in parallel to conventional banking, in the country during early 2000s as a choice to people. After more than a decade, almost one-sixths of overall people's deposits with banks in Pakistan are in Islamic Banking Institutions (IBIs) of the country. Except those that are kept in current accounts, all other amounts in IBIs are in 'investment accounts'. IBIs do not offer interest to their investment accounts holders (IAHs). Rather, they share *profits (loss)* with IAHs; earned by investing the pool(s) of all investment accounts and IBIs' equity in Shariah compliant products like Murabaha, Ijarah, Musharaka etc. Points to be noted are the facts that: a) IAHs are not depositors of IBIs, a) money of IAH with the IBIs is not guaranteed (conceptually, as loss is possible) and thus no longer liability of IBIs (unless some negligence and/or lack of good faith in investment of such money is found). We will use the term 'interest' instead of return in remaining part of this study mainly because about 5/6th of overall banks' deposits in Pakistan are interest based. We suggest SBP to compile and disseminate these and other important variables' data for IBIs and conventional banks separately.

2. The Conceptual Framework

Banks are financial institutions that keep deposits (or maintain investment accounts in case of IBIs), and use this money to purchase assets (or invest in, say, Musharaka in case of IBIs). Main objective of people for maintaining remunerative bank deposits is not to use the same as medium of exchange (other services offered by banks). These are rather for earning return on the savings. Banks assume the function of portfolio management as in Fama (1980). In addition to facing a downward sloping demand curve for lending (and Musharaka type) activities, banks face an upward sloping deposit (and investment accounts) supply curve which depends mainly upon return on deposits. Assuming a linear deposit supply function, we can write its dynamic equation as an ARDL model:

$$\Delta D_t = \delta + \beta r^d + \varphi_i \sum_{i=1}^{p} \Delta D_{t-i} + \gamma_j \sum_{j=0}^{q} \Delta X_{t-j} + \in_t \quad (1)$$

$$D = \alpha + \beta r^d + \gamma X + \varepsilon \quad (2)$$

Where D is the volume of the deposits; r^d is the contemporaneous real deposit rate/return; X is the set of conditioning information to control for other factors associated with (supply of bank) deposits; $\delta,\ \beta, \varphi\ \&\ \gamma$ are parameters; and ε is the stochastic error term. The value of δ gives the supply of deposits at no return and it is expected to be positive when deposits include remunerative demand deposits (like saving accounts) because such deposits are used for cash payments. Non-negative β is the slope of the deposit supply curve. $\beta = 0$ means perfectly inelastic supply of deposits with respect to associated interest rate. Higher value of β indicates relatively higher interest elasticity of banks deposits. Sign of estimated coefficients in γ depends upon the associated variable (as we discuss below).

Banks are not alone in managing the people wealth accumulated through savings. Other institutions (like CDNS in Pakistan) are also interested in managing people's wealth and rather sometimes offer higher returns. Competition induces banks to stay in the market by offering other services associated with banking, sometime free of charge. Banks may offer no explicit returns to depositors which need such services more and frequently. Such non remunerative accounts are classified as current accounts in Pakistan[6]. Other than placing with the government and in the banks, people do have another choice of investment and that is in the country's stock market (Pakistan Stock Exchange (PSX)) which may offer higher returns but principal is not

[6] Subsidized or free banking services to such account holders are implicit interest payments. Because of non-availability of data on such implicit interest payments, we will be considering only explicitly remunerated bank deposits in our study.

guaranteed there[7]. While estimating the deposit supply function for banks, we may consider either the returns offered by the alternate money placement opportunities (in NSS or in PSX) or the quantities attracted by such institutions being competitors of banks. Government borrowing directly from people through NSS (and the return related to such borrowings) also affects deposit mobilisation by banks negatively. Similarly, the return offered by PSX (and the market capitalisation thereof) would be negatively associated with the banks' deposit attraction schemes.

Other than the variables (like returns on deposits/investments) pertaining to the financial institutions, which compete for their pie in the overall accumulated savings (wealth) in the country, we need to see what actually raises the size of the wealth itself. Given the motives (as in the macroeconomics literature) for savings, there are several factors that are likely to influence the savings, particularly in the context of Pakistan economy.

According to permanent income / life cycle hypothesis people make their current consumption on the basis of their view about their going to be permanent income over their life period and they prefer smooth consumption patterns. It clearly means that such people will save (dis-save) when income is above (below) their permanent levels. One can use gross domestic product (GDP) as a proxy for income[8]. In case of Pakistan where a large number of Pakistanis are working abroad and send remittances to their families; and thus these remittances are a major (and in some cases only) source of income for their family. So, for the case of Pakistan, it would be better to analyse gross national product[9] (GNP) instead of GDP. But with this approach we may not be able to see separate impacts of GDP and Workers' remittances (WR) upon banks' deposits. Increase in the gross domestic product and inflow of workers' remittances positively affects banks deposit collection.

If we assume that savings are (only) for rainy days, savings becomes function of (expected) income (Alessie and Lusardi, 1997). Permanent income postulation means there is persistence in production. In order to [re]produce persistence in the output data, habit formation is introduced in consumption by Dusenberry (1969)[10]. Alessie and Lusardi (1997) shows that habit formation affects not only the level of consumption but also that of saving. In other words, savings not only depends upon permanent (expected) income but also upon past savings. Deposits being part of savings, we think it is important to consider past deposits as one of the determinants of the level of deposits in the country. By past, in this study, we mean with one year lag. Furthermore, from Econometrics point of view, it also takes into account the

[7] Principal is not guaranteed in IBI's investment accounts as well.
[8] And we can use smoothed income as a proxy for permanent income.
[9] According to National Income Accounts of Pakistan for FY2014, as reported by Pakistan Bureau of Statistics, net factor income from abroad is 5.4 percent of overall gross national product.
[10] See Choudhary and Levine (2006)

dynamics and control for omitted variable in the model to be estimated, if any (Kemal, Qayyum and Hanif, 2007).

It is not only the income of people which is important for them to (consume and) save; it is also the process of income generation like through use of credit, for working capital and capital expenditures, offered by the banks to private sector. Since credit to private sector also becomes the deposit for the issuing bank, credit creation is also associated with the deposit growth. But in developing countries sometimes government becomes the largest users of banks' credit and (in some cases) crowd outs private sector. It is also pertinent to note here that credit to the government by banks does not become part of banks' deposit, unlike the credit to private sector becomes part of banks' deposits, and goes to the government account. Government deposits are usually excluded from the type of analysis we are doing in this study. In such situation government borrowing from banking system negatively affects the deposit supply for banks.

Branches (BR) network of bank is the main source for banks to collect deposits. Furthermore, 'Number of Accounts' opened in these branches (other than the current accounts) is also an indicator of financial inclusion in the country. Wider the branches network and higher the number of accounts in the banks, larger could be the volume of deposits in the country.

As discussed above, Pakistan has undergone significant changes in the financial sector during the last 25 years. Some of which are crucial to be considered (for example using a dummy variable approach) to account for structural change(s). Significant of those are: initiation of financial sector reforms in 1989-90, introduction of (foreign) payments reforms in 1992 (when resident Pakistanis were allowed to open and maintain bank accounts in foreign currency), interest rate liberalization in 1995, introduction floor for deposit rates for banks from June 1, 2008[11], sensitisation of the fixed deposits in 2006 by exempting fixed deposits of maturity 1 year and longer from Cash Reserve Requirement. We consider these year(s) using dummy variable(s) to see if these have any profound impact on banks' deposits in Pakistan.

3. Data and Methodology

One of the important issues pertaining to the determinants of bank deposits and estimation of interest elasticity of bank deposits is to define what constitutes the bank

[11] This floor was later raised to 6 percent on May 1, 2012. Even with these directives banks had been paying minimum deposit rates to most of their depositors and that too upon minimum monthly balances. Effective from April 1, 2013 banks have been advised by SBP to pay return on saving deposits on average monthly balances. And, rather than paying the monthly fixed minimum deposit rates banks have also been advised to pay not lower than '50 basis point minus the prevailing repo rate'. Repo rate is the rate upon which SBP is willing to have banks deposits if there is no one to get money from the banks.

deposit (in the case of Pakistan) and which interest rate is more relevant for this study. The objective of this study is estimate the real interest rate (r^d) elasticity of real bank deposits (D). Most suitable measure for bank deposits is 'private remunerative bank deposits' for which we have been able to find consistent data for the period 1979-2016. From overall bank deposits we exclude current accounts, interbank deposits and government deposits to arrive at 'private remunerative bank deposits'. Real interest rate is calculated by subtracting inflation from the nominal interest rate. For the nominal interest rate we have used the most relevant rate available for remunerative deposit and that is weighted average deposit rate. To obtain real interest rate upon remunerative deposits we subtracted 12-month average of YoY change in Consumer Price Index (CPI) which is compiled by Pakistan Bureau of Statistics (PBS). As mentioned above we have used contemporaneous real interest rate in this study[12]. One may argue that supply of deposits depends upon expected interest rate rather than current. This may sound relevant but there are at least three practical reasons, which suggest using contemporaneous nominal interest rate rather than expected nominal interest rate to estimate real interest rate in this study. First, this study is based upon annual frequency; and not monthly or quarterly frequency because in Pakistan we do not have monthly or quarterly bank deposit data for longer history. Second, a significant part of the private remunerative deposits are for fixed term in which case the interest rate is agreed by the bank with the deposit holders and thus it is the current offered interest rate that matters (rather than future). In most of such fixed deposits schemes banks pay interest on monthly basis. Third, even in the case of savings accounts (or in case of IAHs in IBIs) though return is paid on six monthly bases; it is calculated on monthly basis.

We now move to other variables associated with deposit supply function as discussed in the conceptual framework. Gross Domestic Product (Y), Workers Remittances (WR) data is used from annual national income accounts as published by PBS. Banks' credit offered to private sector (CP) and the number of overall private remunerative bank accounts in the country (AC) is obtained from different publications of SBP. Data on government borrowing from public (GBP) and government borrowing from banking system (GBB) is obtained from annual budget documents of government of Pakistan. We have also used different dummy variables for different years (like D1992 for 1992) as discussed in the previous section.

We converted all the nominal variables like nominal private remunerative bank deposits, nominal government borrowings, and workers' remittances etc. into real ones by dividing them by CPI. We also took logarithm of all the variables used in this

[12] We have not adjusted the return for a) tax upon profits (which is different for income tax return filer and non-filer but we will not be able to get separate dataset), and b) zakat upon deposits held on Ramzan 1 of each Islamic calendar year which is 2.5 percent of nominal deposit amount if it is greater than a threshold level which is announced annually by the government of Pakistan (but again we do not have separate data for deposits for which depositors have obtain exemption by submitting an affidavit that they will pay the applicable zakat amount themselves).

analysis except dummy variables and different rates of return (like real interest rate, real PSX returns etc.).

Moving toward econometric methodology, we first test for the order of integration of all the variables used in this study using Augmented Dickey Fuller Test (Dickey and Fuller 1979, Dickey and Fuller 1981). Depending upon the order of integration of variables, which we can expect to be 1 (except for the rate or return) based upon economic intuition of the variable we consider here, we may be looking if there is long run relationship between the private remunerative bank deposits and its determinants. For the rate of return we expect order of integration to be zero. If one of the variables amongst the explanatory variables is found to be I(0) and rest of explanatory variables and the dependent variables are all I(1), we can explore if there is cointegration between the variables using ARDL model (Pesaran and Shin (1998, PS(1998)) and Pesaran, Shin and Smith (2001, PSS(2001)). In case we find the evidence of long term relationship between private remunerated bank deposits and its determinants, we will use Fully Modified OLS (FMOLS) approach for the estimation of cointegration equation. It gives efficient and asymptotically unbiased estimates of parameters; the statistics thus obtained can also be used for hypothesis testing even if errors are correlated. We will also perform necessary coefficients' stability tests upon the estimated cointegration equation.

4. Results and Discussion

Time span used in the study is 1979-2016 and we have used annual time series data. We conduct the univariate analysis of all the variables pertaining to the final model estimated in this study. For this purpose we have used ADF unit root test. The results are reported in Table 1 of the Appendix. We can see that all the variables are integrated of order 1 except weighted average real interest rate. The Bounds test for the existence of co-integration is reported in the Table 2. The calculated test statistic higher than the reported critical values implies the existence of co-integration. The test statistic turned out to be significant providing evidence in the favour of co-integration among the variables.

The estimated ARDL model explaining the real private remunerative bank deposit in Pakistan is presented in Table 4 of the Appendix. We can see that real interest rate, real GDP, real workers' remittances, real government borrowing from banks, real government borrowing from public, savings habit (deposit inertia) are found to be statistically significant determinants of real private remunerative bank deposit in Pakistan for the period of 1979 to 2016. This estimated ARDL model also passes goodness of fit and coefficients' stability tests (as shown in Figures 1 and 2 of the Appendix).

All the variables are in log form except real interest rate. Such models are called semi logarithmic model. The estimated coefficient (which is 0.003 in our long run model in

Table 6) of interest rate thus cannot directly be termed as (interest) elasticity (of deposits). In order to use this as an estimated elasticity, we need to multiply this by 100. Thus, estimated interest elasticity of deposit in long run model (Table 6) is 0.3 percent. Or in other words, a 1 percentage increase in real interest rate is associated with 0.3%[13] increase in real private (remunerative) bank deposits in Pakistan. We have found evidence of long term relationship between real private remunerative bank deposits, real interest rate, real GDP, real workers' remittances, real government borrowing from banks, real government borrowing from public, savings habit (deposit inertia) during 1979 to 2016; as presented in Table 3 of the Appendix. If we look at the estimated coefficients of variables as presented in Table 2 of the Appendix, we can see that all have their signs as per economic intuition as we discussed in the conceptual framework section. However, we could not find private sector credit, return on NSS of CDNS, return from investment in PSX, and financial inclusion indicator (like number of remunerative bank accounts) to be statistically significant explanatory variables for real private remunerative banks deposits in Pakistan during 1979-2016.

We have also estimated an error correction model (ECM) model incorporating both short run disturbances and long run level information (Table 5). The coefficient of error correction term shows the speed of adjustment, here it is very high showing that 80 percent of last year's disequilibrium is made up in the current year that is a quick adjustment. In another model (Model 2), we have also looked if there is any impact upon interest elasticity of deposits if we consider estimated real permanent income instead of actual real GDP. In order to smooth GDP time series we have used Fully Modified HP Filter of Hanif, Iqbal and Choudhary (2017)[14]. It turns out that interest elasticity of deposits remains almost the same. It suggests robustness of our estimated results. One may argue that the real interest elasticity of banks' deposits is low. It may be the case this elasticity is underestimated because the deposits data contain not only those deposits which are "collected" by banks in response to any increase in real interest rate in the country but also those deposits which are "generated" by banks in response to any decrease in real interest rate in the country. Currently, deposit data from banks does not distinguish between the two types of deposits that are generated by the two opposite forces and thus use of such "overall" deposits may lead to an underestimation of the real interest elasticity of deposits.[15]

[13] Recent study on Indian data (Q2:2006 to Q3:2018, using real data) reveals that interest elasticity of deposits is 0.5% (RBI Bulletin, May 2019)

[14] There are certain issues with conventional HP filter (Hodrick and Prescott, 1997) including a) fixed value of λ across the series/countries/time and b) end points bias. Fully Modified HP filter (FMHP) of Hanif et al. (2017) addresses these two issues by suggesting an endogenous and a sort of time varying smoothing parameter to estimate a trend of a macroeconomic time sires.

[15] We would like to suggest Statistics Department of SBP to collect deposit data from banks considering above distinction between deposits "collected" and "generated". It may now be an easy task for banks to report overall deposits as per suggested bifurcation because the computer software currently in use of banks may mark the deposits generated by loans separately (by minor changes in the code).

5. Future Research Agenda

In this study, we have estimated the impact of changes in (real) interest rate upon bank deposits, i.e. interest elasticity of deposits, through country level dataset. However, real interest rates could be different in different regions/districts of a country depending upon differences in inflation rates in different districts. This could be one of the possible reasons for different deposit growth rates in different districts of Pakistan. Even if we exclude 12 districts showing triple digit deposit growth rate, deposit growth varied in the range of 7% to 77% during the last decade in 127 districts of Pakistan compared to country level average deposit growth rate of around 13% during the same period. Notwithstanding the fact that nominal interest rate is a sort of regulated price this may or may not be the same across different commercial banks having braches spread all over the country depending upon the composition of various "account types" - saving and fixed - in different districts[16]. Real interest rate, however, would vary from district to district depending upon district level CPI inflation rate. Using these varying real interest rates along with available data on district wise commercial banks deposits, we can estimate real interest elasticity of deposits in Pakistan at district level. If we can use the "collected" deposits data set for such study, as suggested above, that may give us a relatively more accurate estimate of real interest elasticity of banks deposits that too across different districts or we may conduct a panel study on Pakistan.

6. Concluding Remarks

Before the introduction of financial sector reforms in Pakistan the interest elasticity of banks deposits was considered to be too low. According to Nishat and Bilgrami (1989), estimated interest elasticity of deposit was 0.3 percent during 1960 to 1986. Considering significant changes in Pakistan's financial sector landscape, we have estimated a real private bank deposits supply function for different period within 1979-2016. We found that real weighted average deposit rate, real GDP, real workers' remittances, real government borrowing from banks, real government borrowing from public, savings habit (deposit inertia) and foreign payments reforms dummy (for the year 1992) are statistically significant determinants of real private remunerative bank deposit in Pakistan. We found the interest elasticity of banks deposits to be 0.3 percent for 1979-2016. We can say that the interest elasticity of bank deposits in the country has not increased even after the introduction of different financial sector reforms in the country.

[16] Further, share of different maturities of fixed deposits could also be different for different districts which may have implications for weighted average deposit interest rates.

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Appendix

Table 1: Results of Unit Root Test (H_0: Series has Unit Root)

	ADF test value at level	ADF test value at first difference
Log (D)	-1.16 (0.90)	-3.90 (0.01)
r^d	-3.04 (0.04)	- - -
Log (Y)	-1.00 (0.93)	-2.99 (0.05)
Log (WR)	-0.81 (0.95)	-4.92 (0.00)
Log (GBB)	1.13 (0.99)	-4.80 (0.00)
Log (GBP)	-2.42 (0.15)	-3.38 (0.02)
Log (Y^{hp})	3.49 (1.00)	-3.65 (0.04)

p-value in the parenthesis

Table 2: Chow Break Point Test (Break Date: 1992)

Null Hypothesis: No break at specified breakpoints		
Statistics	Value	P-Value
F-statistic	9.63	0.00
Log likelihood ratio	57.16	0.00

Table 3: Bounds Test

Test Statistic	Value	K
F-statistic	6.21	5
Critical Value of Bounds Test		
significance	Lower Bound	Upper Bound
10%	2.08	3.00
5%	2.39	3.38
2.5%	2.70	3.73
1%	3.06	4.15

Table 4: ARDL Model

Variable	Coefficient	P-Value
r^d	-0.004	0.02
LOG(RDEP)	1.49	0.00
LOG(RGBP)	0.35	0.00
LOG(RGOVB)	-0.43	0.00
LOG(RWREM)	0.12	0.00
LOG(RPSC)	-0.90	0.00
LOG(RGDP)	-0.84	0.00
$\Delta(LOG(RDEP(-1))$	-0.50	0.00
$\Delta(LOG(RGBP))$	-0.18	0.04
$\Delta(LOG(RGBP(-1)))$	-0.13	0.02
$\Delta(LOG(RGBP(-2)))$	-0.20	0.00
$\Delta(LOG(RGOVB))$	0.36	0.00
$\Delta(LOG(RWREM)$	-0.22	0.00
$\Delta(LOG(RWREM(-1))$	-0.20	0.00
$\Delta(LOG(RWREM(-2))$	-0.18	0.00
$\Delta(LOG(RPSC))$	0.47	0.00
$\Delta(LOG(RPSC(-1))$	-0.007	0.96
$\Delta(LOG(RPSC(-2))$	-0.08	0.18
$\Delta(LOG(RGDP))$	-0.34	0.53
$\Delta(LOG(RGDP(-1)))$	-0.40	0.43
$\Delta(LOG(RGDP(-2)))$	-0.60	0.13

r^d: real deposit rate, RDEP: real deposits, RGBP: real government borrowing from public; RGOVB: real government borrowing; RWREM: real worker's remittances, RPSC: real private sector credit, RGDP: real GDP.

Table 5: ECM

Variable	Coefficient	P-Value
E(-1)	-0.80	0.00
$\Delta(LOG(RDEP(-1))$	0.16	0.15
$\Delta(LOG(RGBP))$	0.01	0.82
$\Delta(LOG(RGBP(-1)))$	-0.13	0.06
$\Delta(LOG(RGBP(-2)))$	-0.04	0.45
$\Delta(LOG(RGOVB))$	0.09	0.05
$\Delta(LOG(RWREM)$	0.07	0.00
$\Delta(LOG(RWREM(-1))$	-0.01	0.58
$\Delta(LOG(RWREM(-2))$	-0.07	0.00
$\Delta(LOG(RPSC))$	0.55	0.00
$\Delta(LOG(RPSC(-1))$	-0.07	0.39
$\Delta(LOG(RPSC(-2))$	-0.10	0.08
$\Delta(LOG(RGDP))$	0.78	0.02
$\Delta(LOG(RGDP(-1)))$	-0.51	0.07
$\Delta(LOG(RGDP(-2)))$	0.32	0.0.24

Table 6: Long Run relationship derived from ARDL Model in Table 4

Variable	Coefficient	P-Value
RDR	0.0027	0.00
log(RGOVB)	0.29	0.00
log(RGBP)	-0.23	0.00
log(RWREM)	-0.08	0.00
log(RPSC)	0.60	0.00
log(RGDP)	0.56	0.00

Figure 1: Model Diagnostics

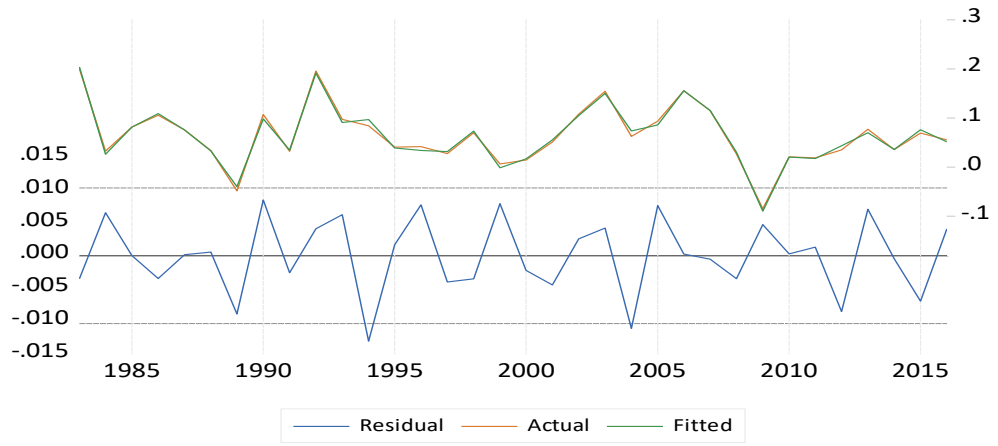
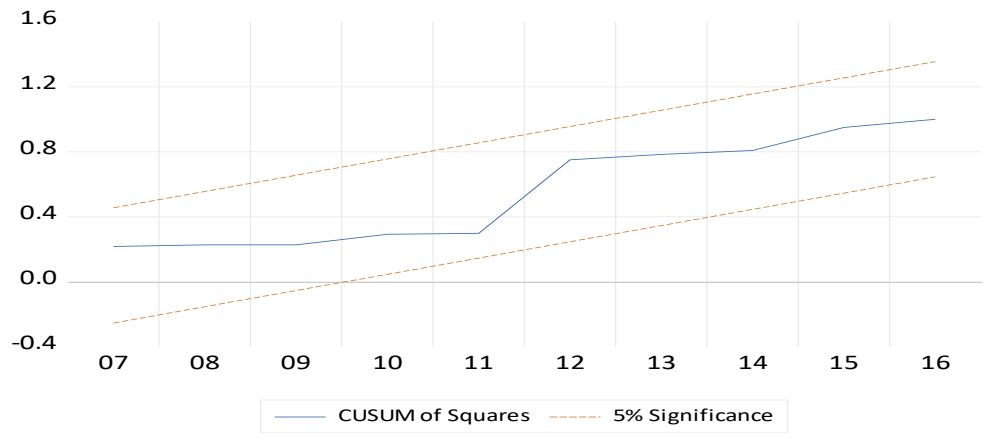


Figure 2: Stability of Model



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Multiple Equilibria in Investments Financed by Debt

An extension to Gertler, Rogoff (1990)

Sabahat Zafar, Nasiba Imaralieva, Bernardo Orellana, Hugo Viladegut, [1]

Abstract: *This paper offers the extension of Gertler and Rogoff (1990), and illustrates that in presence of imperfect capital markets, non-linear relationship exists between level of investment in low-income countries and cost of external debt. This non-linearity can be attributed to concessional loans and financing at early stage of development; adjustments with external supply shocks; and the disparities of capital efficiency in different countries*

JEL Classification:F21, F34, E22,

Keywords: Imperfect Capital Market, External Debt, Investment

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1. Introduction

This paper presents a modification to the original model developed by Gertler and Rogoff (1990); and captures multiple equilibria in the relationship between level of investment and cost of debt in case of low-income countries. Across countries, capital movement is usually associated with the country's level of income and net worth, higher the net worth higher would be the capital inflows and vice versa. This also signifies that the spread in the world's riskless interest rate and loan rate varies across countries and negatively relates with their income level. High-income countries enjoy low riskless rates, whereas low-income countries suffer due to relatively higher rates even if the assumption of risk free rates holds true across countries. The endogeniety of domestic capital market imperfection has remained a source of concern for the policy makers, especially in low-income countries. Capital imperfections may create information asymmetries and introduce an incentive problem between lenders and borrowers often referred as 'moral hazard' problem.

In contrast to Gertler and Rogoff (1990), who established a linear association between a country's per capita income and external debt, we found that these variables experience a non-linear relationship. Specifically, this study found a non-linear association of a country's total and private external debt with income level. This non-linearity can be attributed to number of reasons for instance domestic financial frictions, concessional loans and financing at early stage of development, adjustments with external supply shocks and the disparities of capital efficiency in different countries. To confirm our findings, we present an extension of the model and substantiate our proposal based on the data of 39 developing economies over different years.

The remainder of the paper is organized as follows; section 2 presents a brief literature review, following which a formal model, as well as an extension of that model is developed in section 3. Section 4 examines robustness of the said framework and checks whether our findings are backed up by factual information, and finally section 5 presents some concluding remarks.

2. Literature Review

The imperfect capital mobility between rich and low-income countries and asymmetries in credit market remained as a central point of discussion in economic literature. According to the neoclassical growth model, developing countries with high productivity growth should receive more capital flows; however, empirical evidence suggests that the capital has been moving from developing to developed countries such as US. The academic and research community has produced a substantial amount of contributions covering this topic for academic purposes and policy recommendations. We cover some of those within the framework of our paper.

Gertler and Rogoff (1989) developed a model of international finance under asymmetric information to explain the phenomena of why in low-income economies, stocks of foreign debt of private borrowers experience higher growth relative to their income. In this framework, asymmetric information available only to individual debtors creates frictions in investment markets. The study explained that due to problem of moral hazard, marginal product of capital and spread between borrowing and lending rates were larger in low-income countries.

Atkenson (1991), presented a model of international lending in which retorted why risk sharing between creditors and debtors is incomplete and stated two main reasons i.e., moral hazard and the risk of repudiation that hinders risk sharing in the international lending relationship. He also discussed the role of constrained optimal pattern of capital flows between lenders (who cannot observe borrower's behavior) and borrower (who may renounce his debt) in creating difficulties for evaluation of project efficiency and debt repayment capacities. In the end, he discussed the property of optimal contract and suggested that for incentive reason borrowing country experiences capital outflow and fall in both consumption and investment.

Jeanneau and Marian (2002), could not find any evidence of an asymmetric behavior of determinants with respect to capital inflows or outflows in international lending to emerging economies, suggests that pull and push factors are both responsible for booms and cutbacks in international lending to emerging economies.

Gourinchas and Jeanne (2012), found that capital does not flow more to countries having high growth and investment rate as predicted in neoclassic growth model. The study termed this phenomena as 'allocation puzzle' possibly related to saving (not from investment) and to the behavior of publicly originated capital flows. It tried to explain this puzzle via different explanations for example 1) positive association between saving and growth and role of domestic frictions in distorting this relationship; 2) contribution of low domestic financial development in constraining domestic demand and; 3)part of government policies. However, the study could not find the consistent answer to this puzzle and concluded this puzzle as an open question.

Alfaro et al.,(2008), empirically investigated the role of different theories in explaining the why capital does not flow from rich countries to poor countries and highlighted the role of different policies in increasing capital inflows to poor economies including strengthening the protection of property rights, reducing corruption, increasing government stability, bureaucratic quality and law and order situation.

Koepke (2015), presented thorough review of literature on drivers of capital flows to emerging economies. He suggested that there is no explicit answer to what effects more to capital market imperfections in developing countries, since drivers of capital

flows changes across times and across different types of capital. The study showed that push factors like global risk aversion and external interest rates dominated in effecting portfolio debt and equity flows, but somewhat less for banking flows. Whereas, pull factors such as domestic output growth, asset returns and country risk explained all three capital flows components and banking flows.

3. The Gertler and Rogoff Theoretical Model

The model is an extension to the paper presented by Gertler and Rogoff (1990) that studies the capital flow movements and investment among poor and rich countries. This is a small open economy in which it cannot affect the international interest rate. This economy is having two periods, producing/consuming single good and possessing number of identical individuals. The representative individual is risk-neutral and care only about consuming in period 2:

$$U(c) = c \tag{1}$$

Where c is the consumption in the second-period. Also, the representative individual receives an endowment in period 1: W_1, and an endowment in period 2: W_2.

In that sense, there are saving W_1 which can be executed in two ways. The first option is to offer this to international markets at the world interest rate r (riskeless). The second option is to use these funds to finance a uncertain technology.

In this economy, each individual carries a project. All of these projects are identical in nature and yield following return: If they invest k units in period 1, it yield θ units of second-period output with probability $\pi(k)$, and zero units with probability 1 - $\pi(k)$. Suggested as:

$$y = \begin{cases} \theta \text{ with probability } \pi(k) \\ 0 \text{ with probability } 1\text{- } \pi(k) \end{cases} \tag{2}$$

Here, y is the second-period output. The probability has a concave function. This means that $\pi(.)$ Is increasing, strictly concave and twice continuously differentiable within the range of $\pi(0) = 0, \pi(\infty) = 1$. And, $\frac{r}{\theta} < \pi'(0) < \infty$. Thus, investing more k units, increases the probability that the individual's project will yield a high level of output but the marginal expected return to investment is negative (diminishing). One assumption is that output realizations are independent across individual's projects.

Also, the individual has a financial restriction. He only has endowment W_1 to invest. However, if he desires to capitalize more in his project, at that point he needs to get extra resources from capital market.
Thus, the new restriction is as follows:

$$W_1 + b \geq k \tag{3}$$

Where b is the extra funds that the individual borrows from the capital markets. However, against this amount, he issues a state-contingent security which pays z^g given the project yield a decent outcome (θ), and z^b if the project yield an undersirable outcome (0). In this framework, state-contingent security must offer the investors a market rate of return r.

Thus, the lender will expect the following return:

$$\pi(k)\, z^g + [1 - \pi(k)]z^b = rb \tag{4}$$

And, the individual's expected second-period consumption is given by the following equation:

$$E(c) = \pi(k)\,[\theta - z^g] - [1 - \pi(k)]z^b + r[W_1 + b - k] + W_2 \tag{5}$$

In equation (5), the first two terms represent expected net return on the project (see equation (4)), the subsequent term is the return from risk-free investments abroad, and the last term is the endowment in second period.

So, in this economy, there are lenders and borrowers. In this case, creditors possesses ability to perceive borrower's endowments (W_1, W_2), and their total borrowings (k). However, they cannot observe that how the borrowers uses these funds. For example, rather than invest in their specified project, borrowers can secretly lend these funds abroad.

Also, although investment cannot be observed, lenders can perceive realized output y, the production function $\pi(.)$, and the borrower's future endowment W_2.

Thus, under perfect information, the individual would maximize their investment in the point in which the expected marginal return on this project is equal to the world interest rate. This is the first-best optimum level of investment[2].

$$\pi'(k^*)\theta = r \tag{6}$$

However, in this economy, there is asymmetric information since what borrowers can do with capital (k) is non-observable. Therefore, it is not verifiable by the lender. Thus, contracts can be written by seeing output (y) (and not on k). Given any output-contingent payoffs (z^g, z^b) specified by the contract, the borrower will pick k to

[2] In this case, the borrower will invest all of the funds in his project

maximize her expected consumption in equation (5). Thus, she will equate her expected marginal gain from investing with her opportunity cost of (secretly) holding assets abroad:

$$\pi'(k)[\theta - (z^g - z^b)] = r \tag{7}$$

If $z^g - z^b = 0$, then we are in the case of perfect information. So, given that z^g varies from z^b, k will vary from its first-best optimum level (k^*) (see equation 6). Thus, two things will determine the marginal benefit of borrowers from investing: First, the marginal gain in expected output and second, on the adjustment in his expected commitment to lenders.

If the borrower could promise lenders a fixed payment across different outcomes, borrower would invest the first-best amount k^*. However, since the project yields zero in the bad state, this is not a feasible option. In that sense, since the borrower's consumption must be nonnegative, z^b cannot surpass the second period endowment W_2, which is defined in the following equation:

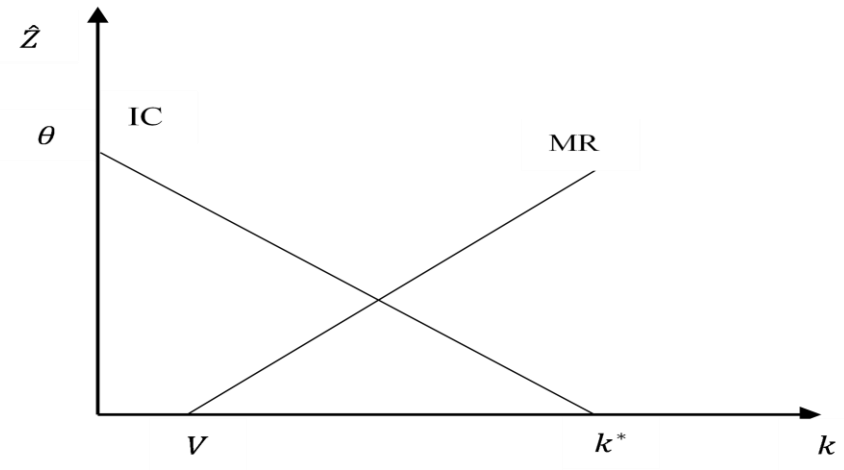
$$z^b \leq W_2 \tag{8}$$

The present value of the borrower's endowment is as follows:

$$V \equiv W_1 + W_2/r$$

So, if the present value of the endowment V is less than k^*, the borrower cannot offer lenders a riskless security.

Figure 1. Equilibrium in the small-country case



In a case, when $V < k^*$, the optimal incentive compatible contract is found by choosing z^g, z^b, b, and k to maximize the individual's expected second-period consumption (equation 5) subject to equations (3), (4), (7), and (8). So, the solution is as follows:

In a bad state, the contract pays creditors W_2, so equation (8) is binding. This reduces the spread between z^g and z^b, thereby minimizing the difference between the borrower's decision rule for k (equation (7)) and the socially efficient rule in equation (6). Likewise, equation (3) is another binding: $W_1 + b = k$. At the state of equilibrium, the borrower does not secretly lend abroad. In other words, more than necessary borrowing to finance k would increase the gap in $z^g \; and \; z^b$. The lender will offer more funding but a higher cost (higher gap).

For information constrained case, since (3) and (8) hold with equality, these equations can be used to eliminate b and z^b from (4) and (7). This results in following two equations which determine k and $\hat{Z} = z^g - z^b = z^g - W_2$:

Incentive Constrain Curve for the Borrowers:

$$\pi'(k)[\theta - \hat{Z}] = r \tag{9}$$

Market Rate of Return for the Lenders:

$$\hat{Z} = r(k - V)/\pi(k) \tag{10}$$

Equation (9) is derived from the incentive constraint (7) and can be drawn as a downward-sloping curve IC in Figure 1. An increase in $\hat{Z}$, lowers the borrower's expected marginal gain from investing and therefore must be offset by a decline in k. The IC curve intersects the vertical axis at a value of $\hat{Z}$, which lies between zero and θ (this is constraint by $\frac{r}{\theta} < \pi'(0) < \infty$). It intersects the horizontal axis at k^* due to equation (9) reduces to equation (6) when $\hat{Z}$ equals zero.

Equation (10) is the constraint that lenders must receive the market rate of return, and is labeled as the MR curve, which is an upward-sloping curve. Thus, when k rises, borrowing increases. In other words, z^g must increase due to z^b cannot adjust (see $\hat{Z} = z^g - z^b = z^g - W_2$). Hence, the curve intersects the horizontal axis at $k = V$.

Investment in the information-constrained case must be below its first-best value k^*. The result that k < k^* follows immediately from a comparison of (6) and (9), as well as from inspection in Figure 1. If k is below k^*, then ex post per-capita output, $\theta\pi(k)$ must lie below its first-best value, $\theta\pi((k^*)$. This means that per-capita investment and per-capita output will depend on per-capita wealth. A rise in V moves the MR curve downward in Figure 1, and leaves the IC curve unchanged, thereby increasing k and lowering $\hat{Z}$.

Also, the spread between the marginal product of capital and the world riskless interest rate will be determined by the income level of a country and in particular, it will be larger for the poorer country (the smaller the country). Though, the world capital market is perfectly integrated (the riskless rate is the same in all countries) the cross-country marginal products of capital may differ. Hence, in poor countries, the spread between the loan rate and the riskless rate will be higher. Thus, the loan (or risky debt) r^L is given by:

$$r^L = \frac{z^g - W_2}{k - V} = \frac{r}{\pi(k)} \tag{11}$$

This decreases in k. Note that r^L is the rate on the uncollateralized component of borrowing.

Figure 2A. Functional form of $\pi(.)$ - Gertler and Rogoff (1990)

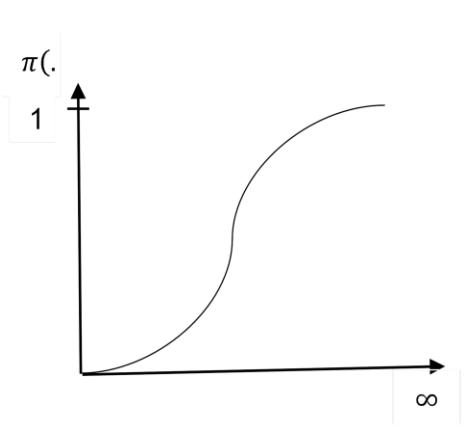
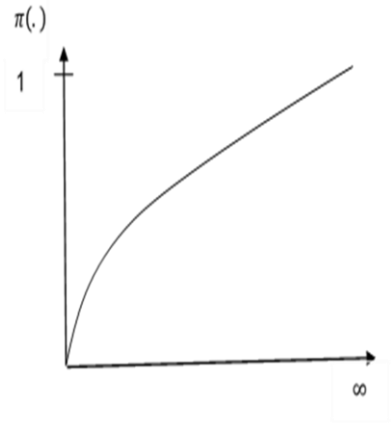


Figure 2B. New functional form of $\pi(.)$-Extension



This new form for the function $\pi^*(.)$ allows that the marginal rate return of capital is higher at some point but then the marginal return of capital is lower. Hence, this change in the functional form of $\pi(.)$ to $\pi^*(.)$ allows that MR curve to be a concave curve (see the appendix for the numerical math simulation).

Thus, in this extension of the model, the market rate of return for the lenders (MR Curve) is a concave function of the level of investment k. At initial levels of k, lenders can lend money at the market rate of return $\hat{Z}$. Nevertheless, there is an inflection point, in which at higher levels of k, the marginal rate of return is lower than $\hat{Z}$. This result contradicts what Gertler and Rogoff (1990) proposes, in which lenders charge higher levels of $\hat{Z}$ at higher levels of k since borrowers do not have more endowment in period 2. A possible explanation for this situation is that financial institutions (lenders) increase their exposure to risk (lending at higher levels of k at lower cost) when they know that they are insured by the Central Bank or the government is able to get support from donors, which evidences problems of moral hazard. In other

words, they allocate more and more money in the market since the Central Bank/IMF can act as a Lender of Last Resort and bail them out (see Figure 3).

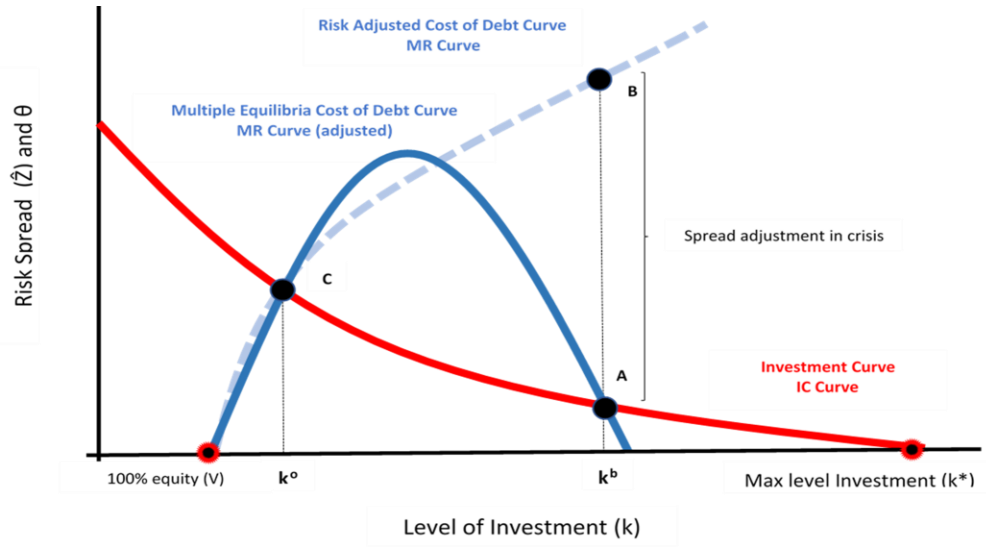
Then, equation (10) takes a new form as equation (12), and it can be represented together with the incentive constraint curve, equation (9), as shown in Figure 3.

(MR Adjusted) Market Rate of Return for the Lenders

$$\hat{Z} = r(k - V)/\pi^*(k) \qquad (12)$$

The concavity of the function representing the market rate of return for the lenders helps to find three important points, noted with A, B and C, in two levels of investment, k^o k^b, represented in Figure 3.

Figure 3: Concave Market Rate of Return for Lenders



First at the level of invest k^b, in point A, from the point of view of the investors, they are experiencing a bullish situation, the level of investment is high and the cost of the debt is low. From the point of view of the lender, they can lend more money at lower cost since they know that the government will bail them out. For instance, the situation could be similar to the behavior of investment in the Asian 5[3] during the early 90s, before the Asian financial crisis[4]. The average investment to GDP level was around 35% for the 5 countries and the EMBI Index was in average levels of 4%.

[3] Asian 5: Thailand, South Korea, Malaysia and the Philippines
[4] The Economist: Gold from the storm. https://www.economist.com/node/9401752

However, as the financial crisis struck in Asia, the EMBI shut up ten points, reaching levels of 14% by 1998[5], resembling the situation portrait in point B. As a result, the unsustainable level of investment resulted in non-performing loans reaching heights of 15%, and several corporations going bankrupt. Nevertheless, the economies started a deleveraging process, from point B to point C, accompanied by a contraction of investment from k^{b} to point k^{o}. The result was that the Asian 5 reached a sustainable level of investment k^{o}, by dropping more than 10% of GDP in investment by 1999. Although volatile the EMBI level also decreased during the next 5 years.

The modification to the original model of Gertler and Rogoff (1990) builds a framework to understand situations such as Sudden Stops. It is particularly interesting from a perspective that it captures the multiple equilibria in the relationship between the level of investment and the cost of debt. For instance, in Figure 3, point A is a typical example of a pre-crisis exuberance of low rates and high investment, while B could portrait a Sudden Stop ala Calvo, and C the consequences. From a microeconomic perspective, the net worth of the borrower, a proxy for the credit worthiness, is a determinant of the market return for the lenders ($\hat{Z}$) at initial levels of investment. However, there is an inflection point when the cost of debt can decay with an additional level of investment financed by extra debt, which will be shown in the next empirical section.

Although there are many reasons behind cycles, one possible explanation is the amplification that the longer finance cycle puts to economic cycles as claimed by Borio (2012). Nonetheless, that is outside the focus of the paper and further studies should try to incorporate the boom-bust story of emerging markets.

Furthermore, the model presented in the paper also shows the flaws respect to the relationship of the levels of debt and the wealth of a country. For example, in the original model, ($\hat{Z}$) the risk spread of debt, depends on the level of expected wealth that can be pledged in the future, which in turn depends on the current level of wealth. However, that is refuted from two angles. First, the level of debt and its cost is not linear as described in the first part of this section (see Figure 2B). And second, the empirical research of the paper shows that countries can accommodate larger levels of debt per-capita relative to income per-capita (see Figure 3 and 4). In other words, capital does flows into poorer countries, contrary to what Gertler and Rogoff (1990) claims, despite the fact that they have less sophisticated markets or even the less advanced technology.

4. Empirical Results

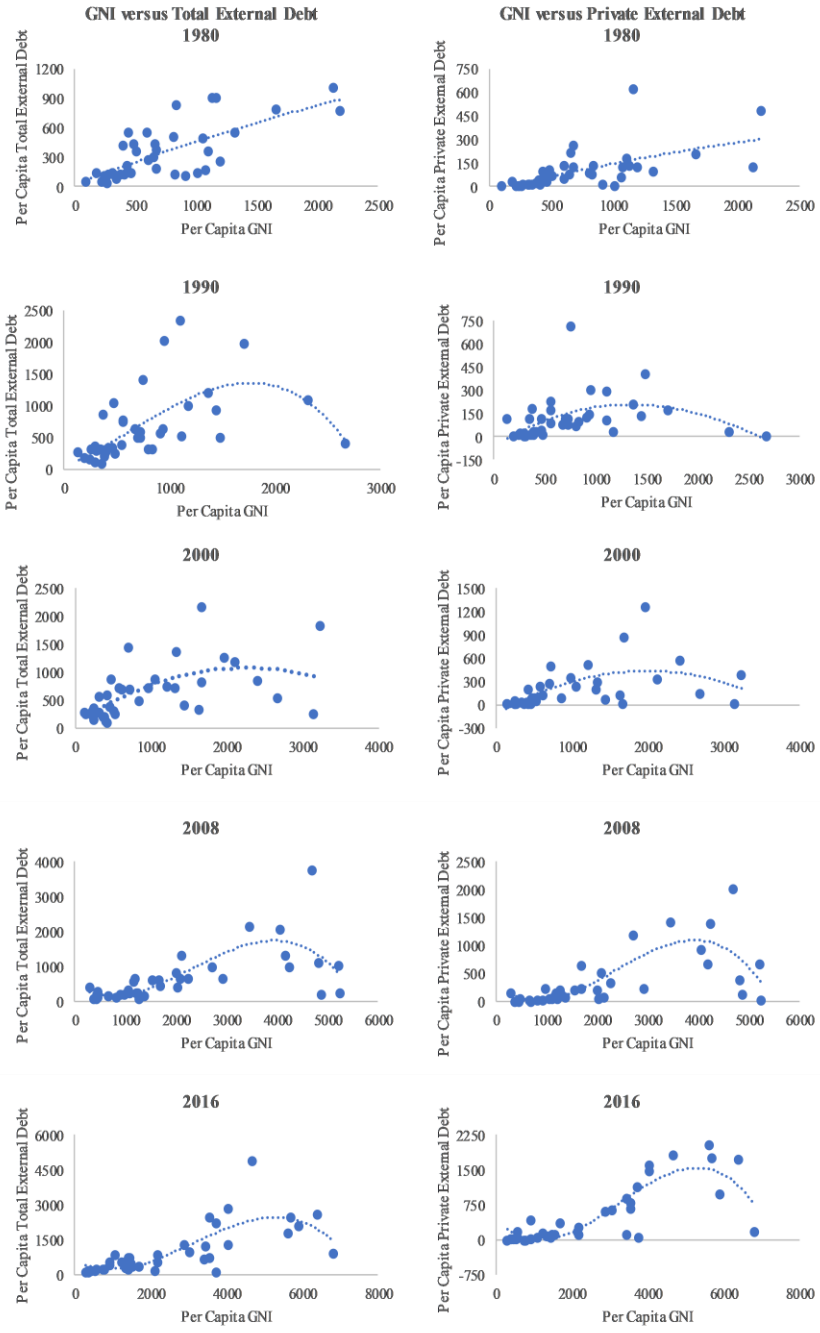
In contrast to Gertler and Rogoff (1990), who suggested that per-capita external borrowing should be increasing linearly in per-capita wealth, we found a positive but non-linear association between these two variables. We present scatter plots of total

[5] IMF Finance and Development Magazine – sept 1999: Moderating Fluctuations in Capital Flows to Emerging Market Economies. http://www.imf.org/external/pubs/ft/fandd/1999/09/mussa.htm

income and total and private external borrowings for thirty-nine developing countries. To check robustness of our results, we examine the relationship over different years and present results in figure 3, for example 1980, 1990, 2000, 2008 and 20016. Scatter plots depicts non-unit relationship between total external debt and GNP, as well as private external debt and GNP.

With rising income scale, borrowing from private as well as overall system increases, however the rate of borrowing declines with higher GNP; this non-linearity could be explained by the number of factors. For instance, at an earlier stage of the development, countries more easily get the program loans or concessional financing, but at higher income level, these borrowing reduced sharply, simply countries are not eligible for these concessional and soft loans. Another explanation could be that the developing economies try to smooth out the external shock (such as increase in oil price) at the beginning, but eventually accustomed to these shocks and smoothed out their consumption and demanded less borrowing to fund their high cost imports. The presence of domestic financial frictions at the earlier stages of development may also explains constraints to domestic demand of foreign funds. The level of capital efficiency may contribute significantly in determining relationship between external debt trend income level, at earlier stage of development, countries tend to pose high capital efficiency, but marginal product of capital reduces with high level of capital employed. This argument is consistent with well-defined rule of diminishing marginal return and can be applied in the Gertler-Rogoff extension model and multiple equilibria. The results are consistent at different time points, and hold true for almost all of time periods, irrespective of high growth period (1990s), in recession (2008) and post-recession period (2016).

Figure 4: Empirical Evidence of concavity in $\hat{Z}$



Source: IMF,Author's Calculations

5. Conclusion

The capital market inefficiencies directly lead to the spread in riskless interest rates and loan rate, the level of disparity is significant in low income countries. We develop a model to identify this non- linear relationship and found that with increasing income level, countries tend to increase their level of external debt with rising income, however the level of debt falls down at higher income level.

We investigated the empirical evidence of this non-linearity and explained possible reasons for example, the concessional loans and financing at earlier stages of development, adjustments with external supply shock such as oil prices, the disparities of capital efficiency in different countries etc. The robustness has been checked with deriving results for different point in time which validates our claim regarding non-linearity of income and foreign debt levels.

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Appendix

This study runs a numerical simulation in Matlab to prove that MR curve can be concave.

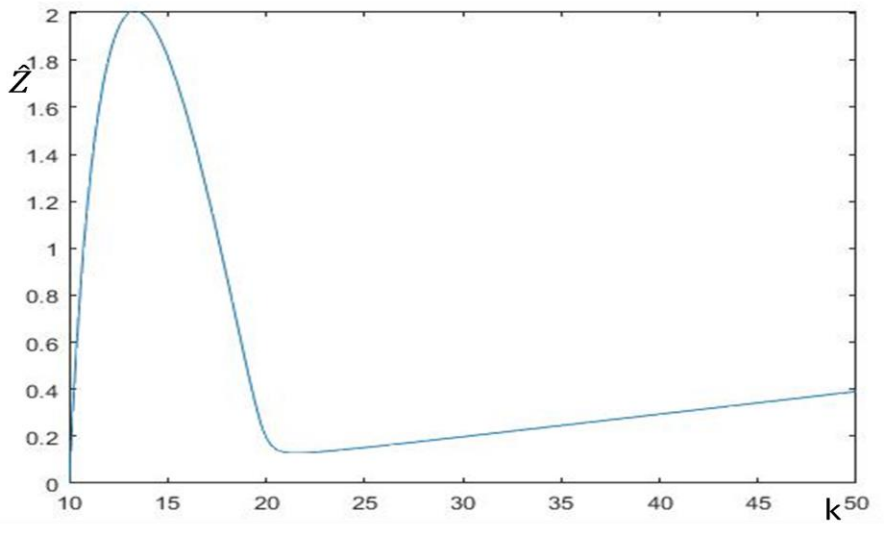
Thus, assuming positives values of the world interest rate (r) equal to 1%, and the present value of the borrower's endowment (V) equal to 10 (this is positive since the borrowers have endowments in period 1 and in period 2) we obtain the new curve for MR in Figure 4.

This shows that at initial values of k, the value of $\hat{Z}$ is high. However, at this value of k increases, the value of $\hat{Z}$ decreases.

Code in Matlab

```
r = 0.01
V = 10
prob = @(k) (1/10)*(k/(k+1))
prob2 = @(k) (atan(1.5*k-1.5*20) + atan(20))/3
fplot(prob2, [0 100])
Zhat = @(k) r*(k-V)/prob2(k)
fplot(Zhat, [10 50])
```

Figure 5: New function based on a numerical simulation



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Quality and Effectiveness of Public Spending on Education in Pakistan

Opinion By

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1. Introduction

The effect of government spending on economic growth and development is an extensively discussed policy issue both theoretically and empirically especially in the context of developing countries. This is largely because many developing economies not only experience large budget deficits amid low level of economic development but also there is significant government involvement in the economy and less control over government expenditures and revenues (Morrison (1982)). Endogenous growth theories advocate the fact that fiscal policy plays an important role in economic development as it affects private sector positively by providing enhanced infrastructure and skilled human capital (Aschauer (1989), Easterly and Rebelo (1993)).

With the given broad reference, aim of this study is to analyze the nature and effectiveness of government development expenditure on education sector in Pakistan. Importance of the government spending increases particularly in case of developing countries as most of such spending is being financed through external or internal borrowing. In this perspective, impact of crowding-out of the private investment (government borrowing can shrink the financial capital available for private firms to invest in physical capital) cannot be overlooked. However, government spending can also encourage long-term growth by spending on infrastructure, education, health or research and development.

With regard to literature on the subject, various studies yield different results as both evidences of crowding-in and crowding-out of private investment in response to government borrowing have been found for developing countries (Atukeren (2005) and Afsono and St. Aubin (2009)). If the main purpose of deficit financing through domestic borrowing is to manage current expenditures then there could be more crowding out of private investment than crowding in. However, crowding in of private investment can be a reality if governments keep emphasizing the development of infrastructure, both physical and social, through improving development expenditures. The spillover impact of such government investment in development goes a long way. It helps in providing employment opportunities in the short run whereas in the long run it creates the favorable amalgamation of physical and human capital for higher economic returns and overall welfare. Returns from physical infrastructure can be achieved in the short run but those from the social sector require commitment and patience. While this justifies the need for sustained development spending, it is also important for the governments to keep in perspective the cumulating gains of inculcating high quality in provision of public goods and services to the people as it would ensure sustainability of crowding in over time.

For Pakistan, in this regard, empirical studies carried out depict mixed results regarding the trend of private investment in relationship to fiscal spending; however,

the focus on quality of the latter is almost missing[2]. Therefore, generalization of any result is difficult.

2. Public Spending on Education and Outcomes- Literature Review

Public expenditure on education has been motivated by the aspiration to enhance human capital formation by embedding superior analytical thinking, problem solving characteristics for long term social and economic benefits and overall development of a nation. Therefore, development of human resources, particularly, improvement and expenditure on the primary education system has long been an important policy objective of government in less developed countries (Meier and Rauch (2005)).

Table 1: South and West Asia -Govt. Expenditure on Education

	Govt. Exp. on Edu. As % of GDP		Govt. Exp. on Edu As % of Gov. Exp.	
	2014	2016	2014	2016
Pakistan	2.5	2.5	11.3	12.6
Bangladesh	2.0	1.5	n.a	11.4
Bhutan	5.9	6.8	17.8	26.2
India	3.8	n.a	n.a	n.a
Iran	2.8	3.4	19.7	19.3
Maldives	3.5	4.2	10.3	11.3
Nepal	4.0	4.4	17.6	17.0
Sri Lanka	1.9	3.5	9.1	9.4
Vietnam	5.7	n.a	18.5	n.a

Source: UIS Database

Vietnam is the recent example that has not only focused but sustainably spent on the quality and coverage of primary education. As a result, it is at the verge of attaining the level of a middle income country in quite a remarkable span of time given the level of destruction it faced during the war with the United States.

Table 2: Government Expenditure per Primary Student (US$)

	2012	2014	2016
Pakistan	100.9	103.1	136.6
Bhutan	na	325.3	n.a
Nepal	80.7	93.5	n.a
Iran	817.3	473.2	468.1
Indonesia	424.3	428.7	442.5
China	4,986.6	5,728.5	6,374.9
Argentina	1,896.5	1,771.3	1,946.9
Norway	19,577.3	19372.7	n.a
South Africa	1,523.1	1,218.0	930.3
Vietnam	361.9	400.0	n.a
UK	9,6421.1	1,0123.97	1,1400.7

Source: UIS Database

[2] Some relevant studies include Khan and Gill (2009), Hussain A. and Muhammad S.D. (2009), Saeed and Ali (2006), Rashid (2005), Naqvi (2002), Hyder and Qayyum (2002), Looney (1995).

Empirically, economic literature confirms the positive relationship between education and economic performance, with higher returns to primary education than to secondary and post-secondary education. However, many studies show that the relationship between public spending for education and measure of education realization is weak ((Noss (1991), Mingat and Tan (1992 and 1998), and Flug, Spilimbergo, and Wachtenheim (1998)). Instead, other variables have been found to be important in explaining education attainment. This includes per capita income, parental sensitivity to costs and benefits, and family background or parental education (Appleton, Hoddinot, and Mackinnon (1996)).

Table 3: South and West Asia -Literacy Profile

	Adult Literacy Rate (15 & above)-in percent			Youth Literacy Rate (15-24)-in percent		
	1995-2004	**2005-2012**	**Projected 2015**	**1995-2004**	**2005-2012**	**Projected 2015**
Pakistan	**43.0**	**55.0**	**58.0**	**55.0**	**71.0**	**75.0**
Bangladesh	47.0	59.0	62.0	64.0	80.0	83.0
Bhutan	n.a	53.0	65.0	n.a	74.0	89.0
India	61.0	63.0	71.0	76.0	81.0	90.0
Iran	77.0	84.0	87.0	93.0	98.0	98.0
Maldives	96.0	98.0	99.0	98.0	99.0	100.0
Nepal	49.0	57.0	64.0	70.0	82.0	87.0
Sri Lanka	91.0	91.0	93.0	96.0	98.0	99.0
Viet Nam	90.0	94.0	95.0	95.0	97.0	98.0

Source: Education for All Global Monitoring Report-2015

Since cost of education is one of the most important concern in less developed countries, given that poor households need to arrange for food and shelter first, government is the only source left for providing education as private sector cannot contribute to this with a profit making motive (Hillman and Jenkner (2004)). Whereas on the other hand, unfortunately, government resources are being spent in less productive and creative manners in developing countries that do not add to develop student performance (Meier and Rauch, 2005). There are plenty of facts that many schools in developing countries are not very efficient due to government's own choice because such plans are least beneficial for them (Lockheed and Verspoor (1991), Ralph Harbison and Hanushek (1992),Glewwe (1999a)). There are cases where teachers and officials support their welfare over those of students, whereby education ministries in developing countries have no idea how to improve their education systems (Lockheed and Verspoor (1991)).

Hence, allocation of public resources for quality service matters for long-term economic growth and development as compared to the continued expansion of low quality schools.

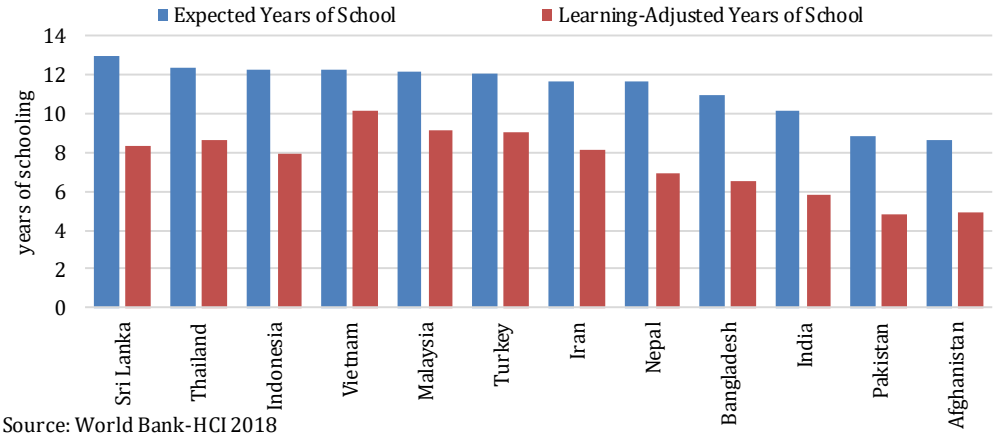
On the quality front, describing as well as measuring quality is considered a tricky task. Definition of quality education also varies as per different researches and organizations. By definition, quality education is one that satisfies basic learning

needs, and enriches the lives of learners and their overall experience of living. Facts over the past decade have shown that attempts to increase enrolment go along with efforts to improve educational quality if children are fascinated by school, stay there and attain significant learning outcomes (UNICEF (2000)). Quality indicators as per UNESCO are: healthy, well-nourished and motivated students; well-trained teachers and active learning techniques; adequate facilities and learning materials; a relevant curriculum that can be taught and learned in a local language and builds upon the knowledge and experience of the teachers and learners; an environment that not only encourages learning but is welcoming, gender-sensitive, healthy and safe. As per the European Commission, a comprehensive list of 16 "quality indicators", such as education and training of teachers, participation in pre-primary education, number of students per computer and educational expenditure per student, will bring about improved quality of education and hence shall augment development.

3. State of Education Sector in Pakistan

Education sector of Pakistan is confronted with various hurdles including

Figure 1: Learning Adjusted Education



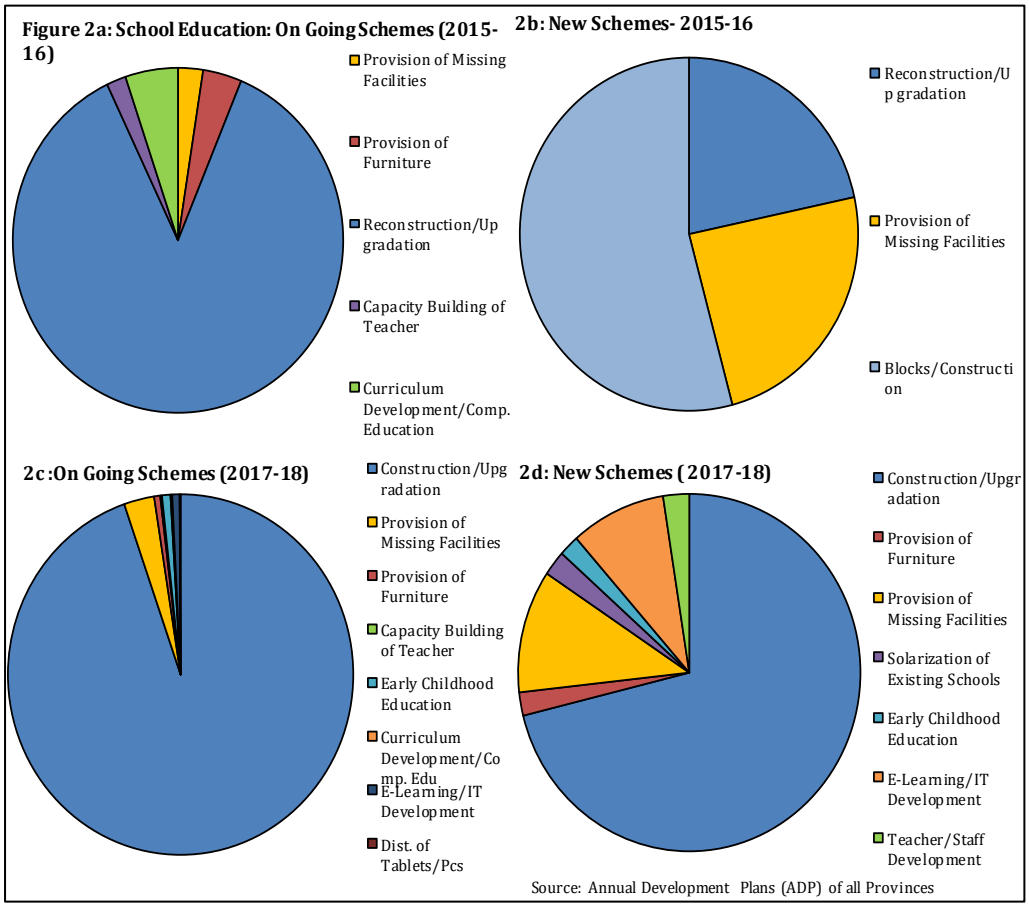
Source: World Bank-HCI 2018

Table 4: Selected Baseline Early Grade Reading Assessments

Country	Program	Year	Languages	Grade	Sample Size	% of children who cannot read a single word in a simple paragraph
Afghanistan	USAID/PACE-A	2007	Dari and Pashtu	End of Grade 2	309	21
Nepal	EGRA	2009	Nepali	Mid-year Grade 2	212	79
Pakistan	Save the Children	2009	Urdu	End of Grade 2	234	66
Manila, Philippines	Save the Children	2009	Filipino, English	Mid-year Grade 3	160,160	1,2
Mindanao, Philippines	Save the Children	2009	Filipino ,English	Mid-year Grade 3	541,541	24,30

Source: Stannard, 2008; Schuh-Moore et al., 2010; Dowd et al., 2010;and Cao, 2010

underinvestment (Table 1,2 and 3), capacity deficient public sector, costly and unregulated private sector, low literacy rate, unclear literacy definition, deficient physical infrastructure and lack of rationale in national level education policy (Akram and Khan, 2007). As per Human Development Report (2015), Pakistan still falls in Low Human Development category in education achievement based on the criteria defined for levels of literacy, enrollment and education quality. It states, since independence, Pakistan has increased the number of primary schools eighteen-fold and multiplied enrolment sixteen times. However, these achievements have been

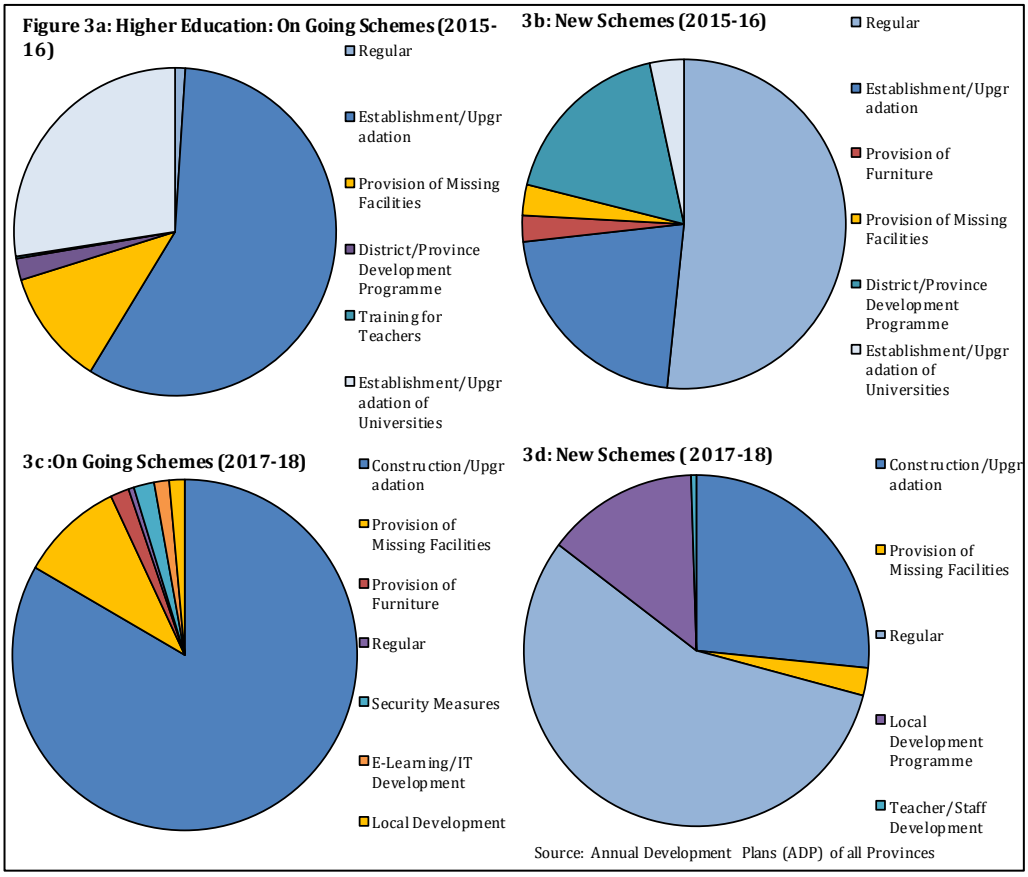


overcome by rising population and lack of quality education (HDR (1998)) (Table 4).

Over the quality of already constrained sector, a survey conducted in 38 rural districts in 2010 revealed that only 44 per cent of class 3 students were capable of reading sentences (level 1 text) in Urdu or their own language, while in arithmetic 39 per cent of class 4 students could only identify simple numbers (level 1 standard) (South Asian Forum for Education Development (2010)) whereas 66 per cent of tested students in Urdu could not read a single word by the end of grade 2 (Asia-Pacific EFA Goal 6-Quality Education, UNESCO and UNICEF (2012)). Similarly, according to World

Bank's Human Capital Index (HCI) - 2018, the number of years of schooling adjusted for quality is lowest, after Afghanistan, when compared to other comparable countries (Figure 1).

Similarly, Early Childhood Development (ECD)[3] has also remained least focused area for the government. Testing upon the parameters[4] of ECD, for instance, only 25.1 percent children were considered developing on track in Sindh province (Multiple Indicator Cluster Survey MICS (2014-15)).



In order to analyze the underlying reasons of such compromised quality of education, especially in public sector, Annual Development Plans (ADPs) and Medium Term Development Framework (MTDF) of all four provinces have been studied for spending behaviors of provincial governments on school education, higher education

[3] It is defined as path in which a child learns to handle complicated level of thinking as per Shonkoff J, and Phillips D (2000), Definition. Literacy and Numeracy skills are one of the important elements of ECD.

[4] To identify 10 letters of alphabets, read 4 simple words, recognize all numbers from 1-10 by the age of 3-5 years.

(colleges and universities) and technical and vocational education for two years i.e. FY16 and FY18.

For school education, analysis suggests that, broadly, expenditures are divided into two main categories i.e. Ongoing Schemes and New Schemes (Figure 2). Both Ongoing Schemes and New Schemes are further bifurcated into multiple categories such as "Provision *of Missing Facilities (PMF)"* and "Reconstruction/Up gradation/Establishment of New/Existing Schools" etc. (Appendix Table A1). As per notes provided for *regular* and *provision of missing facilities (PMF)* and percentage share of each component for FY16, it's evident that bulk of the expenditure is being made for just providing basic infrastructure i.e. construction of schools, classrooms, blocks and hostels, revamping of schools, reconstruction of dangerous buildings and provision of furniture. Moreover, no clear distinction is provided for Regular and PMF, given significant chunk of pie is being allocated for provision of missing facilities[5]. Whereas, proportion of spending on capacity building and curriculum development is trivial. Disaggregated analysis suggests that only Sindh and Punjab are allocating portion of budget for this category.

In FY18, allocation wise developments remained same broadly, however, few new categories with small proportion of budget allocation were also introduced such as e-leaning/IT development, solarization of schools, early childhood development etc. These empirics show that higher allocations of funds are being made for creating new structures, and less focus has been given to provide funds to enhance quality of human capital. Rather, public budget is only exposed to creating a cycle of building-overlooking-eroding/damaging- rebuilding of physical infrastructure. The same fact has been admitted by the government itself, as per Medium Term Development Framework (MTDF) 2014-17, school education department is primarily focused on providing brick-motor i.e. raising the adequate physical infrastructure of schools.

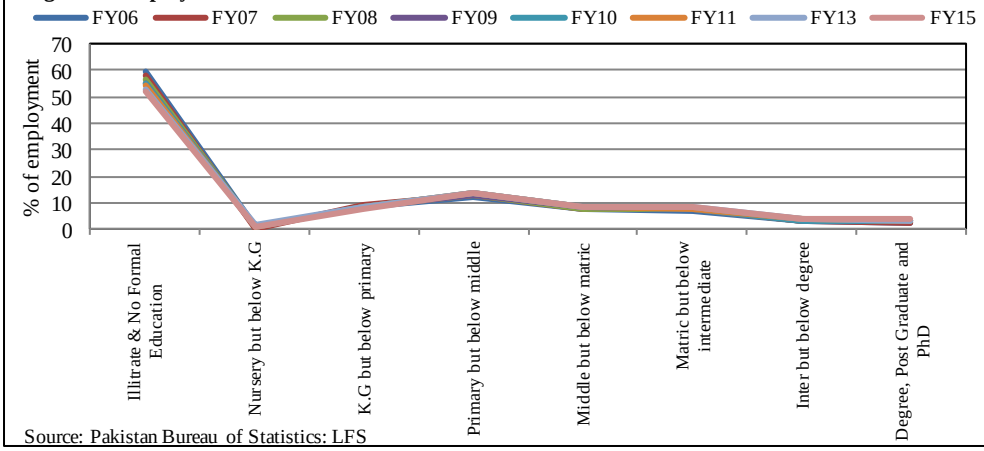
Likewise, government development spending for higher education (which includes both colleges and universities) has been analyzed as well for FY16 and FY18. Similar to school education, major bifurcation is made under the heading of Ongoing Schemes and New Schemes. Further, theses heads are divided into Regular, "Provision *of Missing Facilities (PMF)"* and "Reconstruction/Up gradation/Establishment of Colleges". Major chunk of the expenditures are allocated for Reconstruction/Up gradation/Establishment of Colleges (Figure 3). Other categories pertaining to staff development is present as well but the allocated amount is insignificant. So, higher portion of the education budget is being spent on providing

[5] Expenditure and Quantity of Service Delivery Survey (EQSDS) in Primary School has also pointed out about "Budget Leakages" in Provision of Missing Facilities (PMF). Resources are being misused or not being utilized for the intended purposes. About 22.6 percent of leakages were observed by the survey teams in Punjab.

basic infrastructure rather on quality improvements, such as teacher's training, curriculum development etc.

Apart from primary and higher education, state of technical and vocational education also provides strong basis for analyzing human capital. The technical and vocational education and training (TVET) is extremely important for stimulating economic development, expanding employment size and improving the quality of employment (Cong and Wang (2012)). Our analysis suggests that, on provincial level, not much focus has been given to this category so it could be a part of some already existing bifurcation depicting the same nature of expenditure on basic infrastructure. [6] However, federal government allocated budget of Rs. 348.1 million in 2017-18 compared to Rs. 1,531.1 million in 2015-16 for National Vocational and Technical Training Commission, which is in itself a meager amount given the extent of country's population.

Figure 4: Employment with Level of Education



Source: Pakistan Bureau of Statistics: LFS

In presence of previously analyzed facts, it seems that Pakistan is faced with lack of policy direction and the situation may get out of control if the human capital stagnates at its current level and population keeps on growing with geometric progression. Even looking at the provision of infrastructure alone, financial leakages are rampant. The Dakar Framework stated, 'Corruption is a major drain on the effective use of resources for education and should be drastically curbed.' Moreover, 'Ghosts' are another issue: schools and teachers exits only in papers and not in reality. There were about 6,480 ghost schools in Sindh province and 5,000 in Baluchistan (Global Corruption Report (2013)). Let alone the quality issue, teacher shortages and inadequately trained staff remain a serious concern as well.

[6] Baluchistan allocated Rs. 93.6 million for Technical Education in 2015-16 and Rs 121.0 million in 2017-18 whereas Sindh allocated Rs 1065.0 million in 2017-2018.

4. Policy Implications

In order to understand the trend in government spending on education in Pakistan, all labor force surveys (by Pakistan Bureau of Statistics) have been used to construct the education levels of the employed labor force in Pakistan (Figure 4[7]). It can easily be seen that in the last ten years the distribution has experienced only marginal changes. Even keeping aside the major portion of illiterate and not formally instructed workers, the distribution is skewed towards those with low levels of education. Using some of the raw data from these labor force surveys, we can confirm that there are positive gains from education as well as relevant technical trainings. Just to quote some of them, average wage/income gets higher by around 20 percent as one moves from a lower education level to the next higher mentioned level in the distribution.

Table 5: Total Factor Productivity (TFP) Growth

	2000-2007	2010-2017	2018
Pakistan	2.4	1.7	0
Bangladesh	0.7	0.9	1.2
India	1.7	1.9	2.4
Iran	-0.2	-0.5	-2.5
Vietnam	-2.1	-0.4	0
Thailand	1.9	1.3	1.4
Indonesia	1.3	-0.7	0.7

Source: The Conference Board-Productivity Brief 2019

These gains are lower at lower end of the distribution and are at their highest at attaining the intermediate level and the level of technical graduation. Secondly, attainment of relevant trainings adds about 15-20 percent to the wages/incomes. These results are encouraging as they point towards reassessment of national level policies for their focus on quality and coverage of education at all levels. The skewness of the education distribution of workers also points out that the scope of capacity enhancement in the country is phenomenal if catered to prudently.

To explore the policy implication of the standard technology shock on output gap in a Dynamic Stochastic General Equilibrium Model (DSGE) [8], a simple exercise has been carried out. It is assumed that economic structure of Pakistan and USA mimics the Euro area of Smets and Wouters (2003) with the exception of price and wage rigidities[9]. The amplification in real activity in response to the technology shock shows the extent of intangible amalgamation of physical capital with human capital present in the economy, specifically called total factor productivity (TFP). For

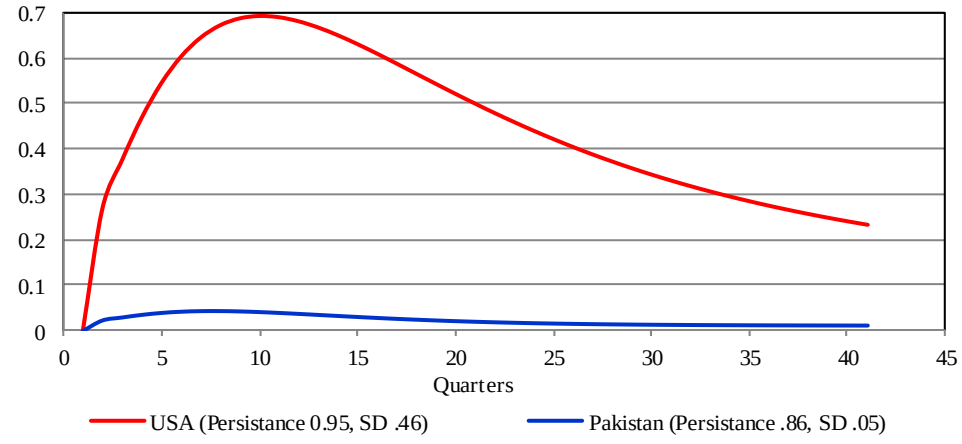
[7] Due to non-availability of detailed data for FY17, the graph covers data from FY06 TO FY15. Same trend is assumed for FY17 as well on account of past trends.

[8] Special thanks to Shahzad Ahmed, Research Department for providing DSGE simulation results.

[9] See SBP Working Paper 47 along with its technical supplement for parameter details.

Pakistan the TFP series[10], obtained as a residual of estimating the standard production function, has persistence of 0.86 and almost no variability as compared to the persistence of 0.95 in USA with standard deviation of 0.46. For comparison purposes, a growth of TFP during 2000-07, 2010-2017 and 2018 is given in Table 5. Apart from Vietnam, that has been reaping benefits from large prior investments in capital other than in information, communication and technology, and Iran, that has faced economic sanctions during all these years, TFP growth in comparable countries have remained much better than that for Pakistan. Figure 5 presents model-based simulation of the impact of a one standard deviation technology shock on the output gap both for Pakistan and USA. It shows that impact of this technology shock is quite high for USA, despite its saturated state of human capital. On the other hand, for Pakistan, despite having the capacity for high marginal gains due to a large population and unexplored segments, the impact is remarkably small. The dynamics of the shock's impact show that quality of human capital as well as the presently installed physical capital does not generate marginal and intangible returns. The lack of adaption/infusion of technology in value addition plays an important role in keeping real growth suppressed. Consequently, it can easily be seen that TFP in Pakistan is much lower than USA and this is the big gap in the quality of human capital that can be filled with appropriate measures. If not addressed, poverty and income inequality are bound to rise further as the mass of population depending on provision of social services by the government keeps getting marginalized not only in term of coverage but also in terms of quality. So, let alone domestic investment, even foreign investors consider such scope of manpower and national/domestic market a missed opportunity.

Figure 5: Impact of Technology shock on the output gap



[10] For Pakistan average contribution of TFP in economic growth has remained around 5%, whereas, in the US this contribution has peaked at about almost half of the overall contribution. Only recently, after the global financial crisis, it has started coming down.

5. Conclusion

Pakistan's overall public (fiscal) spending on education seems to provide short term gains by providing basic infrastructure; whereas, the aspect of long term gain in term of augmentation of human resources with physical capital is missing. In absolute terms, the size of development expenditure on education has increased manifold, however, the outcomes are trivial as significant portion is being spent on providing basic infrastructure. Moreover, anecdotal evidences suggest that lack of transparency and accountability in funds allocation is also a serious hindrance in obtaining desirable results. As a matter of fact, the underlying concern is that even after a span of 69 years, government is lacking behind even in providing basic infrastructure. Resultantly, substandard provision of infrastructure is not even allowing government to attain "access to education" goal effectively let alone to focus ultimately on its quality. Therefore, expenditure on education needs thorough modifications for solid outcome along with a thoughtful long term policy based on commitment for quality.

Appendix

School Education

Table A1: Provision of Budget: School Education-2015-16 (in Million Rs)

	Punjab	Sindh	KPK	Baluchistan	All Provinces
1. On Going Schemes	**618.0**	**692.6**	**627.8**	**912.8**	**2,851.2**
Provision of Missing Facilities**	n.a	50.0	n.a	7.9	57.9
Provision of Furniture	n.a	90.0	n.a	n.a	90.0
Reconstruction/Up gradation/Establishment of New/Existing Schools	n.a	520	627.8	904.9	2,052.7
Capacity Building of Teacher	n.a	45.0	n.a	n.a	45.0
Curriculum Development/Comp. Education	n.a	122.0	n.a	n.a	122.0
2. New Schemes	**19,052.0**	**167.5**	**530.0**	**1,027.3**	**20,776.8**
Reconstruction/Up gradation/Establishment of New/Existing Schools	2,932.8	n.a	530.0	1,014.3	4,477.1
Provision of Missing Facilities**	5,000.0	n.a	n.a	13.0	5,013.0
Blocks/Construction	11,119.1	82.5	n.a	n.a	11,201.6
Total (1+2)	**19,670.0**	**860.1**	**1,157.8**	**1,940.1**	**23,628.0**

* Total amount is addition of School Education and Teacher Education, ** This category does not give further details of missing facilities

Source: Annual Development Plans (ADP) of all Provinces (2015-16)

Table A2: Budget Allocation for School Education-2017-18 (in Million Rs)

	Punjab	Sindh*	KPK	Baluchistan	All Provinces
Primary & Secondary Education					
1. On Going Schemes	**9561.0**	**6469.1**	**12637.2**	**3105.9**	**31773.2**
Provision of Missing Facilities**	33	858.8	N.A	8.6	900.4
Provision of Furniture	N.A	180.9	N.A	N.A	180.9
Re-habilitation/Reconstruction/Upgradation/Establishment of New/Existing Schools	9230	5127.41	12637.2	3097.3	30091.9
Capacity Building of Teacher	51	N.A	N.A	N.A	51.0
Early Childhood Education		252.0	N.A	N.A	252.0
Curriculum Development/Comp. Edu	N.A	50.0	N.A	N.A	50.0
E-Learning/IT Development	219	N.A	N.A	N.A	219.0
Dist. of Tablets/Pcs	28	N.A	N.A	N.A	28.0
2. New Schemes	**12837.0**	**2333.6**	**1362.7**	**1777.2**	**18310.5**
Re-habilitation/Reconstruction/Upgradation/Establishment of New/Existing Schools	8326.6	1557.2	1362.7	1777.2	13023.7
Provision of Furniture	25	361.0	N.A	N.A	386.0
Provision of Missing Facilities**	2036.0	N.A	N.A	N.A	2036.0
Solarization of Existing Schools	N.A	415	N.A	N.A	415.0
Early Childhood Education	350	N.A	N.A	N.A	350.0
E-Learning/IT Development	1650	N.A	N.A	N.A	1650.0
Teacher/Staff Development	450	N.A	N.A	N.A	450.0
Total (1+2)	**22398.0**	**8802.7**	**13999.9**	**4883.1**	**50083.7**
Other Programme					
Education Foundation	16000.0	625.9	N.A	N.A	16625.9
Public School Support Programme	7000.0	N.A	N.A	N.A	7000.0
Danish School and Center of Excellence	3000.0	N.A	N.A	N.A	3000.0
Teacher Education	N.A	239.6	N.A	N.A	239.6
Misc.	4962.0	1581.8	N.A	N.A	6543.8

* Total amount is addition of School Education and Teacher Education

** This category does not give further details of missing facilities

Source: Annual Development Plans (ADP) of all Provinces

Higher Education

Table A3: Provision of Budget: Higher Education (College and University)

2015-16 (in Million Rs)	Punjab	Sindh	KPK ^	Baluchistan	All Provinces
Higher Education (Colleges and Universities)					
1. On Going Schemes	**3,056.1**	**2,202.6**	**4,374.0**	**2,232.8**	**11,865.5**
Regular*	121.9	na	na	na	121.9
Establishment/Upgradation/Construction of Colleges	1,424.1	2,132.6	2,154.6	1,144.1	6855.3
Provision of Missing Facilities**	845.7	70.0	434.0	8.3	1358.0
District/Province Development Programme	253.0	na	na	na	253.0
Training for Teachers	na	na	25.5	na	25.5
Establishment/Upgradation of Universities	411.5		1760.0	1080.9	3252.4
2. New Schemes	**8,673.9**	**174.0**	**1,685.0**	**750.0**	**11,282.9**
Regular*	5,830.0	na	na	na	5830.0
Establishment/Upgradation/Construction of Colleges	560.0	84.0	1,120.0	673.4	2437.4
Provision of Furniture	na	90.0	200.0	na	290.0
Provision of Missing Facilities**	283.9		40.0	17.0	340.9
District/Province Development Programme	2,000.0	na	na	na	2000.0
Establishment/Upgradation of Universities	na		325.0	60.0	385.0
Total (1+2)	**11,730.0**	**,2376.6**	**6,059.0**	**2,982.8**	**23,148.4**

^ Excluding "Construction of Libraries", * It includes Construction of Hostels, Renovation/Revamping/Upgradation of Colleges, Provision/Replacement of IT Labs, Re-construction of Dangerous Buildings, Provision of Furniture,** This category does not give further details of missing facilities

Table A4: Budget Allocation for Higher (College) Education-2017-18 (in Million Rs)

	Punjab	Sindh*	KPK	Baluchistan	All Provinces
Regular, Cadet and Commerce Colleges					
1. On Going Schemes	**6152.0**	**5000.0**	**3145.3**	**1938.9**	**16236.2**
Provision of Missing Facilities**	1086	407.8	4	6.0	1503.8
Provision of Furniture	N.A	271.0	N.A	N.A	271.0
Re-habilitation/Reconstruction/Upgradation/Establishment of New/Existing Schools	3857.9	4321.1	2842.5	1933.0	**12954.5**
Regular	80	N.A	N.A	N.A	80.0
Security Measures	N.A	N.A	298.7	N.A	298.7
E-Learning/IT Development	219	N.A	N.A	N.A	219.0
Local Development	225	N.A	N.A	N.A	225.0
2. New Schemes	**5883.0**	N.A	**1545.0**	**712.1**	**8140.1**
Re-habilitation/Reconstruction/Upgradation/Establishment of New/Existing Schools	120.0	N.A	1305.0	712.1	2137.1
Provision of Furniture	N.A	N.A	100	N.A	100.0
Provision of Missing Facilities**	105.0	N.A	100	N.A	205.0
Regular	4517	N.A	N.A	N.A	4517.0
Local Development Programme	1108	N.A	N.A	N.A	1108.0
Minister's SDGs	34	N.A	N.A	N.A	34.0
Teacher/Staff Development	N.A	N.A	40	N.A	40.0
Total (1+2)	**12035.0**	**5000.0**	**4690.3**	**2651.0**	**24376.3**
Other Development Programme	6000	N.A	N.A	N.A	6000

Source: Annual Development Plans (ADP) of all Provinces

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